Project 1

Groundwater System Interconnection Project

Supporting Documents

ANNUAL REPORT

Upper Los Angeles River Area Watermaster

Re: City of Los Angeles vs. City of San Fernando, et al.

Superior Court Case No. 650079 – County of Los Angeles

WATERMASTER SERVICE
IN THE
UPPER LOS ANGELES RIVER AREA
LOS ANGELES COUNTY, CALIFORNIA

2011-12 WATER YEAR

OCTOBER 1, 2011 – SEPTEMBER 30, 2012

MAY 2013

ANNUAL REPORT
UPPER LOS ANGELES RIVER AREA WATERMASTER

RE: CITY OF LOS ANGELES VS. CITY OF SAN FERNANDO, ET AL.
CASE NO. 650079 - COUNTY OF LOS ANGELES

WATERMASTER SERVICE IN THE UPPER LOS ANGELES RIVER AREA (ULARA) LOS ANGELES COUNTY, CALIFORNIA

2011-12 WATER YEAR
OCTOBER 1, 2011 - SEPTEMBER 30, 2012

ULARA WATERMASTER
Richard C. Slade, PG
Richard C. Slade & Associates LLC

ASSISTANT WATERMASTER
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GROUNDWATER HYDROLOGY/MODELING STAFF
Hadi Jonny, PE
LADWP

WATERMASTER STAFF AT LADWP

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Copies of this report may be viewed and downloaded from the ULARA Watermaster website located at http://ularawatermaster.com/

MAY 2013

The basic consensus is that the current remedy needs to be replaced on an expedited basis with the NHOU2IR. The new remedy should provide extractions at a substantially higher flow rate to help provide for further plume containment and to permit extraction from deeper portions of the aquifer; these activities will help address the vertical and horizontal extent of the contaminant mass. This, in combination with additional strategically located extraction wells, should broaden the containment area and further help to prevent the continued migration of contaminants toward the nearby LADWP wellfields.

2. *BURBANK OPERABLE UNIT (BOU)* - The BOU, funded by Lockheed-Martin under a USEPA Consent Decree and operated by the City of Burbank, uses air stripping and liquid-phase GAC to remove VOCs from groundwater (local groundwater also contains elevated concentrations of nitrate and chromium), and then blends the treated water with imported water from the MWD for delivery within the City of Burbank.

   Burbank assumed operation and maintenance of the BOU in 2001. Initially, the facility had difficulty in sustaining operation at the designed treatment rate of 9,000 gpm. Burbank, Lockheed-Martin, and the USEPA cooperated in efforts to determine the cause(s) of the reduced production. Over the past few years, several process enhancements and repairs have been made to the liquid-phase GAC vessels and to the vapor-phase GAC vessels at the factory.

   As part of the requirement to close the first consent decree, USEPA required the City of Burbank to demonstrate that the BOU would operate at its design capacity. In the summer of 2010, Burbank successfully completed a 60-day performance test at the BOU by pumping the wells at a combined rate of 9000 gpm. To ensure the effectiveness of the remedy EPA monitored drawdown and the extent of the cone of depression by conducting a multi-well pumping test for 30 days during the demonstration time frame. EPA used water levels and pumping rate data monitored during this pumping test to update its values for the hydraulic conductivity, transmissivity, and storativity in the BOU area for the Basinwide Groundwater Model.

   The City of Burbank is also concerned about hexavalent chromium in groundwater produced at the BOU and has been blending its pumped groundwater with imported water to keep the concentration of total chromium at or below the City's goal of 5 µg/L; the BOU treatment facility was not designed to treat chromium.

A total of 9,993 AF of contaminated groundwater was treated by the BOU in the 2011-12 Water Year, a decrease of 401 AF over the prior year's volume of groundwater treated by this facility.

3. *GLENDALE NORTH AND SOUTH OPERABLE UNITS (now referred to as one single "GOU")* – Construction of the GOU was completed and this allowed for treated water to be available for delivery on August 1, 2000. The system includes four Glendale North OU extraction wells (with a total pumping capacity of 3,300 gpm) and four Glendale South OU extraction wells (with a total capacity of 1,700 gpm). The treatment process uses aeration and liquid-phase GAC to treat VOC-contaminated groundwater and then blends the treated water with imported MWD water at the Grandview Pump Station. A total of 7,830 AF of contaminated groundwater was treated in 2011-12.

4. *GLENDALE CHROMIUM OPERABLE UNIT* – Established in 2007, the GCOU was created to help charachterize the extent of chromium contamination in the groundwater in the area, and to determine appropriate remedial action. EPA is working with the California Department of Toxic Substances Control and the LARWQCB to identify and clean up sources of chromium contamination. Remedial investigation of chromium contamination in groundwater in the GCOU began in 2011. During 2012, field work began to construct as many as 30 new groundwater monitoring wells to help evaluate the location and extent of the chromium contamination in the area.

<u>Other Treatment Facilities</u>

1. *VERDUGO PARK WATER TREATMENT PLANT (VPWTP)* – Glendale's VPWTP serves as a filtration and disinfection facility. A total of 316 AF of groundwater was treated in the 2011-12 Water Year.

2. *GLENWOOD NITRATE WATER TREATMENT PLANT* - CVWD's Glenwood Nitrate Water Treatment Plant, which uses an ion-exchange process for nitrate removal, treated 447 AF in the 2011-12 Water Year

3. *POLLOCK WELLS TREATMENT PLANT* (PWTP) – The 3,000-gpm PWTP was dedicated on March 17, 1999. This treatment plant uses four liquid phase

APPENDIX A
GROUNDWATER EXTRACTIONS

2011-12 WATER YEAR
(acre-feet)

LACDPW Well No.	Owner Well No.	2011 Oct.	2011 Nov.	2011 Dec.	2012 Jan.	2012 Feb.	2012 Mar.	2012 Apr.	2012 May	2012 June	2012 July	2012 Aug.	2012 Sept.	TOTAL
						San Fernando Basin								
A. W. Warner Properties														
Plaza Six		0.91	0.88	0.83	1.00	0.88	0.93	0.91	0.95	0.90	0.83	0.74	0.71	10.47
A. W. Warner Properties														
Plaza Three		0.73	0.71	0.87	0.69	0.73	0.76	0.81	0.79	0.71	0.74	0.63	0.59	8.76
Angelica Healthcare Services			(abandoned 12/97)											
3934A	M050A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Avalon Encino														
---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bally, Nico														
---	---	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.70
BFI Sunshine Canyon Landfill														
---	---	8.09	7.05	7.89	8.71	6.39	8.27	8.26	8.46	7.41	7.54	6.73	7.41	92.21
Boeing (Rockwell International)														
---	E-1 to E-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Boeing Santa Susana Field Laboratory														
Delta	WS-09A	0.51	1.94	0.00	0.01	0.21	2.71	2.29	2.64	2.62	1.70	1.32	1.19	17.14
	RD-24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total:	0.51	1.94	0.00	0.01	0.21	2.71	2.29	2.64	2.62	1.70	1.32	1.19	17.14
Burbank, City of														
3841C	6A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3882P	7	0.00	0.56	0.00	0.00	0.00	0.49	0.00	0.00	0.53	0.00	0.00	0.53	2.11
3851E	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3851K	13A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3882T	15	0.00	0.38	0.00	0.00	0.00	0.49	0.00	0.00	0.66	0.00	0.00	0.53	2.06
3841G	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total:	0.00	0.94	0.00	0.00	0.00	0.98	0.00	0.00	1.19	0.00	0.00	1.06	4.17
Burbank Operable Unit														
3871L	VO-1	24.33	82.91	113.61	109.08	57.35	90.57	92.83	128.75	155.04	106.25	107.44	87.13	1,155.29
3861G	VO-2	0.30	45.68	1.08	0.00	0.00	23.76	37.51	8.05	1.07	31.37	37.37	111.90	298.09
3861K	VO-3	140.57	58.33	121.57	136.74	30.11	49.32	118.35	134.78	126.99	97.09	121.20	88.55	1,223.60
3861L	VO-4	112.32	111.75	54.88	109.15	21.09	61.81	98.02	77.26	167.73	137.60	154.01	161.88	1,267.50
3850X	VO-5	169.75	120.50	170.21	96.48	51.80	134.96	110.08	74.98	100.13	126.52	161.53	153.39	1,470.33
3850Z	VO-6	0.07	0.00	0.00	0.00	0.00	0.13	4.91	188.50	109.46	118.56	156.87	139.47	717.97
3850AB	VO-7	187.12	174.05	174.81	119.39	61.67	183.17	150.23	151.36	161.57	222.34	185.41	163.09	1,934.21
3851C	V0-8	118.87	162.73	138.71	185.51	81.02	176.45	154.26	174.64	195.28	177.09	167.14	194.42	1,926.12
	Total:	753.33	755.95	774.87	756.35	303.04	720.17	766.19	938.32	1,017.27	1,016.82	1,090.97	1,099.83	9,993.11
Douglas Emmett Management, LLC (Trillium)														
Well #1	---	1.75	3.28	2.15	1.85	2.52	2.64	2.57	2.16	2.13	1.65	0.34	0.00	23.04
Well #2	---	1.21	1.38	1.34	1.31	0.75	0.00	0.00	0.46	0.00	1.01	1.46	1.79	10.71
	Total:	2.96	4.66	3.49	3.16	3.27	2.64	2.57	2.62	2.13	2.66	1.80	1.79	33.75
Fassberg Construction														
N/A		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
First Financial Plaza Site														
N/A	F.F.P.S.	0.93	0.98	1.70	0.82	0.75	0.79	1.13	1.38	1.38	1.12	1.02	0.70	12.70
Forest Lawn Memorial Park														
3947B	3	4.58	2.02	0.00	0.00	0.00	0.00	0.05	10.58	20.58	14.08	11.15	0.41	63.45
3947C	4	4.31	1.91	0.00	0.00	0.00	0.00	0.00	0.00	5.95	14.34	9.62	0.00	36.13
3947M	8	16.66	7.47	0.00	1.57	23.37	17.36	18.96	45.50	86.76	57.17	44.92	1.61	321.35
	Total:	25.55	11.40	0.00	1.57	23.37	17.36	19.01	56.08	113.29	85.59	65.69	2.02	420.93

Los Angeles Department of Water & Power

URBAN WATER
MANAGEMENT PLAN

2010

RESOLUTION NO. 011 268

WHEREAS, the California Urban Water Management Planning Act requires California water suppliers to prepare and adopt an Urban Water Management Plan every five years that describes their historical and future efforts in the area of water resources; and

WHEREAS, the Los Angeles Department of Water and Power (LADWP) has prepared a five-year update to the City of Los Angeles ' Urban Water Management Plan (UWMP) pursuant to applicable provisions of Sections 10610 through 10656 of the California Water Code; and

WHEREAS, the UWMP is required as a condition of application for various water system grant and loan funding opportunities administered by the State of California; and

WHEREAS, LADWP has selected Method 3 of the four methods developed by the California Department of Water Resources for calculating the 2020 water use target and 2015 interim target in the UWMP as required in the California Water Conservation Act of 2009, SBX7-7; and

WHEREAS, LADWP's current water rate structure includes funding for water conservation, water recycling, and stormwater capture programs; and

WHEREAS, the development of the UWMP involved public meeting notices, public involvement, and incorporated oral and written public comments prior to final adoption; and

WHEREAS, the final UWMP must be adopted by LADWP's Board of Water and Power Commissioners and submitted to the California Department of Water Resources by July 1, 2011.

NOW, THEREFORE, BE IT RESOLVED, that the City of Los Angeles Department of Water and Power 2010 Urban Water Management Plan is hereby adopted; and

BE IT FURTHER RESOLVED that the President or Vice President of the Board, or the General Manager or such person as he shall designate in writing as his designee, and the Secretary, Assistant Secretary, or the Acting Secretary of the Board be and they are hereby authorized, empowered, and directed to approve said UWMP for and on behalf of LADWP.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of a Resolution adopted by the Board of Water and Power Commissioners of the City of Los Angeles at its meeting held MAY 03 2011

APPROVED AS TO FORM AND LEGALITY
CARMEN A. TRUTANICH, CITY ATTORNEY

APR 11 2011

BY [signature]
JANNA SIDLEY
DEPUTY CITY ATTORNEY

Barbara E. Moschos

Secretary

Chapter Eight

Metropolitan Water District Supplies

8.0 Overview

As a member agency, the City of Los Angeles purchases water from the Metropolitan Water District of Southern California (MWD) to supplement its supplies from local groundwater, Los Angeles Aqueduct (LAA) deliveries, and recycled water. LADWP has historically purchased MWD water to make up the deficit between demand and other City supplies. As a percentage of the City's total water supply, MWD water varies from 4 percent in Fiscal Year (FY) 1983/84 to 71 percent in FY 2008/09 with the 5-year average of 52 percent between FY 2005/06 and FY 2009/10. Exhibit 1F in Chapter 1 illustrates the City's reliance on MWD water during dry years and increasingly in recent years as LAA supply as been cut back for environmental enhancement projects. Although the City plans to reduce its reliance on MWD supply, it has made significant investments in MWD and will continue to rely on the wholesaler to meet its current and future supplemental water needs.

MWD is the largest water wholesaler for domestic and municipal uses in California providing nearly 19 million people with on average 1.7 billion gallons of water per day to a service area of approximately 5,200 square miles. MWD was formed by the MWD Act and exists pursuant to this statute which was enacted by the California Legislature in 1927. MWD's adopted purpose is to develop, store, and distribute water to Southern California residents. In 1928, MWD was incorporated as a public agency following a vote by residents in 13 cities in Southern California. Operating solely as a wholesaler, MWD owns and operates the Colorado River Aqueduct (CRA), is a contractor for water from the California State Water Project (SWP), manages and owns in-basin surface storage facilities, stores groundwater within the basin via contracts, engages in groundwater storage outside the basin, and conducts water transfers to provide additional supplies for its member agencies. Today, MWD has 26 member agencies consisting of 11 water districts, one county water authority, and 14 cities, including the City of Los Angeles.

This Urban Water Management Plan projects LADWP's reliance on MWD water supplies will be reduced by half from the current five-year average of 52 percent of total demand to 24 percent by FY 2034/35 under average weather conditions.

8.0.1 History

Initially formed to import water into the Southern California region, MWD's first project was to build the CRA to import water from the Colorado River. The City of Los Angeles provided the capital dollars to initiate and complete land surveys of all proposed alignments for the Aqueduct. Construction was financed through $220 million in bond sales during the Great Depression. Ten years after initiating construction, Colorado River water reached Southern California in 1941. To meet further water demands in the southern California region, MWD contracted with the SWP in 1960 for almost half of the SWP's water supplies which are delivered from the San Francisco Bay-Delta region into Southern California via the California Aqueduct. After completion of the California Aqueduct, deliveries of SWP water were first received in 1972.

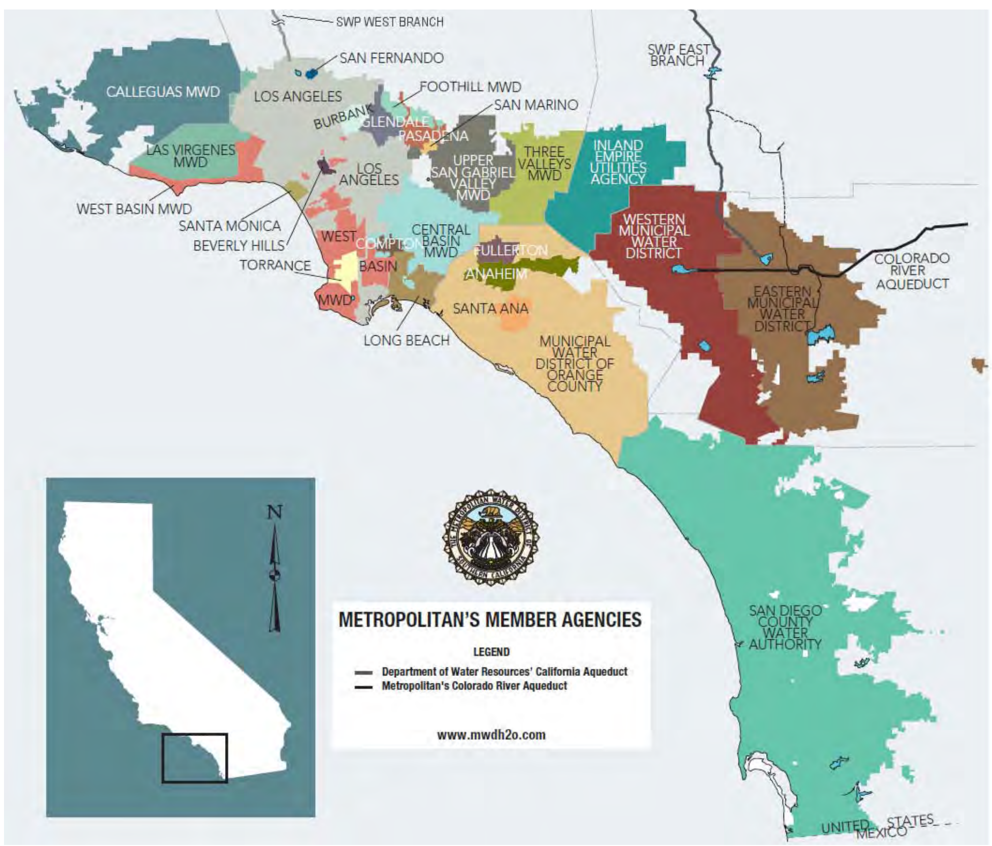
8.0.2 Governance

MWD is governed by a Board of Directors composed of 37 individuals with a minimum of one representative from each of MWD's 26 member agencies. The allocation of the directors and voting rights are determined by each agency's assessed valuation. The City of Los Angeles has four Directors on MWD's Board and controls 19.44 percent of the vote. MWD's Administrative Code defines various tasks which the Board has delegated to MWD staff. A General Manager oversees MWD staff. The General Manager, General Auditor, General Counsel, and Ethics Officer serve under direction and authority given directly by the Board.

8.0.3 Service Area

Originally serving an area of 675 square miles in 1928, MWD's service area has grown to approximately 5,200 square miles serving 19 million people via its 26 member agencies. MWD's service area covers portions of Los Angeles, Ventura, Orange, Riverside, San Bernardino, and

Exhibit 8A
MWD Service Area



Courtesy of The Metropolitan Water District of Southern California

San Diego counties as depicted in Exhibit 8A. MWD member agencies serve 152 cities and 89 unincorporated areas. Member agencies provide wholesale, retail, or a combination of wholesale/retail water sales in their individual service territories.

8.0.4 Major Infrastructure

MWD delivers approximately 6,000 AF per day of treated and untreated water to its member agencies through its vast infrastructure network. Major facilities include the CRA, pumping plants, pipelines, treatment plants, reservoirs, and hydroelectric recovery power plants. A summary of the major facilities and capacities are provided in Exhibit 8B and Exhibit 8C illustrates the geographic locations of the facilities.

Exhibit 8B Major MWD Facilities Summary

Facility	Units	Capacity
Colorado River Aqueduct		
Aqueduct	242 miles	1.3 million AFY
Pumping Plants	5 plants	1,617 feet of total lift
Pipelines	819 miles	
Water Treatment Plants		
Joseph Jensen		750 mgd
Robert A. Skinner		630 mgd
F.E. Weymouth		520 mgd
Robert B. Diemer		520 mgd
Henry J. Mills		220 mgd
Total Treatment Capacity		2,640 mgd
Reservoirs		
Diamond Valley Lake		810,000 AF
Lake Matthews		182,000 AF
Lake Skinner		44,000 AF
Copper Basin		24,200 AF
Gene Wash		6,300 AF
Live Oak		2,500 AF
Garvey		1,600 AF
Palos Verdes		1,100 AF
Orange County		212 AF
Total Reservoir Capacity		1,071,912 AF
Hydroelectric Recovery Plants	16 plants	122 megawatts

Exhibit 8C Major MWD Facilities

Courtesy of The Metropolitan Water District of Southern California

8.1 Supply Sources

Colorado River supplies, State Water Project supplies, In-Basin Storage, Outside-Basin Storage, and Water Transfers together comprise MWD's total system water supply sources. These sources provide supplemental water to meet the demands in Ventura, Los Angeles, Riverside, Orange, San Bernardino and San Diego Counties.

8.1.1 Colorado River

The Colorado River forms California's border with Arizona to the east. The drainage area in California that contributes water to the Colorado River is relatively small and has an arid climate. Accordingly, California has no major tributaries contributing water to the Colorado River.

The Colorado River Board of California is the California state agency given authority to protect the interests and rights of the state and its citizens in matters pertaining to the Colorado River. The Board is comprised of 10 gubernatorial appointees representing the LADWP, MWD, San Diego County Water Authority, Palo Verde Irrigation District, Coachella Valley Water District, Imperial Irrigation District, Department of Water Resources, Department of Fish and Game, and two public members.

8.1.1.1 The Law of the River

The Secretary of the Interior is vested with the responsibility to manage the mainstream waters of the Colorado River pursuant to applicable federal law. This responsibility is carried out consistent with a body of documents referred to as the Law of the River. Water rights to Colorado River water are governed by a complex collection of federal laws, state laws, a treaty with Mexico, other agreements with Mexico, Supreme Court decrees, contracts with the Secretary, interstate compacts, state, and administrative actions at the federal and state levels. Collectively, these documents and associated interpretations are commonly referred to as the "Law of the River" and govern water rights and operations on the Colorado River.

The following are particularly notable among these documents:

1. The Colorado River Compact of 1922, which apportioned beneficial consumptive use of water between the Colorado River Upper Basin and Lower Basin, and defined the term "States of the Lower Division" to mean the States of Arizona, California, and Nevada. Serving as the basis of the "Law of the River," the Compact apportioned water to each basin in anticipation of a dam on the Colorado River. The Upper Basin is the portion of the Basin upstream of Lee Ferry, Arizona, while the Lower Basin is downstream of this point. Each basin was apportioned 7.5 million acre-feet (MAF) annually, and the Lower Basin received the option to an additional 1 MAF annually based on excess flows. California is within the Lower Basin along with Arizona and Nevada.

2. The Boulder Canyon Project Act (Act) of 1928, enacted by Congress to authorize construction of Hoover Dam and the All-American Canal. The Act required that water users in the Lower Basin have a contract with the Secretary, and established the responsibilities of the Secretary to direct, manage, and coordinate the operation of Colorado River dams and related works in the Lower Basin. The Act stipulated conditions, one of which required California to limit Colorado River water use to 4.4 MAF annually plus one-half of the excess water unapportioned by the Colorado River Compact. To satisfy the condition, the California Legislature enacted the Limitation Act in 1929 limiting its use of Colorado River water to the basic apportionment of 4.4 MAF.

3. The California Seven Party Agreement of 1931. Developed in response to the Limitation Act and through regulations adopted by the Secretary, which established the relative priorities of rights among major users of Colorado River water in California. The Seven Party Agreement apportioned California's share of Colorado River water to California contractors. Within the agreement, priorities were established for each of the four agencies holding contracts for Colorado River water with the U.S. Bureau of Reclamation. These priorities are shown in Exhibit D. Seven priorities were established with the first four priorities satisfying California's allocation of 4.4 MAF annually and the fifth and sixth priorities relating to California's share of excess Colorado River flows. MWD holds the fourth and fifth priorities. The fourth priority allocates 550 thousand acre-feet (TAF) of California's apportionment to MWD and the fifth priority allocates 662 TAF of California's share of excess flows to MWD.

4. The 1944 Treaty (and subsequent minutes of the International Boundary and Water Commission) related to the quantity and quality of Colorado River water delivered to Mexico. The Treaty guaranteed an annual quantity of 1.5 MAF to be delivered in accordance with the provisions of the Treaty.

5. The 1963 United States Supreme Court Decision in Arizona v. California, which confirmed the Lower Basin mainstream apportionments of:

   2.8 million acre-feet per year (AFY) for use in Arizona,

   4.4 million AFY for use in California, and

   0.3 million AFY for use in Nevada provided water for Indian reservations and other federal reservations in Arizona, California, and Nevada; and confirmed the significant role of the Secretary in managing the mainstream Colorado River within the Lower Basin.

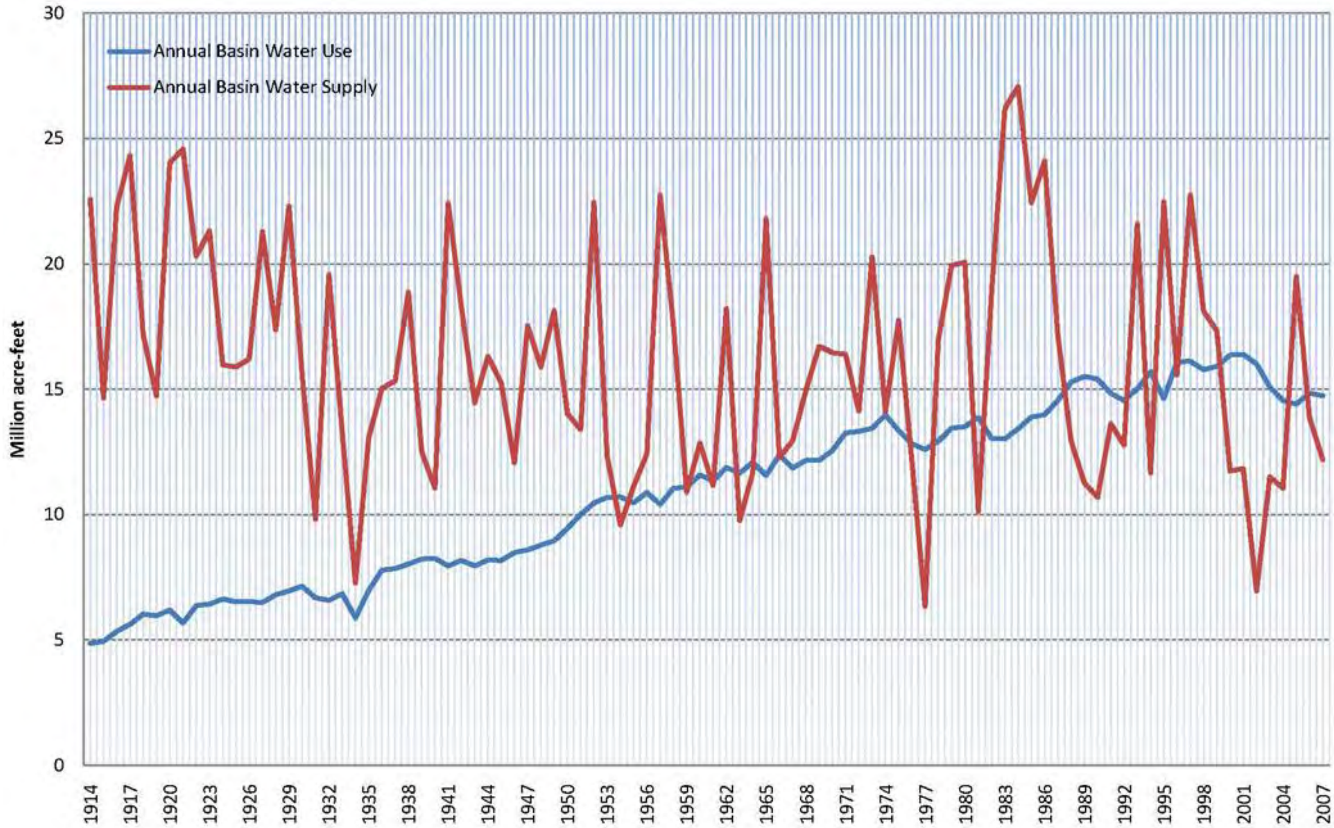
6. The 1964 United States Supreme Court Decree (Decree) in *Arizona v. California* which implemented the Supreme Court's 1963 decision; allocated 50 percent of the surplus water available for use in California; and allowed the Secretary to release water apportioned to but unused in one state for use in the other two states. The Decree was supplemented over time after its adoption and the Supreme Court entered a Consolidated Decree in 2006 which incorporates all applicable provisions of the earlier-issued Decrees.

7. The Colorado River Basin Project Act of 1968, which authorized construction of a number of water development projects including the Central Arizona Project (CAP); provided existing California, Arizona, and Nevada water contractors a priority over the CAP and other users of the same character in Arizona and Nevada whenever less than 7.5 million AFY is available; and required the Secretary to develop the Long Range Operating Criteria and issue an Annual Operating Plan for mainstream reservoirs.

Exhibit 8D
Listing of Priorities - Seven Party Agreement

Priority Number	Agency and Description of Service Area	Beneficial Consumptive Use (Acre-feet/year)
1	Palo Verde Irrigation District - 104,500 acres	3,850,000
2	Yuma Project, California Portion, not exceeding 25,000 acres	
3(a)	Imperial Irrigation District	
3(b)	Palo Verde Irrigation District - 16,000 acres	
4	Metropolitan Water District, City of Los Angeles and/or others on the coastal plain	550,000
5	Metropolitan Water District, City of Los Angeles and/or others on the coastal plain	662,000
6(a)	Imperial Irrigation District	300,000
6(b)	Palo Verde Irrigation District - 16,000 acres of adjoining mesa	
	Total	**5,362,000**

Exhibit 8E
Historical Annual Colorado River Supply and Use

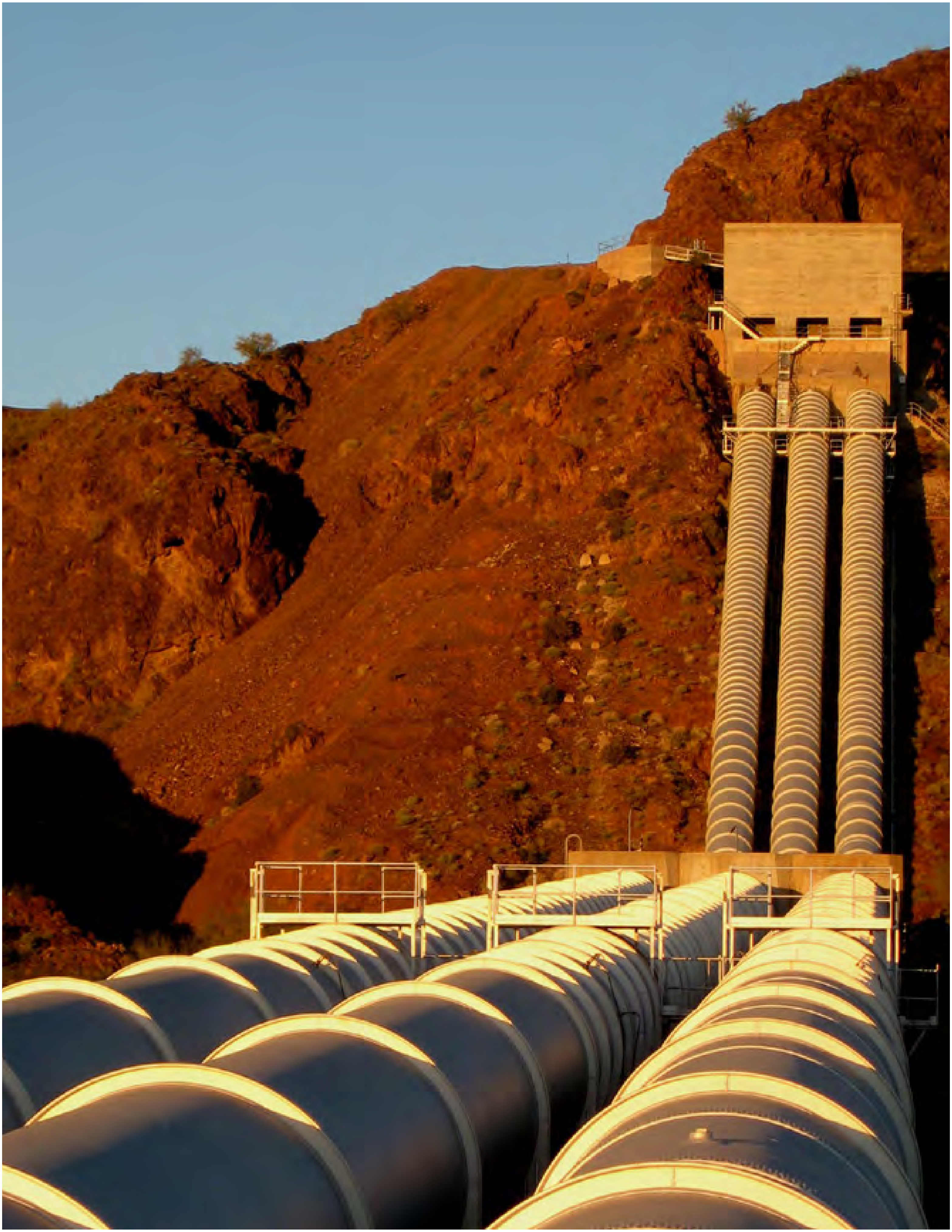


8.1.1.2 Colorado Supply Reliability

Exhibit 8E illustrates the historical annual Colorado River Basin supply and demand beginning 1914 through 2007. The steady increase of demand has caught up with the supply.

Reliability of CRA water for MWD has decreased overtime as a consequence of multiple events. Historically, California had used up to 5.4 million AFY as Arizona and Nevada were not using their normal apportionments of Colorado River water and surplus water was made available by the Secretary. The 1964 Decree and the 2006 Consolidated Decree of the US Supreme Court in *Arizona v. California* confirmed California's allocation was limited to 4.4 MAF annually. As a result, MWD can now only rely on its fourth priority allocation of 550 TAF annually. Prior to this, MWD was able to satisfy its fifth priority allocation with Nevada and Arizona's unused water. However, in 1985 Arizona began increasing deliveries to its Central Arizona Project reducing the availability of unused apportionment to fill MWD's fifth priority.

Because of dry years on the Colorado River system and Arizona and Nevada using their full apportionment, the U.S. Secretary of Interior asserted that California must come up with a plan to live within its 4.4 MAF apportionment. Therefore, users from California have developed California's Colorado River Water Use Plan (California Plan). The users included: MWD, Palo Verde Irrigation District (PVID), Imperial Irrigation District (IID), and Coachella Valley Water District (CVWD). This plan identifies actions that California will take to operate within its 4.4 million acre-foot entitlement. Exhibit 8F and Exhibit 8G illustrate the historical total Colorado River Basin storage and the historical Lake Mead elevation, which show a protracted dry period beginning around 1999.



California currently consumes its normal apportionment of 4.4 million AFY. The order of priority is as follows:

1. PVID - gross area of 104,500 acres of land in the Palo Verde Valley.

2. Yuma Project-Reservation Division - not exceeding a gross area of 25,000 acres in California.

3(a). IID - lands in the Imperial Valley served by the All-American Canal. Export out of basin, primarily agricultural usage. Also, second 63,000 AF in priority 6(a) and balance of any remaining priority 6(a) and 7 water available.

3(b). CVWD - lands in the Coachella Valley served by the Coachella Branch of the All-American Canal. Export out of basin, agricultural usage. Also third 119,000 AF in priority 6(a) and balance of any remaining priority 6(a) and 7 water available.

3(c). PVID - 16,000 acres of land on the Lower Palo Verde Mesa, also priority 6(b).

4. MWD – 550,000 AF, also 662,000 AF in priority 5, and first 38,000 AF in 6(a)

A component of the California Plan was completion of the Quantification Settlement Agreement (QSA) in 2003, which established baseline water use for each California party with Colorado River water rights. Key to the agreement is the quantification of IID at 3.1 MAF and CVWD at 330 TAF. Completion of the QSA facilitates the transfer of water from agricultural agencies to urban water suppliers by allowing water conserved on farm land to be made available for urban use. As a result of litigation, the QSA and eleven other agreements were ruled invalid on February 11, 2010. MWD in conjunction with CVWD and the SDCWA have appealed the court's decision. Ultimately, the total impact of the court's decisions on MWD's Colorado River supplies cannot be determined at this time pending the outcome of the appeal. However, MWD's existing conservation, land fallowing, and transfer programs for Colorado River supplies are independent of the QSA and will not be impacted by the QSA lawsuit.

Along with MWD's apportionment, MWD has developed a number of water supply programs to improve reliability of Colorado River supplies, such as agricultural water transfers and storage programs, and has multiple programs under development as listed in Exhibit 8G. Developed programs in conjunction

Exhibit 8F
Historical Total Colorado River Basin Storage

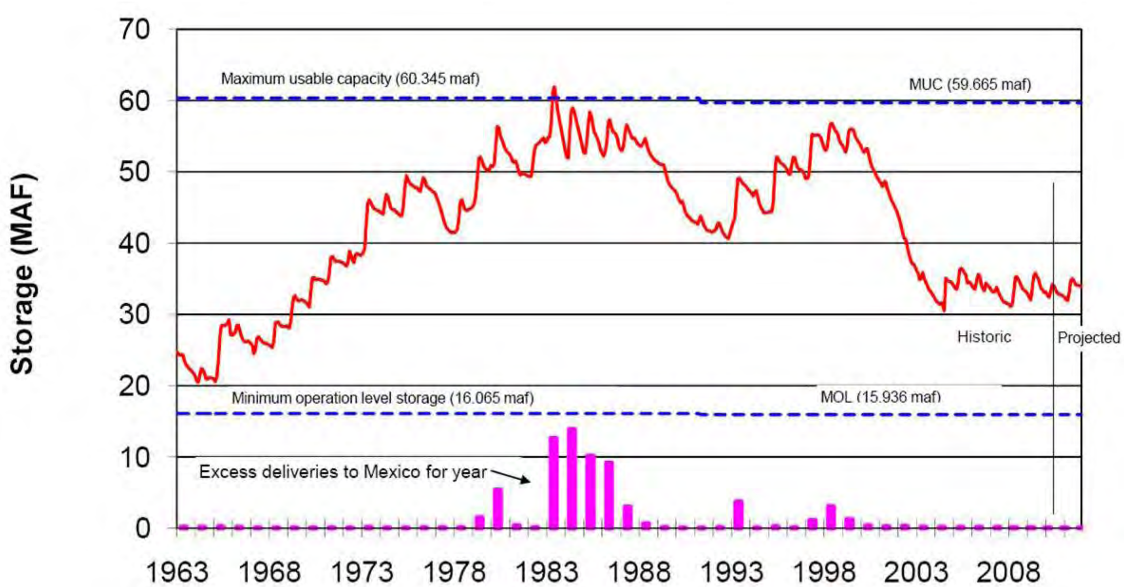
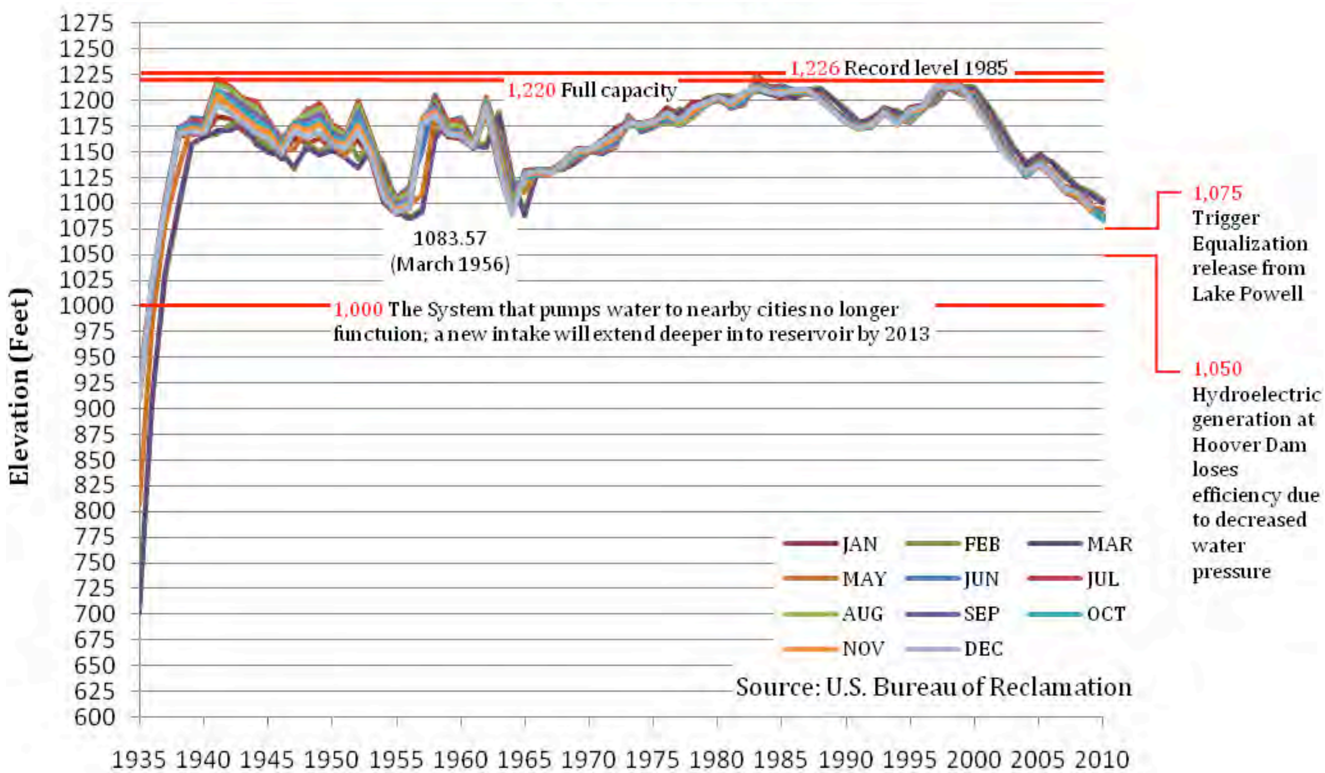


Exhibit 8G
Historical Lake Mead Elevation



The bathtub ring at Lake Mead, August 2010, lake elevation 1,087 feet.

Exhibit 8H
MWD's CRA Forecast Supplies in 2035, Average Year (1922 - 2004 Hydrology)

Program	Supply (Thousands of AF)/ Year
Current	
Basic Apportionment - Priority 4	550
Imperial Irrigation District/MWD Conservation Program	85
Priority 5 Apportionment (Surplus)	13
Palo Verde Irrigation District Land Management Crop Rotation and Water Supply Program	133
Lower Colorado Water Supply Project	5
Lake Mead Storage Program	400
Quechan Settlement Agreement Supply	7
Forbearance for Present Perfected Rights	-47
Coachella Valley Water District State Water Project/QSA Transfer Obligation	-35
Desert Water Agency and Coachella Valley Water District SWP Table A Obligation	-155
Desert Water Agency and Coachella Valley Water District SWP Table A Transfer Call-back	82
Desert Water Agency and Coachella Valley Water District Advance Delivery Account	73
Drop 2 Reservoir Funding	25
Southern Nevada Water Authority Agreement	0
Subtotal of Current Programs	**1,136**
Programs Under Development	
Additional Palo Verde Irrigation District Transfers	62
Arizona Programs - Central Arizona Project	50
California Indians/Other Agriculture	10
ICS Exchange	25
Agreements with Coachella Valley Water District	35
Hayfield Groundwater Extraction Project	0
Subtotal of Proposed Programs	**182**
Additional Non-MWD CRA Supplies	
San Diego County Water Authority/ Imperial Irrigation District Transfer	200
Coachella and All-American Canal Lining	
To San Diego County Water Authority	80
To San Luis Rey Settlement Parties[1]	16
Subtotal of Non-MWD CRA Supplies	**296**
Maximum CRA Supply Capability[2]	**1,614**
Minus Supply CRA Capacity Constraint of 1.25 MAF Annually	**-364**
Maximum Forecast CRA Deliveries	**1,250**
Minus Non-MWD Supplies[3]	**-296**
Maximum MWD Supply Capability[4]	**954**

1. Subject to satisfaction of conditions specified in agreement among MWD, the US, and the San Luis Rey Settlement Parties
2. Total amount of supplies available without taking into consideration of CRA capacity constraint of 1.25 MAF annually.
3. Exchange obligation for San Diego County Water Authority - Imperial Irrigation District transfer and the Coachella and All-American Canal Lining Projects.
4. The amount of CRA water available to MWD after meeting exchange obligations.

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

with MWD's apportionment will provide MWD with approximately 1.14 MAF in 2035 under an average year (1922 – 2004 hydrology). Proposed programs under development could add another 182 TAF per year. Non-MWD supplies conveyed through the CRA are forecast at 296 TAF for a total CRA supply capability of 1.61 MAF. However, the CRA has a supply capacity constraint of 1.25 MAF. After subtracting MWD's conveyance obligation of non-MWD supplies, MWD's supplies for 2035 under average year, single-dry year (1977 hydrology), and multi-dry year (1990 – 1992 hydrology) scenarios are all forecast at 954 TAF. Exhibit 8H summarizes the CRA supply forecast for 2035 under an average year.

8.1.1.3 Water Quality Issues

Water quality issues for Colorado River supplies cover high salinity levels, perchlorate, nutrients, uranium, chromium VI, N-nitrosodimethlamine (NDMA), and pharmaceuticals and personal care products (PPCPs). High salinity levels present the most significant issue and the only foreseeable water quality constraint for the Colorado River supply. MWD expects its source control programs for the CRA to adequately address the other water quality issues. MWD has also bolstered its water security measures across all of its operations since 2001, including an increase in water quality tests. Details of MWD's water quality initiatives are available in MWD's 2010 Regional Urban Water Management Plan (RUWMP).

Salinity

Water obtained from the Colorado River has the highest salinity levels of all MWD supply sources averaging 630 mg/L since 1976. Salts are eroded from saline sediments deposited in prehistoric marine environments in the Colorado River Basin (Basin), dissolved by precipitation, and conveyed into the Basin's water courses. Salinity issues have been recognized in the Basin for over 30 years. The seven basin states formed the Colorado River Basin Salinity Control Forum (Forum) to mutually cooperate on salinity issues in the Basin. The Forum recommended the U.S. Environmental Protection Agency (USEPA) to act upon the Forum's proposal and in response the USEPA approved water quality standards and established numeric criteria for controlling salinity increases. Each Basin State adopted the water quality standards, which are designed to limit the flow-weighted average annual salinity level to 1972 levels or below. An outgrowth of the Forum was the Colorado River Basin Control Program. At the core of the program is the reduction in salts entering the river system by intercepting and controlling non-point sources, wastewater, and saline hot springs. Salinity reduction projects have reduced salinity concentration of Colorado River water by over 100mg/L, which equates to approximately $264 million per year in avoided damages (2005 dollars).

MWD adopted a Salinity Management Policy in 1999 with the goal of achieving salinity concentrations of less than 500 mg/L at delivery. To reduce salinity levels, Colorado River supplies are blended with SWP water supplies to achieve the salinity target. In some years, the target is not possible to achieve as a result of hydrologic conditions that increase salinity on the Colorado River and decrease SWP water available for blending. Additionally, to maximize the use of recycled water for agriculture, MWD attempts to import lower salinity imported water during the spring/summer months to reduce salinity levels in recycled water supplies.

Perchlorate

In 1997 perchlorate was first detected in the Colorado River. It was attributed to an industrial site upstream of the Las Vegas Wash in Nevada which drains to the river. Subsequently, an additional perchlorate plume was found to be migrating from an additional industrial site, but had not reached the Las Vegas Wash. Since the initial discovery of contamination, remediation efforts have significantly reduced perchlorate loading from the Las Vegas Wash. At Lake Havasu, downstream of the convergence of the Las Vegas Wash and Colorado River, perchlorate levels have decreased from 9 μg/L at their peak in 1998 to less than 6 μg/L in October 2002. Since June 2006, typical levels have been less than 2 μg/L.

Nutrients

Excessive nutrient levels in water can stimulate algal and aquatic weed growth leading to taste and odor concerns. Nutrients include both phosphorous and nitrogen compounds. Other impacts of algal and aquatic weed growth include reductions in operating efficiencies and potentially provide an additional food source for invasive aquatic species, such as quagga and zebra mussels.

Naturally, the Colorado River system has relatively low concentrations of phosphorous. Additional loading to the system as upstream urbanization increases has the ability to increase phosphorous concentrations and impact MWD's ability to blend low nutrient concentration CRA water with high nutrient concentration SWP water. MWD continues to work with agencies located along the lower Colorado River to improve wastewater management in order to reduce phosphorous loading.

Uranium

Near Moab, Utah, a 16-million ton pile of uranium tailings located approximately 750 feet from the Colorado River is a potential source of uranium loading to the river. In 1999, the US Department of Energy began remediating the site by removing tailings and treating contaminated groundwater. Complete removal of the pile is expected by 2025 or 2019 if additional funding is secured. MWD is tracking clean-up progress and continues to support rapid clean-up of the site.

To address recent uranium mining claims in the vicinity of the Colorado River and the Grand Canyon Area, MWD has sent letters to the Secretary of Interior to highlight MWD's concern of source water protection and recommended close federal oversight. In 1999, the Department of Interior placed a two-year hold on mining claims for 1 million acres adjacent to the Grand Canyon area to conduct additional analyses and H.R. 644, Grand Canyon Watersheds Protection Act, was introduced in 2009. H.R. 644, if approved, would prohibit new mining activities around the Grand Canyon area.

Chromium VI

Chromium VI has been detected in a groundwater aquifer in the vicinity of the Colorado River near Topock, Arizona. The source of the contamination is a natural gas compression site operated by Pacific Gas and Electric (PG&E) that previously used chromium VI in its operations. Monitoring upstream and downstream of the site range from non-detect (0.03 μg/L) to 0.06 μg/L which are considered within the background range for the river. MWD is actively involved in the corrective action process through its participation in stakeholder workgroups and partnerships with State and federal regulators, Indian tribes, and other stakeholders. The Final Environmental Impact Report (EIR) for the Topock Chromium VI remediation project is complete and has been certified by California Department of Toxic Substances Control. U.S. Department of Interior has issued a Federal Record of Decision which states that PG&E holds sole responsibility for the substantial threat of the release of Chromium VI near Topock, Arizona. A time-critical removal action is authorized and PG&E's clean-up operations are under the direction and oversight of the Department of Toxic Substances Control.

NDMA and Pharmaceuticals and Personal Care Products

N-nitrosodimenthylamine is a by-product formed by secondary disinfection of some natural waters with chloramines. MWD is

involved with projects to understand the potential sources of NDMA precursors in its source watersheds and to develop treatment strategies to minimize NDMA formation at its water treatment facilities. In 2007, MWD initiated monitoring efforts to measure PPCPs in its source supplies. PPCPs have been detected at very low levels (low ng/L level; parts per trillion) consistent with monitoring results from other utilities. MWD is involved with programs to improve analytical testing methods, characterize PPCP in drinking water sources in California, and effects of PPCPs on groundwater recharge and recycled water use.

8.1.2 State Water Project

MWD began receiving water from the SWP in 1972. MWD is the largest of 29 contractors for water from the SWP, holding a contract for 1.912 MAF per year, or 46 percent of the total contracted amount of the 4.173 MAF ultimate delivery capacity of the project. Variable hydrology, environmental issues, and regulatory restrictions in the San Francisco Bay/ Sacramento-San Joaquin River Delta (Bay-Delta) have periodically reduced the quantity of water that the SWP delivers to MWD.

Exhibit 81
State Water Project Major Facilities

Courtesy of the State of California Department of Water Resources

8.1.2.1 Major State Water Project Facilities

The SWP is owned by the State of California and operated by the Department of Water Resources (DWR) delivering water to two-thirds of the population of California and 750,000 acres of farmland. The SWP system consists of 701 miles of aqueduct, 34 storage facilities totaling 5.8 MAF of storage, five hydro-electric power plants, four pumping-generating plants, 17 pumping plants, and three pump stations. Exhibit 8I illustrates the location of major SWP facilities. SWP facilities originate in Northern California at Lake Oroville on the Feather River. Water released from Lake Oroville flows into the Feather River, goes downstream to its confluence with the Sacramento River, and then travels into the Bay-Delta. Water is pumped from the Bay-Delta region to contractors in areas north and south of the San Francisco Bay and south of the Bay-Delta. SWP deliveries consist solely of untreated water. In addition to delivering water to its contractors, the SWP is operated to improve water quality in the Bay-Delta region, control flood waters, and provide recreation, power generation, and environmental enhancement.

MWD receives SWP water at three locations: Castaic Lake in Los Angeles County, Devil Canyon Afterbay in San Bernardino County, and Box Spring Turnout at Lake Perris in Riverside County. In addition, MWD has flexible storage rights of 65 TAF at Lake Perris at the terminus of the East Branch of the SWP and 153.95 TAF at Castaic Lake at the terminus of the West Branch.

8.1.2.2 Contract Allocations

Contract allocations, also known as entitlements, for SWP contractors are provided by DWR in a table commonly referred to as Table A and shown in Exhibit 8J. Allocations are based on the original projected SWP maximum yield of 4.173 MAF. Table A is a tool used by DWR to allocate fixed and variable SWP costs and yearly water entitlements to the contractors. Table A contract amounts do not reflect actual deliveries a contractor should expect to receive. MWD has a Table A contract amount of 1.912 MAF. MWD's full Table A contract amount was made available to MWD for the first time in 2006.

DWR annually approves the amount of contract allocations SWP contractors will receive. The contract allocation amount received by contractors varies based on contractor demands and projected available water supplies. Variables impacting projected water supplies include snowpack in the Sierra Nevada, capacity available in reservoirs, operational constraints, and demands of other water users. Operational constraints include pumping restrictions related to fish species listed as either threatened or endangered under the federal or state Endangered Species Acts. Contractors' requests for portions of their entitlements cannot always be met. In some years there are shortages and in other years surpluses. In 2008 and 2009, SWP contractors received only 35 percent and 40 percent, respectively, of their SWP contract allocations.

DWR bi-annually prepares the State Water Project Delivery Reliability Report to provide contractors with current and projected water supply availability for SWP. The 2009 draft released in January 2010 indicates expected deliveries for multiple-dry year periods will vary from 32 to 38 percent of maximum Table A amounts and for multiple-year wet periods, 72 to 94 percent of maximum Table A amounts. Overall the report shows increased reductions in water deliveries on average when compared to the previous 2007 report. Factors impacting deliveries include environmental constraints and hydrologic changes as a result of climate change.

Exhibit 8J Table A Maximum Annual SWP Amounts (acre-feet)

Contractor Maximum SWP Table A

North Bay

Napa County Flood Control and Water Conservation District	29,025
Solano County Water Agency	47,756
Subtotal	**76,781**

South Bay

Alameda County Flood Control and Water Conservation District, Zone 7	80,619
Alameda County Water District	42,000
Santa Clara Valley Water District	100,000
Subtotal	**222,619**

San Joaquin Valley

Oak Flat Water District	5,700
Kings County	9,305
Dudley Ridge Water District	57,343
Empire West Side Irrigation District	3,000
Kern County Water Agency	998,730
Tulare Lake Basin Water Storage District	95,922
Subtotal	**1,170,000**

Central Coastal

San Luis Obispo County Flood Control and Water Conservation District	25,000
Santa Barbara County Flood Control and Water Conservation District	45,486
Subtotal	**70,486**

Southern California

Antelope Valley-East Kern Water Agency	141,400
Castaic Lake Water Agency	95,200
Coachella Valley Water District	121,100
Crestline-Lake Arrowhead Water Agency	5,800
Desert Water Agency	50,000
Littlerock Creek Irrigation District	2,300
Mojave Water Agency	75,800
Metropolitan Water District of Southern California	1,911,500
Palmdale Water District	21,300
San Bernardino Valley MWD	102,600
San Gabriel Valley MWD	28,800
San Gorgonio Pass Water Agency	17,300
Ventura County Flood Control District	20,000
Subtotal	**2,593,100**
Delta Delivery Total	**4,132,986**

Feather River

Butte County	27,500
Plumas County Flood Control and Water Conservation District	2,700
Yuba City	9,600
Subtotal	**39,800**
Total	**4,172,786**

In addition to MWD's Table A amount, MWD has long term agreements in place to obtain additional SWP supplies through five other programs:

- Article 21
- Turnback Pool
- Yuba River Accord
- San Luis Carryover Storage
- Desert Water Agency and Coachella Valley Water District Table A Transfer

Article 21 is in reference to a provision in the SWP contract with DWR that allows SWP contractors, such as MWD, to take additional water deliveries in addition to Table A amounts. Article 21 water is only available under certain conditions as outlined in Article 21. SWP Article 21 of the contracts permits delivery of water excess to delivery of SWP Table A and some other water types to those contractors requesting it. SWP Article 21 water is apportioned to those contractors requesting it in the same proportion as their SWP Table A.

Turnback Pool (Pool) water allows a contractor that has been allocated Table A annual entitlement that the contractor will not use to sell that water to other SWP contractors through the Pool. If there are more requests from contractors to purchase water from the Pool than the amount in the Pool, the water in the Pool is allocated among those contractors requesting water in proportion to their Table A entitlements. If requests to purchase water from the Pool total are less than the amount of water in the Pool, the sale of water is allocated to the selling contractors in proportion to their respective amounts of water in the Pool.

In 2007, MWD and DWR signed an agreement allowing MWD to participate in the Yuba Dry Year Water Purchase Program. Under this program, transfers are available from the Yuba County Water Agency during dry years up to 2025. MWD completed purchases of 26.4 TAF and 42.9 TAF in 2008 and 2009, respectively.

As part of the Monterey Amendment, which modified the contractors' long term contracts with DWR, the use of carryover storage by contractors was permitted in the San Luis Reservoir for use during dry years. Carryover storage is curtailed if it impedes with the storage of SWP water for project needs.

MWD entered into a transfer agreement with the DWA and CVWD for their Table A contract amounts in exchange for an equal amount of water from the CRA. Both DWA and CVWD are SWP contractors, but have no physical connections to obtain SWP water. MWD is able to transfer CRA water to both agencies as a result of their locations adjacent to CRA facilities. DWA and CVWD have a combined Table A amount of 1.912 MAF per year. MWD additionally can provide DWA and CVWD with deliveries of MWD's other SWP water supplies and non-SWP supplies utilizing SWP facilities, thus allowing MWD additional flexibility in managing its water supply portfolio.

MWD also engages in short-term transfer agreements using SWP facilities to bolster supplies as opportunities become available as discussed in the Groundwater Storage and Transfers sub-section. Historically, MWD has obtained transfers through the Governor's Water Bank, Dry-Year Purchase Programs, and the State Water Contractors Water Transfer Program.

MWD expects to receive 2.046 MAF through its SWP supplies in 2035 under average conditions (1922 – 2004 hydrology). Exhibit 8K summarizes MWD's SWP supplies by program. Current programs are expected to result in 1.441 MAF and programs under development are expected to add an additional 605 TAF. Under multi-year dry conditions (1990 – 1992 hydrology), MWD expects to receive only 956 TAF and 1,003 TAF under a single-dry year (1977 hydrology).

8.1.2.3 Water Quality Issues

Water quality issues for SWP supplies include total organic carbon (TOC), bromide, arsenic, nutrients, NDMA, and PPCPs. TOC and bromide in SWP water present the greatest water quality issues and have restricted MWD's ability to use SWP water at various times as the contaminants form disinfection byproducts during water treatment processes. MWD has initiated a process to upgrade its treatment processes to ozone disinfection to reduce formation of disinfection byproducts and lift potential restrictions on SWP water usage. MWD requires low salinity levels of SWP water to meet blending requirements for CRA water, and therefore, any increase in salinity levels in SWP supplies is a concern to MWD.

MWD supported DWR in the establishment of a policy regarding water quality of non-SWP water transported through the SWP system and in the expansion of Municipal Water Quality Investigations Programs to include additional monitoring and advanced warnings to contractors that may impact water treatment processes.

MWD is utilizing its water supply portfolio options to conduct water quality exchanges to reduce TOC and bromide. MWD has stored SWP water during periods of high water quality in groundwater storage basins for later use when SWP is at a lower water quality. These storage programs were initially designed to provide water during dry SWP conditions, but a few of these programs are now operated for dual-purposes.

TOC and bromide in high concentrations lead to the formation of disinfection byproducts when source water is treated with disinfectants, such as chlorine. Agricultural drainage to the Bay-Delta and seawater comingling with Bay-Delta supplies increases these contaminants. The Bay Delta Conservation Plan (BDCP) has outlined multiple options to improve the water supply reliability and habitat protection, which is being prepared through a collaboration of state, federal, and local water agencies, state and

Exhibit 8K
MWD Forecast Supplies of SWP Water in 2035, Average Year (1922 - 2004 Hydrology)

Program	Supply (Thousands of AF)
Current	
MWD Table A	1,026
Desert Water Agency and Coachella Valley Water District SWP Table A Transfer	155
San Luis Carryover Storage[1]	208
Article 21 Supplies	52
Yuba River Accord Purchase	0
Subtotal of Current Programs[2]	**1,441**
Programs Under Development	
Delta Conveyance Improvements	605
Integrated Resources Plan SWP Target[3]	0
Subtotal of Proposed Programs[2]	**605**
Maximum SWP Supply Capability[2]	**2,046**

1. Includes carryover water from Desert Water Agency and Coachella Valley Water District.
2. Does not include transfers and water banking associated with SWP.
3. Remaining supply needed to meet Integrated Resources Plan target.

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

federal fish agencies, environmental organizations, and other interested parties. The overall goal of BDCP is identifying water flow and habitat restoration actions to both improve water supply reliability and recover endangered and sensitive species and their habitats Bay-Delta. MWD is in the process of computing upgrades to its water treatment plants to use ozone as the primary disinfectant. Ozone disinfection is very effective treatment for control of bromate formation and will allow MWD to treat higher quantities of SWP supplies without blending those supplies with CRA water.

Arsenic

SWP supplies not banked in MWD's SWP groundwater storage programs naturally contain low levels of arsenic ranging from non-detect to 4.0 µg/L and do not require additional treatment for arsenic removal. SWP supplies banked in at least one of these groundwater storage programs contain arsenic levels close to or at the regulatory threshold of 10 µg/L requiring additional treatment for arsenic removal. Historically, MWD has at times restricted flows from one groundwater storage program as a result of arsenic levels. One groundwater storage partner has initiated a pilot arsenic removal program, albeit raising the cost of the groundwater storage program. Arsenic can also be removed at water treatment plants by increasing coagulant doses. To handle arsenic removed during water treatment processes, MWD has had to invest in solids handling facilities.

Nutrients

Nutrient levels in SWP water are significantly higher than in Colorado River water. Both phosphorous and nitrogen compounds are a concern in SWP water, but similar to CRA supplies phosphorous is the limiting nutrient. Nutrient sources in SWP water include wastewater discharges, agricultural drainage, and sediments from nutrient rich soils in the Bay-Delta. MWD reservoirs have been temporarily bypassed at times as a result of taste and odor events related to nutrients leading to short-term supply impacts.

MWD is working with other water agencies also receiving SWP water from the Bay-Delta region to reduce the impact of nutrient loading from wastewater plants discharging to the Bay-Delta. To assist in managing its operations, MWD has implemented an algae monitoring and management program designed to provide warnings in advance of algae and taste and odor issues at its reservoirs allowing adjustments in other system operations.

NDMA and Pharmaceuticals and Personal Care Products

Similar to all of its water supply sources, NDMA and PPCPs are constituents of emerging concern. As described above for Colorado River supplies, MWD is involved with efforts to address both NDMA and PPCPs.

Salinity

Over the long term salinity concentrations in SWP water are significantly lower than in CRA water, but the timing of supply availability and total dissolved solids (TDS) concentrations can vary in response to hydrologic conditions. Additionally, salinity concentrations vary in the short term in response to seasonal and tidal flow patterns. MWD requires lower salinity SWP water to blend with CRA water to meet salinity requirements for its member agencies. MWD's blended salinity objective is 500 mg/L.

Environmental constraints also impact MWD's ability to meet its salinity objective. Since 2007, pumping operations in the Bay-Delta have been limited to prevent environmental harm (as discussed in the Bay-Delta Issues subsection below). MWD must rely on higher salinity CRA water resulting in an exceedance in MWD's salinity objective at times.

SWP salinity concentrations as specified in the SWP Water Service Contract have not been met. Article 19 of SWP Water Service Contract specifies ten-year average salinity concentrations of 220 mg/L and a monthly maximum of 440 mg/L. MWD is working with DWR and other agencies to reduce salinity in SWP Bay-Delta supplies through multiple programs. These programs include modifying agricultural drainages and completing basin plans on the San Joaquin River, modifying levees around flooded islands in the Bay-Delta, and installing gates to reduce transportation of salts from seawater.

8.1.2.4 Bay-Delta Issues

The Bay-Delta is a major waterway at the confluence of the Sacramento and San Joaquin rivers serving multiple and at times conflicting purposes exacerbated during dry years when water to meet the needs of both people and the environment is in short supply. Approximately two-thirds of Californians receive at least a portion of their water from the Bay-Delta. Almost all water delivered via the SWP to Southern California must pass through the Bay-Delta. Runoff from more than 40 percent of the state is also conveyed through the Bay-Delta forming the eastern edge of the San Francisco bay's estuary. A large portion of the Bay-Delta region lies below sea level and is protected by more than 1,100 miles of levees to prevent flooding. Deterioration of the Bay-Delta ecosystem coupled with infrastructure concerns, hydrologic variability, climate change, litigation, regulatory restrictions, and previously discussed water quality issues have resulted in supply reliability challenges for SWP contractors who depend upon the Bay-Delta for water supplies.

Environmental

As an estuarine environment, the Bay-Delta provides habitat for migratory and resident fish and birds, including those placed on the threatened or endangered species list under the federal or California Endangered Species Act (ESA). Five fish species residing in the Bay-Delta were listed as endangered under the ESA, and one additional species was listed as threatened in 2009 under the California ESA. As a result of a combination of lawsuits regarding the ESA listed species and biological opinions and incidental take permits (permits for inadvertently harming ESA listed species) from the U.S. Fish and Wildlife Service and National Marine Fisheries Service, SWP exports and pumping operations in the Bay-Delta have been significantly curtailed. However, DWR prepared a Water Allocation Analysis in 2010 indicating that MWD could receive 150 to 200 TAF less water than forecast for 2010 under average hydrologic conditions. Ongoing litigation, additional species listing, and regulations could further curtail pumping operations and have an additional adverse impact on MWD's supplies and reserves. MWD has filed a lawsuit in conjunction with other SWP contractors challenging one of the biological opinions. As discussed below under the Delta Plan, the Delta Vision process is designed to develop long term solutions to these issues.

Infrastructure

Bay-Delta channels are constrained by a levee system to protect below sea level islands in the Bay-Delta from flooding. Land in the Bay-Delta subsides mainly from ongoing oxidation of aerated peat soils. Some islands are presently twenty feet or more below sea level. Land subsidence is expected to continue which increases the risk of levee failure and island flooding. Many of the levees are old and do not meet modern engineering standards. A catastrophic earthquake could cause widespread levee failure shutting down SWP operations for an extended period of time. Following a levee failure, the flow of water onto an island can pull saline water from the San Francisco Bay into the central Bay-Delta area and, if coupled with pumping in the south Bay-Delta, draw saline water into the south Bay-Delta area. Therefore, pumping in the south Bay-Delta may need to be stopped or slowed down for an extended period, and additional flows may

Photo courtesy of The Metropolitan Water District of Southern California.

need to be released from Lake Oroville to flush saline water out of the Bay-Delta. Any salinity introduced into Bay-Delta may also impact Bay-Delta water quality for an extended period of time.

Recognizing the need for protecting these vulnerable Bay-Delta levees, the Bay-Delta Levees Program was formed to coordinate improvements to and maintenance of the Bay-Delta levees. Over the next few years, the DWR and other agencies will conduct a Comprehensive Program Evaluation. This program will supplement existing risk studies, develop a strategic plan, recommend priorities, and provide estimates for the Bay-Delta Levees Program.

8.1.2.5 Delta Plan

Former California Governor Arnold Schwarzenegger established the Delta Vision Process in 2006 to address ongoing Bay-Delta conflicts through long-term solutions. The independent Blue Ribbon Task Force completed their vision for sustainable management of the Bay-Delta in 2008. After delivery of the Delta Vision recommendations and goals, the State Legislature initiated the process to conduct information hearings and draft legislation. Ultimately, the Governor called the Seventh Extraordinary Session to address the Bay-Delta and water issues in the State. Resulting legislation included the approval of SB 1 X7 addressing Bay-Delta policy reforms and governance of the Bay-Delta.

A key concept of SB 1 X7 is the formation of a Delta Stewardship Council (Council). The Council is an independent State agency tasked to equally further the goals of Delta restoration and water supply reliability. One of the Council's first major tasks is to develop, adopt, and begin implementation of a Delta Plan by January 1, 2012. Key requirements of the plan as summarized in the MWD RUWMP are:

- Further the coequal goals of ecosystem restoration and water supply reliability.
- Attempt to reduce risks to people, property, and State interests.
- Promote Statewide water conservation, water use efficiency, and sustainable use of water to achieve the coequal goals.
- Improvements to water conveyance/ storage and operations of such facilities to achieve the coequal goals.
- Consider including the Bay Delta Conservation Plan (BDCP) into the Delta Plan and allow the BDCP to be eligible for State funding if specific conditions are met.

The BDCP is a joint effort of State and federal fish agencies; State, Federal, and local water agencies; environmental organizations; and other parties with the goal of providing for both improvements in water reliability through securing long-term permits to operate the SWP and species/habitat protection in the Delta. MWD is a member of the Steering Committee. An outcome of the plan will be the identification of water flow and habitat restoration actions that assist in recovery of ESA listed and sensitive species and their associated habitats in the Bay-Delta. A range of options to accomplish the outcome will be carried forward to the environmental review phase.

Photo courtesy of The Metropolitan Water District of Southern California.

8.1.3 In-Basin Storage

In basin-storage facilities play a key role in maintaining MWD's reliability during droughts or other imported water curtailments and emergency outages. In-basin storage facilities consist of surface reservoirs and contracted groundwater basin storage. Conjunctive use of surface reservoirs and groundwater basins was first initiated by MWD in the 1950's. Long term storage goals for in-basin storage facilities were established in MWD's Water Surplus and Drought Management Plan (WSDM). The WSDM plan allows storage for hydrology variances, water quality, and SWP and CRA issues.

MWD has established emergency in-basin storage requirements based on a major earthquake that could potentially cutoff all supplies for six months from the all aqueducts serving the region, the CRA, both SWP branches, and LADWP's LAA. Under this scenario, MWD would maintain deliveries by suspending interruptible deliveries, implementing mandatory water use reductions of 25 percent of normal-year demands, water would be made available from surface reservoir and groundwater supplies stored as part of MWD's interruptible supply program, and full local groundwater production would occur. MWD's emergency storage requirement is a function of projected demands and varies with time.

8.1.3.1 Surface Reservoirs

MWD owns and operates seven in-basin surface storage reservoirs. Four of the reservoirs, Live Oak, Garvey, Palos Verdes, and Orange County, are used for regulatory purposes and do not provide drought or emergency storage. Additionally, MWD owns and operates two reservoirs, Copper Basin and Gene Wash, along the CRA outside of the basin for system regulation purposes. Outside its basin, MWD has 1.45 MAF storage rights in Lake Mead on the Colorado River pursuant to its intentionally created surplus agreement with the U.S. Bureau of Reclamation. MWD also has storage rights in DWR's SWP terminal reservoirs, Lake Perris and Castaic Lake, as previously discussed. The total capacity of all in-basin surface reservoirs, inclusive of the rights in the terminal reservoirs, is 1.26 MAF, as listed in Exhibit 8L.

MWD operates its three main storage reservoirs, Diamond Valley Lake, Lake Skinner and Lake Matthews, for dry-year, emergency, and seasonal storage. MWD has identified a dry-year storage capacity goal of 620 TAF by 2020. To date, this goal has been met and will be sustained with storage at Diamond Valley Lake and the two terminal reservoirs. Under an average year scenario for 2035 (1922-1994 hydrology), 576 TAF per year

Exhibit 8L
MWD's In-Basin Surface Reservoir Capacity

Reservoir	Capacity (AF)
Dry Year/Emergency/Seasonal Storage Purposes	
Diamond Valley Lake	810,000
Lake Matthews	182,000
Lake Skinner	44,000
Lake Perris (Storage Rights)[1]	65,000
Castaic Lake (Storage Rights)[1]	153,940
Subtotal	1,254,940
Regulatory Purposes	
Live Oak	2,500
Garvey	1,600
Palos Verdes	1,100
Orange County	212
Subtotal	5,412
Total Reservoir Capacity	**1,260,352**

1. MWD holds storage rights for flexible use in DWR terminal storage facilities, Lake Perris and Castaic Lake. In addition, MWD has emergency storage of 334 TAF in DWR's reservoirs.

of in-basin surface storage is projected to be available, exclusive of emergency supplies, as summarized in Exhibit 8M.

MWD reserves a portion of its in-basin surface reservoir storage capacity for emergencies. MWD's emergency surface reservoir storage portfolio is split between storage in its three main reservoirs and DWR reservoirs. MWD's emergency storage capacity, based on demands for 2030, is forecast to be approximately 610 TAF. Approximately 276 TAF is projected to be stored in MWD's facilities and the balance of 334 TAF in DWR's facilities. The balance of available storage capacity, 975 TAF, is for dry-year and seasonal storage.

Any additional reservoir capacity is used for seasonal storage and system operations. Seasonal storage is required to meet peak demands. MWD incorporates reserves of 5 percent into reservoir operations to account for imported water transmission infrastructure maintenance that would restrict or temporarily halt imported water flows.

8.1.3.2 Contracted Groundwater Basin Storage

To improve reliability, MWD engages in contracted groundwater basin storage within the basin area. By 2020, MWD aims to develop an annual dry supply of 300 TAF. To meet this goal, MWD has worked with local water agencies to increase groundwater storage. Groundwater storage occurs using the following methods:

- Direct delivery – Water is delivered directly by MWD to local groundwater storage facilities through the use of injection wells and spreading basins.

- In-lieu delivery – Water is delivered directly to a member agency's distribution system and the member agency uses the delivered water and forgoes pumping allowing water to remain in storage.

MWD engages in three main types of storage programs: replenishment,

Exhibit 8M
MWD Forecast Supplies of In-Basin Surface Storage Supplies in 2035, Average Year (1922 – 2004 Hydrology)

Program	Supply (Thousands of AF)/Year
In-Basin Surface Storage (Diamond Valley Lake, Lake Skinner, Lake Matthews)	444
Lake Perris and Castaic Lake MWD Storage Rights	132
Maximum MWD Supply Capability	**576**

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

cyclical, and conjunctive use. These programs are designed to deliver water to agencies prior to the actual need for the demands, allowing MWD to store supplies for use in dry years. Since 2007, MWD has used these programs to address SWP shortages. MWD provides financial incentives and funding to assist agencies to assist with developing storage programs.

Replenishment programs provide water to agencies at a discounted cost and can be withdrawn by the recipient after one year. Cyclic storage contracts allow surplus imported water to be delivered for recharge in advance of the actual water purchase. The delivered water is in excess of an agency's planned and budgeted deliveries. The agency purchases the water at a later time when it has a need for groundwater replenishment deliveries.

Conjunctive use contracts allow MWD to request an agency to withdraw previously stored MWD water from storage during dry periods or emergencies. Agencies must pay MWD the current water rate when they are requested to withdraw water from storage. Water withdrawn from storage allows MWD to temporarily curtail deliveries by an equal amount. MWD currently has ten conjunctive use programs with a combined storage capacity of 421.9 TAF and a dry-year yield of 117.3 TAF per year as summarized in Exhibit 8N.

MWD prepared a Groundwater Assessment Study in 2007 in conjunction with local agencies and groundwater basin managers. As indicated in the report, there is substantial groundwater storage available in the basin, but there are multiple challenges that must be met to utilize the identified storage. Challenges include infrastructure limitations, contamination, legal issues, and funding.

To further increase the availability of in-basin groundwater storage, MWD has identified nine potential storage programs in the basin and an additional two

Exhibit 8N In-Basin Conjunctive Use Programs

Program	Storage Capacity (Thousands of AF)	Dry-Year Yield (Thousands of AF/Year)	Balance 12/31/09 (Thousands of AF)
Los Angeles County			
Long Beach Conjunctive Use Project	13	4.3	6.4
Foothill Area GW Storage Project	9	3	0.6
Long Beach Conjunctive Use Project: Expansion in Lakewood	4	1.2	`
City of Compton Conjunctive Use Program	2	0.8	0
Upper Claremont Heights Conjunctive Use	3	1	0
Orange County			
Orange County GW Conjunctive Use Program	66	22	8.6
San Bernardino County			
Chino Basin Programs	100	33	23
Live Oak Basin Conjunctive Use Project	3	1	0.7
Riverside County			
Elsinore Groundwater Storage Program	12	4	0
Ventura County			
North Las Posas Groundwater Storage Program	210	47	43.5
Total	421.9	117.3	84.6

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

Exhibit 80
MWD Forecast Supplies of In-Basin Groundwater Storage in 2035, Average Year (1922 - 2004 Hydrology)

Program	Supply (Thousands of AF/Year)
Current	
Conjunctive Use	115
Cyclic Storage	139
LADWP Tujunga Well Field Groundwater Recovery Project	12
Subtotal of Current Programs	266
Programs Under Development	
Raymond Basin Conjunctive Use	22
Subtotal of Programs Under Development	22
Maximum MWD Supply Capability	**288**

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

programs are under development. The Raymond Basin Conjunctive Use Program and the LADWP Groundwater Recovery Project are expected to add an additional 34 TAF per year in 2035 under an average year (1922 – 2004 hydrology).

In 2009, a reconnaissance-level analysis was prepared for analyzing the potential for using recycled water as a supply source for a conjunctive use program. The study concluded up to 100 TAF of groundwater storage and production could be potentially developed in four major groundwater basins using Los Angeles County Department of Sanitation supplies. MWD initiated a formal study in 2010 to further study. This concept along with the potential to use City of Los Angeles recycled water supplies from the Hyperion Wastewater Treatment Plant as an additional source.

Exhibit 80 provides a summary of forecast groundwater storage supplies available in 2035 under an average year (1922 -2004 hydrology). Approximately 289 TAF per year are forecast to be available.

8.1.4 Groundwater Storage and Water Transfers

MWD engages in groundwater storage outside of the basin and water transfers to increase the reliability of SWP dry-year supplies. Groundwater storage and water transfers were initiated by MWD in response to concerns that MWD's supply reliability objectives could not be met by the SWP. Groundwater storage and transfer programs were developed to allow MWD to reach its SWP reliability goal. All groundwater storage and water transfer programs designed to bolster SWP reliability are located within the vicinity of the SWP or Central Valley Project (CVP) facilities to facilitate the ultimate deliver of water to MWD. Groundwater storage programs involve agreements allowing MWD to store its SWP contract Table A water in excess of MWD demands and to purchase water for storage. MWD calls for delivery of the stored water during dry years. Transfers involve purchases by MWD from willing sellers during dry years when necessary.

Exhibit 8P
MWD Forecast Supplies of Groundwater Storage and Transfers in 2035, Average Year (1922 - 2004 Hydrology)

Program	Supply (Thousands of AF/Year)
Current	
San Bernardino Valley MWD Minimum Purchase	20
San Bernardino Valley MWD Option Purchase	29
Central Valley Storage and Transfers	
Semitropic Water Banking and Exchange Program	69
Arvin-Edison Water Management Program	75
San Bernardino Valley MWD Program	50
Kern Delta Water Management Program	50
Subtotal of Current Programs	**293**
Programs Under Development	
Mojave Groundwater Storage Program	43
North of Delta/In-Delta Transfers	33
San Bernardino Valley MWD Central Feeder	5
Shasta Return	18
Semitropic Agricultural Water Reuse	11
Subtotal of Proposed Programs	**110**
Maximum Supply Capability	**403**

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

Exhibit 8P summarizes MWD's out of basin groundwater storage and transfer programs supplies in 2035, under an average year (1922 – 2004 hydrology). Current programs are expected to deliver 293 TAF in 2035. Five programs under development are forecasted to deliver an additional 110 TAF for a total of 403 TAF in 2035.

8.1.4.1 Groundwater Storage

MWD has four Central Valley groundwater storage programs with a fifth program under development as described below.

The Semitropic Water Banking and Exchange Program is a partnership formed in 1994 between Semitropic Water Storage District (SWSD), MWD, and five other banking partners. The bank has a total storage capacity of 650 TAF, of which MWD has 350 TAF of storage volume. During years of excess SWP deliveries, beyond MWD's demands, a portion of MWD's SWP entitlement water is stored for withdrawal during dry years. Deliveries for storage are transferred via SWP facilities for direct use by agricultural users that in turn forgo pumping an equal volume of water. In dry years, water is pumped from storage to SWP facilities for delivery to MWD or entitlements are exchanged. MWD's average annual supply capability for a dry year (1977 hydrology) is 125 TAF and for multiple dry years (1990 – 1992 hydrology) is 107 TAF. By the end of 2009, MWD had 45 TAF in storage.

Since 1997, MWD has had an agreement with Arvin-Edison Water Storage District to use 350 TAF of storage in its groundwater basins. The agreement was amended in 2008 to include the South Canal Improvement project to deliver higher quality water to MWD. During wet years, MWD delivers SWP water in excess of its demands for storage and receives return water in dry years in a similar manner as the Semitropic program, except a combination of SWP and CVP facilities are used to transfer the water and water can be stored by a combination of direct spreading or in lieu use by agricultural users. MWD's average supply capability is 75 TAF for either a single dry year (1977 hydrology) or multiple dry years (1990 – 1992 hydrology). In 2009, MWF had 95 TAF in storage.

The San Bernardino Municipal Water District Program (SBMWD) allows for the purchase and storage of SWP water on behalf of MWD. MWD has a minimum purchase agreement with SBMWD of 20 TAF per year of SBMWD's SWP Table A amount. Additionally, MWD has the option to purchase SBMWD's additional SWP allocation when available and the first right-of-refusal to purchase additional SWP supplies available to SBMWD beyond the minimum and option agreements. If MWD does not require the minimum purchase amount for operations, MWD can store up to 50 AF for future use in dry years within SBMWD's groundwater basins. Water is delivered to MWD via SWP facilities and groundwater pumping conveyed through local connections to MWD's service area. MWD's average annual supply capability for a dry year (1977 hydrology) is 70 TAF and for multiple dry years (1990 – 1992 hydrology) is 37 TAF. By the end of 2009, MWD had no water in storage and deliveries have been suspended upon a mutual agreement between MWD and SBMWD.

MWD entered into an agreement with the Kern Delta Water District (Kern-Delta) for the Kern-Delta Water Management Plan in 2001 to allow up to 250 TAF of groundwater storage. During wet years MWD delivers SWP water in excess of its demands for storage and receives return water in a similar manner as the Semitropic program, except the water can be stored by direct recharge or in lieu use by agricultural users. Per terms of the agreement, MWD can potentially store beyond 250 TAF. In dry years, water is pumped from storage to SWP facilities for delivery to MWD or entitlements are exchanged. When the project is completed 50 TAF per year of dry year supply can be withdrawn. At the close of 2009, MWD had 10 TAF in storage and expects to fully withdraw the amount in 2010.

The Mojave Groundwater Storage Program is currently a demonstration project between MWD and Mojave Water Agency. Similar to the other groundwater storage programs, MWD's excess SWP water will be stored during wet years for withdrawal during dry years. When fully operational, the program is expected to have a dry year yield of 35 TAF.

8.1.4.2 Transfers

MWD utilizes Central Valley water transfers to obtain additional supplies originally destined for agricultural users on an as needed basis. Past transfer agreements have used both spot markets and option contracts. Spot markets occur when there are willing sellers and buyers. Option contracts lock-in MWD's ability to have the option to purchase supplies if needed. Additionally, MWD has multiple long-term transfer programs under

Exhibit 8Q
MWD Historic Central Valley Water Transfers

Program	Purchases by MWD[1] (AF/Year)
1991 Governor's Water Bank	215,000
1992 Governor's Water Bank	10,000
1994 Governor's Water Bank	100
2001 Dry Year Purchase Program	80,000
2003 MWD Transfer Program	126,230
2005 State Water Contractors Water Transfer Program[2]	0
2008 State Water Contractors Water Transfer Program	26,621
2009 Governor's Water Bank	36,900

1. Transfers requiring use of Bay-Delta result in a water loss of 20 percent. Transfers requiring the California Aqueduct for delivery to MWD's service area result in a 3 percent water loss.
2. 127,275 in options were secured, but not needed.

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

development. MWD's ability to conduct transfers and the amount of water to be transferred using SWP facilities are a function of hydrologic conditions, market conditions, and pumping restrictions in the Bay-Delta region. Transfers may require the use of the Bay-Delta for conveyance dependent upon the origin of the water. Historic transfers, as listed in Exhibit 8Q, indicate MWD is capable of negotiating contracts with agricultural districts and the State's Drought Water Bank to obtain transfers. MWD also has demonstrated it can work with DWR and the U.S. Bureau of Reclamation (USBR). Cooperation of both agencies is required as transfers use a combination of DWR's SWP and USBR's CVP facilities. Transfers from north of the Bay-Delta result in the loss of 20 percent of the water during conveyance while transfers via the California Aqueduct to MWD's service area result in the loss of 3 percent water during conveyance. During dry years and when pumping capacity in the Bay-Delta is available, MWD expects to be able to transfer 125 TAF through SWP facilities.

Exhibit 8R
MWD System Forecast Supplies and Demands, Average Year (1922 - 2004 Hydrology)

Forecast year	Supply (Thousands of AF per Year)				
	2015	**2020**	**2025**	**2030**	**2035**
Current Programs					
In-Basin Surface Reservoir and Groundwater Storage	685	931	1,076	964	830
State Water Project[1]	1,550	1,629	1,763	1,733	1,734
Colorado River Aqueduct					
Colorado River Aqueduct Supply[2]	1,507	1,529	1,472	1,432	1,429
Aqueduct Capacity Limit[3]	1,250	1,250	1,250	1,250	1,250
Colorado Aqueduct Capability	1,250	1,250	1,250	1,250	1,250
Capability of Current Programs	**3,485**	**3,810**	**4,089**	**3,947**	**3,814**
Demands					
Firm Demands on MWD	1,826	1,660	1,705	1,769	1,826
Imperial Irrigation District - San Diego County Water Authority Transfers and Canal Linings[4]	180	273	280	280	280
Total Demands on MWD	**2,006**	**1,933**	**1,985**	**2,049**	**2,106**
Surplus	**1,479**	**1,877**	**2,104**	**1,898**	**1,708**
Programs Under Development					
In-Basin Surface Reservoir and Groundwater Storage	206	306	336	336	336
State Water Project[1]	382	383	715	715	715
Colorado River Aqueduct					
Colorado River Aqueduct Supply	187	187	187	182	182
Aqueduct Capacity Limit[2]	0	0	0	0	0
Colorado Aqueduct Capability	0	0	0	0	0
Capability of Programs Under Development	**775**	**876**	**1,238**	**1,233**	**1,233**
Maximum MWD Supply Capability	**4,260**	**4,686**	**5,327**	**5,180**	**5,047**
Potential Surplus	**2,254**	**2,753**	**3,342**	**3,131**	**2,941**

1. Includes water transfers and groundwater banking associated with SWP.
2. Includes 296 TAF of non-MWD supplies conveyed in CRA for Imperial Irrigation District - San Diego County Water Authority Transfers and Canal Linings.
3. CRA has a capacity constraint of 1.25 MAF per year.
4. Does not include 16 TAF subject to satisfaction of conditions specified in agreement among MWD, the US, and the San Luis Rey Settlement

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

8.2 MWD Supply Reliability and Projected LADWP Purchases

MWD's 2010 Integrated Water Resources Plan (IRP) update serves as the foundation for supply forecasts discussed in the RUMWP and continues to ensure system reliability for its member agencies. The 2010 IRP update concluded that the resource targets identified in previous updates, taking into consideration changed conditions identified since that time, will continue to provide for 100 percent reliability through 2030. MWD's subsequent evaluation to extend the resource targets by an additional five years through their 2010 draft RUWMP also concluded the same full reliability during average (1922 – 2004 hydrology), single dry (1977 hydrology), and multiple dry years (1990 - 1992 hydrology). For each of the scenarios, there is a surplus in every forecast year. Exhibit 8R summarizes MWD's reliability in five year increments extending to 2035.

The City purchases MWD water to make up the deficit between demand and other City supplies. Whether LADWP can provide reliable water services to the residents of Los Angeles is highly dependent on MWD's assurance on supply reliability. However, the recent water supply shortage caused by dry weather and pumping restrictions in the Bay-Delta prompted the City to develop a more sustainable water supply portfolio with emphasis on local water supplies such as recycled water, groundwater cleanup, stormwater capture, and conservation. LADWP's reliance on MWD water supply is projected to be cut in half from the current five-year average of 52 percent of the total demand to 24 percent by 2034-35 under average weather conditions.

The reliability of MWD's water supply is more fully discussed in Chapter 10, Integrated Resources Planning. The projected LADWP water purchase is further discussed in Chapter 11, Water Service Reliability Assessment under various weather scenarios.

8.3 MWD Rate Structure and LADWP's Purchased Water Costs

8.3.1 MWD Rate Structure

MWD's rates are structured on a tier–based system with two tiers and a surplus category. Nine major elements determine the actual price a member agency will pay for deliveries. All of the elements are volumetric based except for two fixed rates, the Readiness-to Serve Charge and the Capacity Charge.

Tier 1 rates are reflective of actual costs of existing supplies and are designed to recover most of the supply costs. Member agencies are allocated a specified volume of Tier 1 water that can be purchased within a given year. In 2011, LADWP's Tier 1 limit is 304,970 AF. Any purchases above this are charged at the Tier 2 rate. MWD has instituted a temporary Bay-Delta surcharge to recover costs associated with lower SWP deliveries related to pumping restrictions. The surcharge will remain in effect until SWP yields improve.

Tier 2 rates send a price signal associated with MWD's costs of developing additional long-term firm supply options. Member agencies with growing demands on MWD will have a higher proportion of deliveries within the Tier 2 range.

Surplus water is water in excess of consumptive municipal and industrial demands. Surplus water is available at two discounted levels dependent upon the end use. Replenishment Program water is discounted for replenishing local agency supplies. The program has been suspended as a result of dry conditions and uncertain future supplies. The Interim Agricultural Water Program (IAWP) provides discounted water for agricultural use. This program is being phased out and will terminate beginning in 2013.

Exhibit 8S
MWD Rates and Charges

Rates and Charges	Effective Rate January 1		
	2010	2011	2012
Tier 1 Supply Rate ($/AF)	101	104	106
Delta Supply Surcharge ($/AF)	69	51	58
Tier 2 Supply Rate ($/AF)	280	280	290
System Access Rate ($/AF)	154	204	217
Water Stewardship Rate ($/AF)	41	41	43
System Power Rate ($/AF)	119	127	136
Full Service Untreated Volumetric Cost ($/AF)			
Tier 1	484	527	560
Tier 2	594	652	686
Replenishment Water Untreated ($/AF)	366	409	442
Interim Agricultural Water Untreated ($/AF)	416	482	537
Treatment Surcharge ($/AF)	217	217	234
Full Service Treated Volumetric Cost ($/AF)			
Tier 1	701	744	794
Tier 2	811	869	920
Treated Replenishment Water ($/AF)	558	601	651
Treated Interim Agricultural Water Program ($/AF)	615	687	765
Readiness-to-Serve Charge ($/M)	114	125	146
Capacity Charge ($/cfs)	7,200	7,200	7,400

Source: 2010 Regional Urban Water Management Plan, Metropolitan Water District of Southern California

Exhibit 8S summarizes the rates and charges for member agencies effective on January 1 of 2010, 2011, and 2012.

8.3.2 LADWP's Purchased Water Costs

MWD's water rates vary from $484 per AF of tier 1 untreated water to $811 per AF of tier 2 treated water in 2010. The average unit cost of MWD water supply depends on the proportions of treated water and untreated water, tier 1 water, and tier 2 water purchased in a given period. From 2003 to 2009, LADWP purchased 88 percent tier 1 water and 12 percent tier 2 water, and 70 percent untreated water and 30 percent treated water on average. The tier 2 water purchase varied from no purchase in 2005 and 2006 to 29 percent in 2007 and 2008. The treated water purchase varied from 20 percent in 2007 to 46 percent in 2005. Exhibit 8T illustrates the various combinations.

The Readiness-to-Serve Charge and Capacity Charge are predetermined fixed charges for each member agency and not affected by the quantity of MWD water purchased. However, they add on to the unit cost of the City's MWD water purchase. The City's current share of the Readiness-to-Serve Charge is 15.12 percent or $17.24 million in 2010. The Capacity Charge is calculated based on the summer daily peak flow from the previous three years. The City's 2010 Capacity Charge is $5.9 million based on the daily peak flow of 822 cfs in 2008 summer. Both charges added an additional $110 per AF to the unit cost of LADWP's MWD water purchase in 2010.

Exhibit 8T
Percentage of LADWP's Purchased Water in Various MWD Rate Categories

MWD Deliveries	**Tier 1**		**Tier 2**		Total Tier 1	Total Tier 2	Total Untreated	Total Treated
Calender Year	**Untreated**	**Treated**	**Untreated**	**Treated**				
	%	%	%	%	%	%	%	%
2003	73	22	4	2	95	5	76	24
2004	71	25	3	1	96	4	74	26
2005	54	46	0	0	100	0	54	46
2006	58	42	0	0	100	0	58	42
2007	56	15	25	5	71	29	80	20
2008	48	23	23	6	71	29	71	29
2009	67	20	10	3	87	13	77	23
2010	62	38	0	0	100	0	62	38
Average	61	29	8	2	90	10	69	31

Groundwater Assessment Study

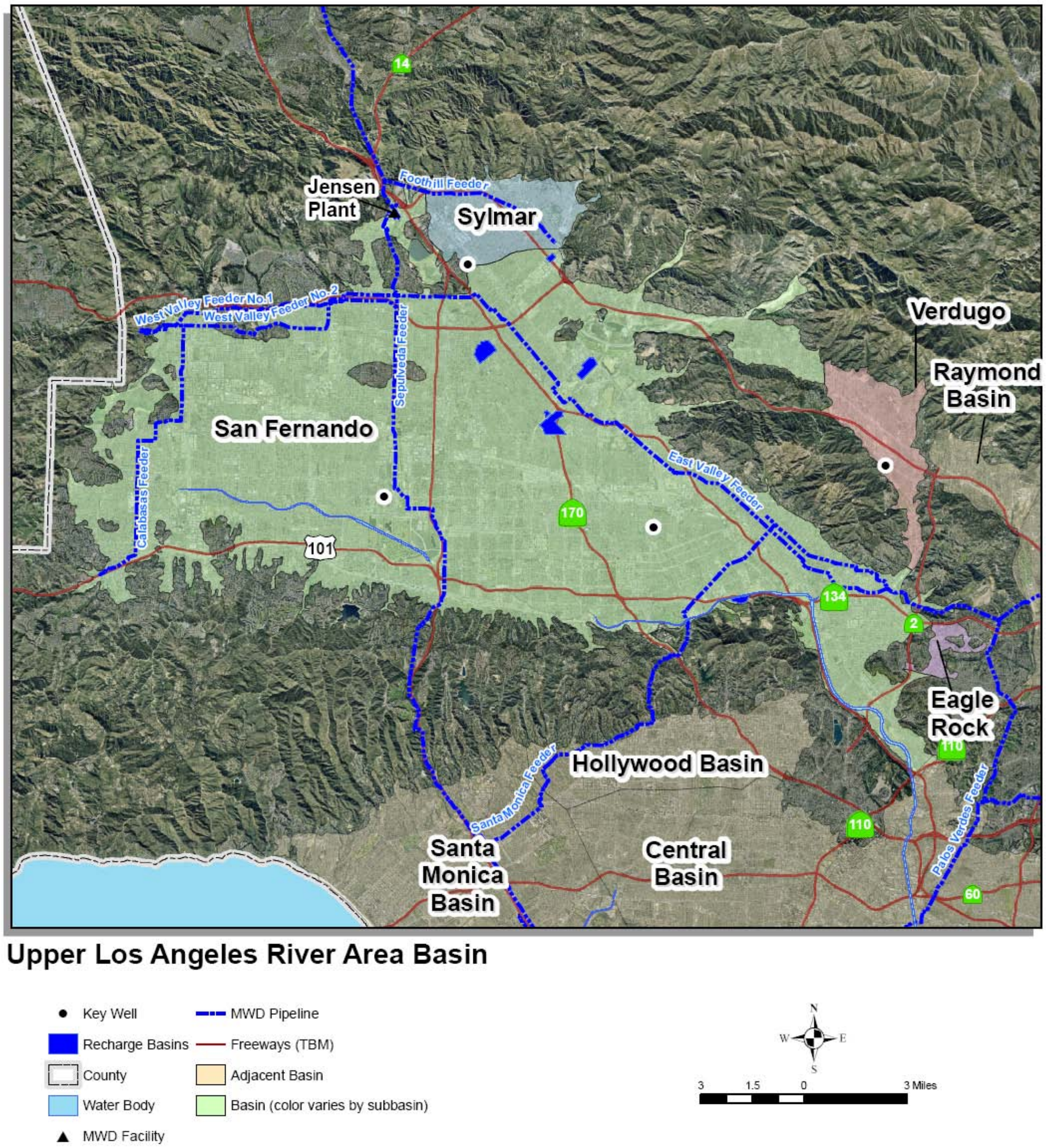
A Status Report on the Use of Groundwater in the Service Area of the Metropolitan Water District of Southern California

Report Number 1308

September 2007

The Upper Los Angeles River Area (ULARA) Basins are located within Los Angeles River Watershed in Los Angeles County. The ULARA Basins include the San Fernando, Sylmar, Verdugo and Eagle Rock Basins and underlie the Metropolitan member agencies of the cities of Los Angeles, San Fernando, Burbank, and Glendale and Foothill Municipal Water District (Foothill MWD). A map of the basins with the ULARA is provided in **Figure 2-1**.

Figure 2-1
Map of the ULARA Basins



BASIN CHARACTERIZATION

The following section provides a physical description of the groundwater basins within the ULARA including their location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The groundwater basins within ULARA are nearly surrounded by impermeable sedimentary, granitic and metamorphic bedrock underlying the surrounding San Gabriel and Santa Monica mountains. **Table 2-1** provides a summary of the characteristics of the ULARA Basins.

The San Fernando Basin, the largest of the four basins within the ULARA, is an unconfined aquifer contained by the Santa Monica Mountains on the south, the Simi Hills to the West, the Santa Susana Mountains to the northwest, and the San Gabriel Mountains and Verdugo Hills on the northeast with a relatively thin finger extending eastward into the Tujunga Canyon between the San Gabriel Mountains and the Verdugo Hills. The Sylmar Basin, is a confined aquifer system separated from the San Fernando Basin by the Sylmar Fault Zone in the underlying geology. The Verdugo Basin is located in Crescenta Valley, a down-dropped block between the San Gabriel Mountains to the northeast, and the Verdugo Mountains to the southwest and east of the groundwater divide that separates it from the finger of the San Fernando Basin in Tujunga Canyon. In contrast to the other nearby groundwater basins, the Verdugo Basin (1) is relatively small in area and relatively steeply sloping, (2) the aquifer units are relatively thin, and (3) the aquifer units have relatively low hydraulic conductivity (Geomatrix, 2005). The smallest basin within the ULARA and least significant in terms of groundwater storage is the Eagle Rock basin, located in the extreme southeastern edge of the San Fernando Basin.

The State Water Rights Board in the Report of the Referee for the Judgment over the ULARA estimated approximately 3.2 million AF of total groundwater storage capacity in the San Fernando Basin. The estimated storage capacities of the Sylmar and Verdugo Basins are 310,000 AF and 160,000 AF, respectively. Considering the relatively insignificant total storage capacity of the Eagle Rock groundwater basin, these combined volumes lead to an estimated total of about 3.67 million AF for the storage capacity of the groundwater basins within the ULARA.

Safe Yield/Long Term Balance of Recharge and Discharge

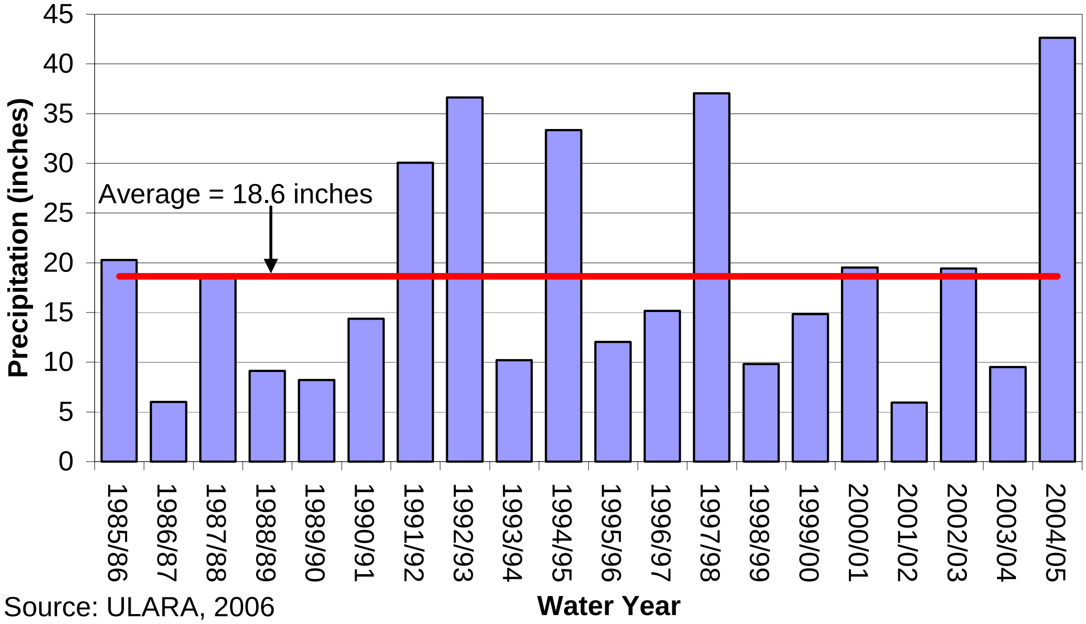
The primary inflows to the ULARA groundwater basins are imported water and natural precipitation and runoff during the rain season. Because the runoff is seasonal in nature, natural recharge is limited. **Figure 2-2** provides the historical precipitation data from the San Fernando Basin between the 1985/86 to 2004/05 water years. Over this time period, rainfall varied between 6 to about 43 inches per year, with an average of about 18.6 inches per year. The data on **Figure 2-2** shows above average precipitation between 1991 and 1993, in 1994/95, in 1997/98, with the highest of about 43 inches occurring in the 2004/05 water year. In contrast, the historical annual precipitation for water years 1949 through 2003 in the Verdugo Basin has ranged from 8.95 to 55.16 inches with a long-term average of 23.37 inches (Geomatrix, 2005).

Table 2-1
Summary of the Hydrogeologic Parameters of the ULARA Basins

Parameter	Description
Structure	
Aquifer(s)	Unconfined to confined
Depth of groundwater basin	San Fernando: 0 to 1,200 feet Sylmar: 50 to 6,000 feet Verdugo: 40 to 400 feet Eagle Rock: Data not available
Depth of producing zones or screen intervals	San Fernando: 58 to 800 feet Sylmar: 64 to 435 feet Verdugo: 150 to 400 feet Eagle Rock: Data not available
Yield and Storage	
Native Safe Yield	San Fernando: 43,660 AFY
Safe Yield	San Fernando: 90,680 AFY Sylmar: 6.810 AFY [2] Verdugo: 7,150 AFY Eagle Rock: Negligible
Extraction Rights [1] (2005-06 water year)	San Fernando: 96,838 AFY Sylmar: 6,510 AFY Verdugo: 7,150 AFY Eagle Rock: Negligible
Total Storage	San Fernando: 3.2 million AF Sylmar: 310,000 AF Verdugo: 160,000 AF Eagle Rock: Negligible
Unused Storage Space	Data not available
Portion of Unused Storage Available for Storage.(Following the 2004/05 water year)	San Fernando: 504,475 AF Sylmar: Limited Verdugo: Limited Eagle Rock: Negligible

Source: Watermaster 2006a and Watermaster, 2006b
[1]Does not include stored water credits or physical solution water
[2]Safe yield of Sylmar Basin was increased from 6,510 to 6,810 AFY in December 2006.

Figure 2-2
Historical Precipitation in the ULARA Basins

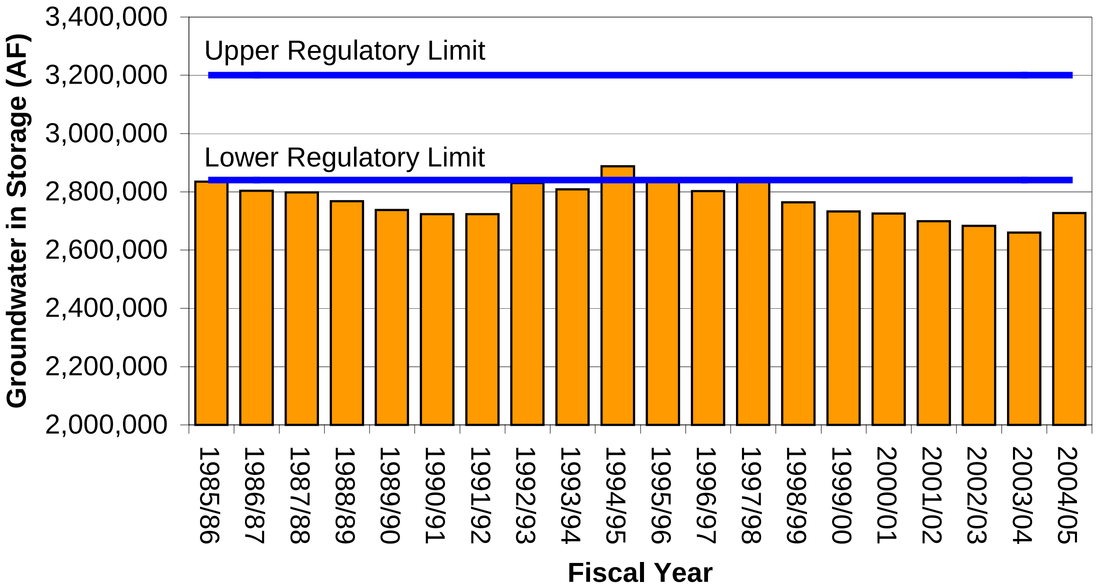


Source: ULARA, 2006

The native safe yield for the ULARA Basins is summarized in **Table 2-1**. These amounts have been fixed by the adjudication of the basins, as discussed below. In the San Fernando Basin, the Judgment (described below) distinguishes between native safe yield (portion of safe yield derived from native waters) and safe yield (includes return flows from imported water), and divides annual extraction rights based on native and imported water origins. The annual extraction right, which is also summarized in **Table 2-1**, includes the native safe yield plus imported water return credits in the San Fernando Basin. The total extraction rights within the ULARA Basins for water year 2005/06 were 110,498 AF (Watermaster, 2006a). At the end of the 2004/05 water year, there were nearly 419,000 AF in stored water credits in the ULARA Basins, increasing the allowable pumping to more than 529,000 AF. As discussed below, stored groundwater can be extracted by the parties in excess of annual pumping rights with approval of the Watermaster.

Figure 2-3 provides a summary of the groundwater in storage in the San Fernando Basin, the largest of the ULARA Basins, from water year 1985/86 to 2004/05. The State Water Rights Board derived a regulatory storage requirement of 360,000 AF for the San Fernando Basin, spanning the interval of 210,000 AF above and 150,000 AF below amount of water in storage in 1954 (2.99 million AF). Despite the heavy rains of the 2004/05 water year, the storage volume at the end of water year 2004/05 was about 113,000 AF below the lowest level of the regulatory storage requirement. Due to the currently depleted groundwater in the San Fernando Basin it is estimated that approximately 504,475 AF (decline in storage since 1928) is available as additional storage capacity (Watermaster, 2006a).

Figure 2-3
Historical Groundwater in Storage Estimates for the San Fernando Basin



GROUNDWATER MANAGEMENT

The following section describes how the ULARA Basins are managed. This discussion includes a brief description of the governing structure and the relationship with other groundwater basins.

Basin Governance

The ULARA Basins are adjudicated. Groundwater production in the ULARA Basins is constrained by the 1979 Final San Fernando Judgment (1979 Judgment) and the 1984 Sylmar Basin Stipulation (1984 Stipulation). This adjudication limits groundwater extraction from all four groundwater basins and established a court appointed Watermaster and Administrative Committee to administer the Court's rulings. The Administrative Committee, as summarized in **Table 2-2,** is made up of a representative from each of the five public agencies overlying the ULARA.

The 1979 Judgment upheld the Pueblo Water Rights of the city of Los Angeles to all groundwater in the San Fernando Basin derived from precipitation within the ULARA and all surface and groundwater underflows from the Sylmar and Verdugo basins (Watermaster, 2005). Furthermore the cities of Burbank, Glendale and Los Angeles were given rights to all San Fernando groundwater derived from water imported by these cities from outside the ULARA and either spread or delivered within the San Fernando Basin. Return credits are granted in the San Fernando Basin. The city of San Fernando was not granted return flow rights in the San Fernando Basin because they where not able to import water until becoming a member of Metropolitan in 1971. The Judgment also contains provisions and stipulations regarding storage of water, stored water credit and arrangements for physical solution water for certain parties (Watermaster, 2006a). There are no storage rights in either the Verdugo or the Eagle Rock Basins.

Under the 1984 Stipulation, the cities of Los Angeles and San Fernando were assigned equal rights to the safe yield of the Sylmar Basin. In 1996, the safe yield was increased from 6,210 AFY to 6,510 AFY. In addition, the safe yield was increased again in December 2006 to 6,810 AFY. These cities also have the right to store groundwater via in-lieu methods and the right to extract equivalent amounts.

Table 2-2
Summary of Management Agencies in the ULARA Basins

Agency	Role
ULARA Watermaster	Overall management authority under the California Superior Court
The City of Burbank	MWD member agency, water retailer and ULARA administrative committee member
The City of Glendale	MWD member agency, water retailer and ULARA administrative committee member
The City of Los Angeles	MWD member agency, water retailer and ULARA administrative committee member. Owns Tujunga Spreading Grounds
The City of San Fernando	MWD member agency, water retailer and ULARA administrative committee member
The Crescenta Valley Water District (CVWD)	Water retailer and ULARA administrative committee member
Los Angeles County Public Works (LACDPW)	Owns and operates spreading facilities

Interactions with Adjoining Basins

Groundwater outflow from the Verdugo Basin into the San Fernando Basin occurs beneath Verdugo Wash at the extreme eastern edge of the ULARA. Groundwater outflow from the ULARA occurs through the Los Angeles River Narrows in the southeast corner of the San Fernando Basin where approximately 400 AF of underflow passes downstream into the Central Basin. In addition, approximately 2,000 to 4,000 AFY of rising groundwater leaves the San Fernando Basin as surface flow into the Central Basin (Watermaster, 2007). An average of about 300 to 400 AF of underflow passes into the Raymond Basin from the Verdugo Basin (DWR, 2004 and Geomatrix, 2005). These flows are accounted for in each basin's adjudication so there are no separate agreements regarding these flows.

WATER SUPPLY FACILITIES AND OPERATIONS

The following section describes the existing water supply facilities in the ULARA Basins. These include 146 groundwater production wells and 314 acres of recharge ponds for groundwater recharge.

Active Production Wells

There are 146 active production wells within the ULARA Basins. A total of 77,995 AF were pumped from the ULARA groundwater basins during the 2004/05 water year. Approximately 94 percent or 73,500 AF of the total volume was pumped from municipal production with the remaining production from private wells. A summary of production from these wells is provided in **Table 2-3**. Historical production is also summarized on **Figure 2-4**.

Table 2-3
Summary of Production Wells in the ULARA Basins

Basin	Number of Wells	Estimated Production Capacity (AFY) [1]	Average Production 1985-2004 (AFY)	Well Operation Cost [2] ($/AF)
San Fernando	122	220,000	88,370	$24 to $165 Average $63 (2004)
Sylmar	6	8,700	5,770	
Verdugo	17	7,400	5,090	Data not available
Eagle Rock	3	230	224	Data not available
Total	**146**	**236,330**	**99,454**	--

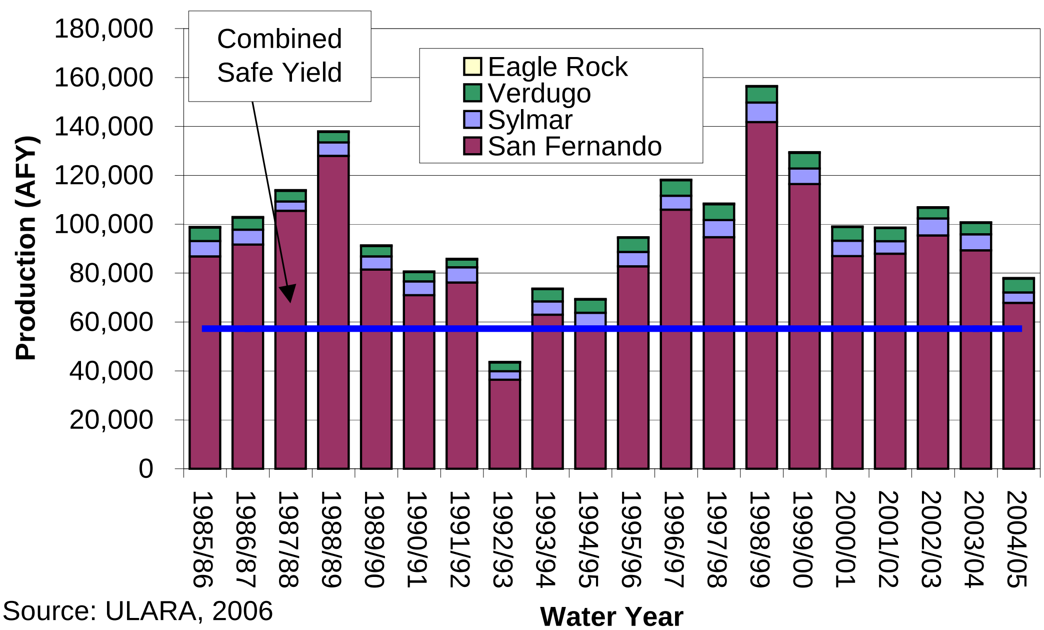
Source: Watermaster, 2006a and 2006b; LA, 2006c
1. Based on maximum annual basin production over the past 5 years for Eagle Rock Basin; Other Basins Watermaster, 2006c, LA, 2006c based upon 10 month per year operation.
2. LA, 2006a

Within the Verdugo Basin, CVWD groundwater production has generally declined since the late-1990s, from about 4,000 AFY in 1999 to about 3,000 AFY in 2002 (Geomatrix, 2005). CVWD pumps groundwater from 11 supply wells in Verdugo Basin. Five wells (6, 8, 10, 12, and 14) pump water to the Glenwood Ion Exchange Nitrate Removal Facility where nitrate is removed from the water. Discharge from five other wells (1, 5, 7, 9, and 11) is pumped without nitrate treatment into the CVWD system. Well 2 is used for standby or emergency supply and is not pumped on an ongoing basis (Geomatrix, 2005).

In the ULARA groundwater basins there were a total of 75 inactive wells. The City of Los Angeles reports that 8 of the inactive wells in the San Fernando groundwater basin are planned to be online within the next 5 years (LA, 2006a).

Table 2-3 also summarizes the general pumping and disinfection costs of municipal production wells in the San Fernando Basin. These costs do not include annual maintenance.

Figure 2-4
Historical Groundwater Production in the ULARA Basins



Source: ULARA, 2006

Other Production

The relatively small percentage of the total production is from private or non-municipal wells as summarized in **Table 2-3**.

ASR Wells

There are no ASR wells reported in the ULARA Basins.

Spreading Basins

Approximately 314 acres of recharge spreading basins are located over the San Fernando Basin with an estimated total capacity of approximately 104,000 AFY, as summarized in **Table 2-4**. The locations of the spreading areas are shown on **Figure 2-1**.

Table 2-4
Summary of Spreading Basins in the ULARA Basins

Spreading Basins	Area (acres)	Recharge Capacity (cfs) [1]	Recharge Capacity (AFY) [1]	Source Water	Owner
Hansen	105	49	35,000	Runoff	LACDPW
Pacoima	107	40	23,000	Runoff	LACDPW
Lopez	12	7	2,000	Runoff	LACDPW
Branford	7	1	1,000	Runoff	LACDPW
Tujunga	83	99	43,000	Runoff	LADWP
Total	**314**	**196**	**104,000**	--	--

Source: LA, 2006a.

These basins are used for spreading both imported water and surface water diversions, through mostly surface water runoff from the Pacoima, Big Tujunga and Hansen Dams which are operated by LACDPW both as flood control dams as well as to regulate storm flows to allow recapture of the flows in the downstream spreading basins (LA, 2006a; ULARA, 2005).

Figure 2-5 provides a summary of the spreading of surface water runoff to recharge groundwater in the ULARA Basins, principally the San Fernando Basin, over the 1985/86 to 2004/05 water years.

Recharge spreading basins do not currently exist in the Sylmar, Verdugo or Eagle Rock groundwater basins. However, within the Verdugo Basin, modifications and improvements to existing debris basins are being considered in order to retain water and increase the rate of recharge (Geomatrix, 2005).

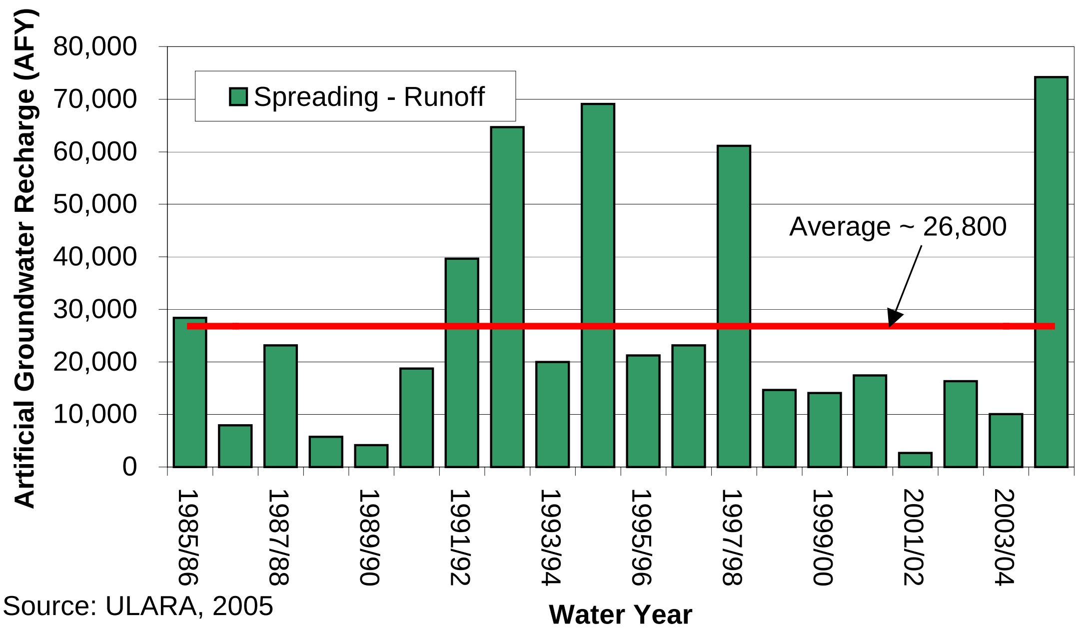
Seawater Intrusion Barriers

There are no seawater intrusion barriers in the ULARA Basins.

Desalters

There are no desalters in the ULARA Basins.

Figure 2-5
Summary of Groundwater Recharge in the ULARA Basins



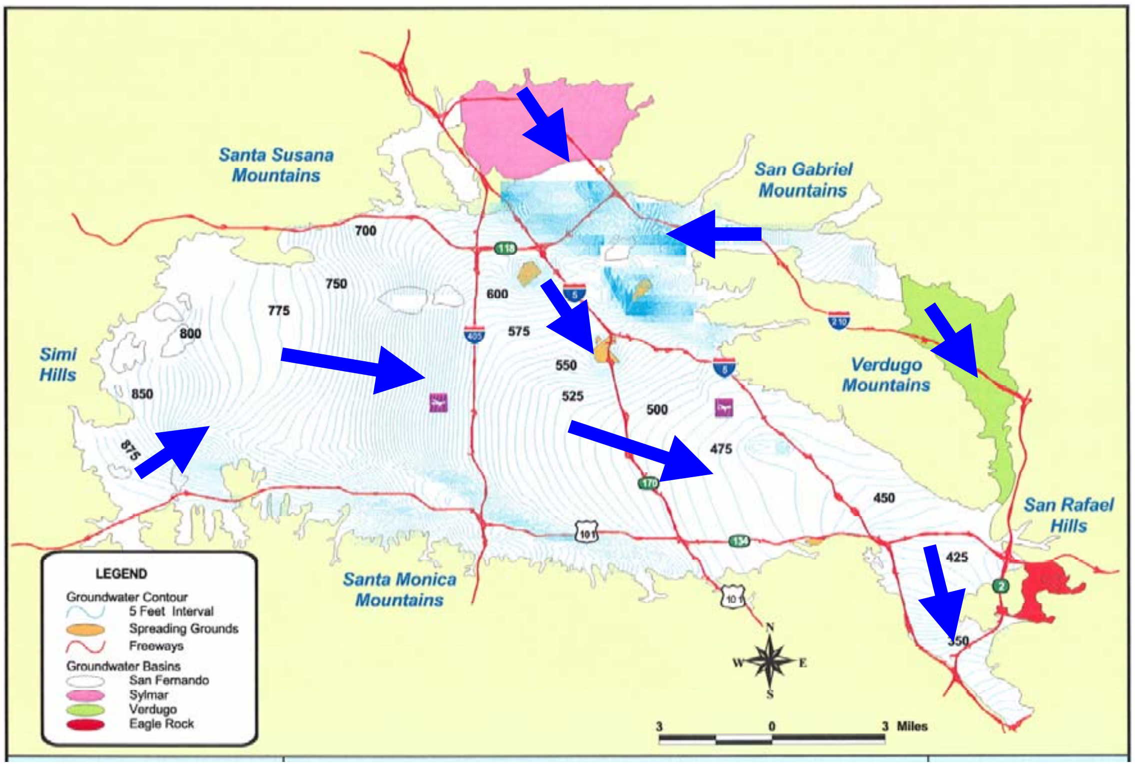
Source: ULARA, 2005

GROUNDWATER LEVELS

The depth to groundwater in the San Fernando, Sylmar, and Verdugo basins range between 24 to 400 feet, 50 to 115 feet, and 17 to 190 feet bgs, respectively. Shallow groundwater conditions are encountered in the western end of the San Fernando Basin. These areas are subject to rising groundwater and high liquefaction potential. However, because of finer sediments and naturally occurring high TDS in this portion of the basin, these areas are not produced. A groundwater contour map during the spring of 2005 is shown in **Figure 2-6**. Groundwater flow is generally from west to east across the majority of the San Fernando Basin. Groundwater flows turns southward in the eastern and southeastern portion of the basin where groundwater flows into the Central Basin. Groundwater flow is generally toward the south-southeast into the San Fernando Basin from the Verdugo and Sylmar Basins as water levels are substantially higher in these basins.

Figures 2-7 and 2-8 show the changes in groundwater level in representative areas within the ULARA from 1985 to 2004. Locally, groundwater levels have risen or remained reasonably constant due to reduction in specific well field production. In other areas, groundwater levels have fallen due to increased production from specific well fields and/or diminished recharge from specific spreading grounds. However, in general, groundwater storage has been steadily declining since the early 1980s in the San Fernando Basin due to heavy pumping, limited artificial recharge and low precipitation. Due to the heavy rains and decreased pumping during water year 2004/05, water levels in the basin have begun to recover, but this effect may be temporary. Despite a positive balance in stored water credits in the San Fernando Basin, groundwater levels and storage continued to decline. This imbalance is being addressed by the pumping parties and the Watermaster.

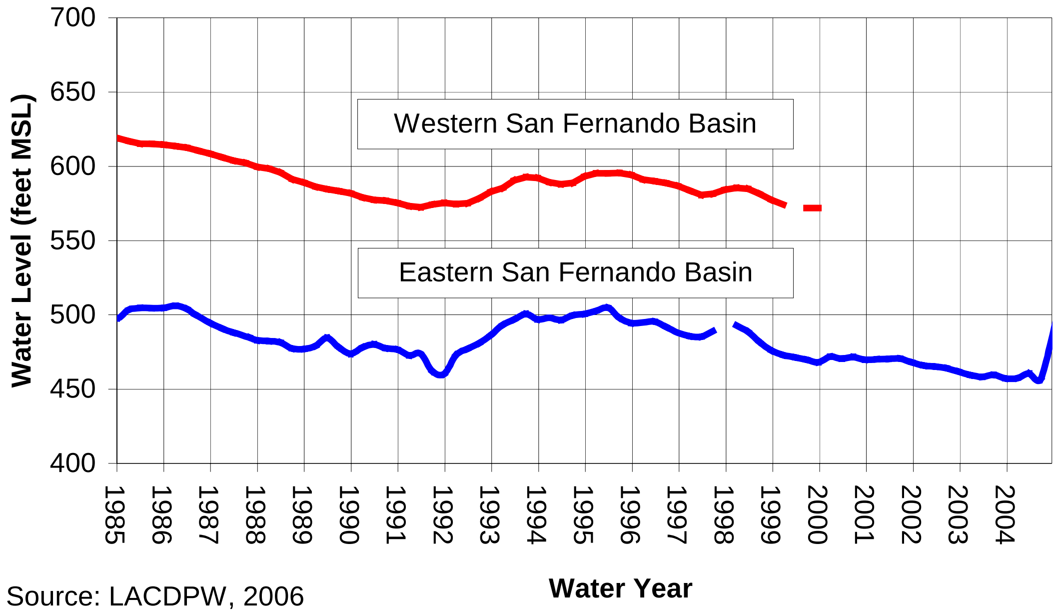
Figure 2-6
Groundwater Contour Map in the ULARA Basins – Spring 2005



Source: ULARA, 2006a

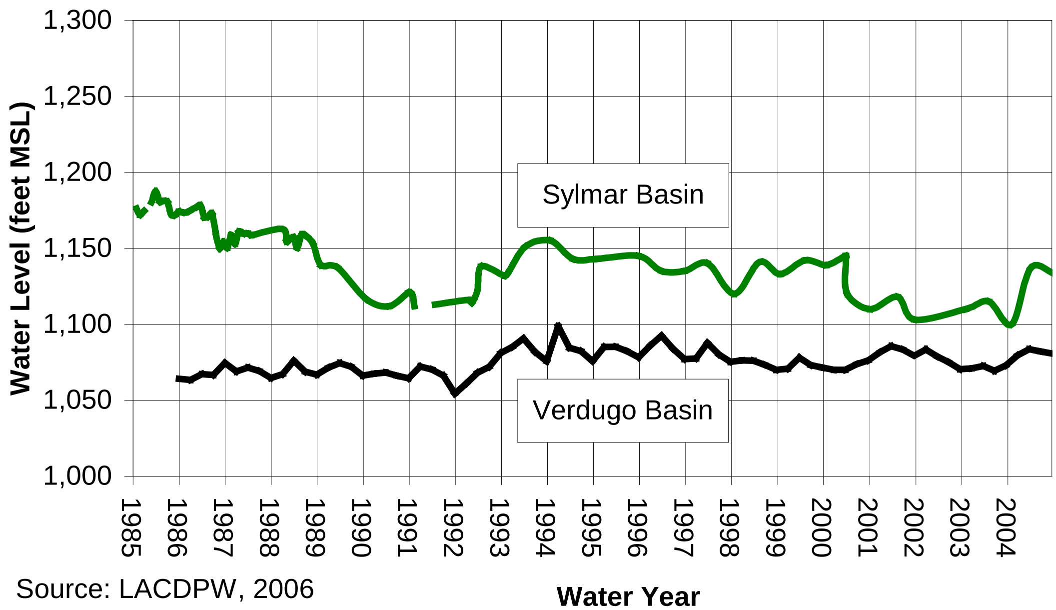
Groundwater levels show seasonal variation in response to precipitation, runoff and pumping. In the Verdugo Basin, depth to groundwater ranged from about 17 to approximately 190 feet below ground surface between 1981 and 2002. Between 1983 and 1992, groundwater level elevations declined following a prolonged dry period and cessation of septic system recharge. A significant rise occurred between 1992 and 1995, along with wetter climatic conditions. Since 1995 groundwater elevations have gradually declined throughout the basin. Water levels in the basin declined in recent years due to lower precipitation and increases in groundwater pumping (Geomatrix, 2005).

Figure 2-7
Historical Water Levels in the San Fernando Basin



Source: LACDPW, 2006

Figure 2-8
Historical Water Levels in the Verdugo and Sylmar Basins



Source: LACDPW, 2006

GROUNDWATER QUALITY

The following provides a brief description of the groundwater quality issues in the ULARA Basins.

Groundwater Quality Monitoring

The various cities and agencies operating municipal wells and responsible parties remediating contaminated groundwater are sampling their wells for water quality on a regular basis and the results are submitted to the California Department of Health Services (DHS) (LA, 2006a). The USEPA also samples approximately 100 monitoring wells in the eastern portion of the San Fernando Basin on a quarterly and annual basis (LA, 2006a). The results are also cataloged and monitored by the ULARA Watermaster and the Regional Board.

Groundwater Contaminants

Groundwater in the ULARA Basins has significant contamination issues. A number of the groundwater production wells are located with the bounds of a Superfund area. Elevated concentrations of volatile organic compounds (VOCs), such as trichloroethylene (TCE) and tetrachloroethylene (PCE), as well as other contaminants, such as hexavalent chromium have prompted the city of Los Angeles to discontinue pumping at numerous production wells. Maps depicting the locations of these plumes and nitrate are shown in **Figure 2-9** through **Figure 2-11** (LA, 2006a and Watermaster, 2006). Emerging contaminants, such as 1,4 dioxane, have also been found in concentrations high enough to necessitate the alteration of groundwater pumping operations. **Table 2-5** summarizes the constituents of concern within the ULARA Basins.

In addition, perchlorate, a constituent of regional concern has been detected in 2 wells above the notification level of 6 µg/L, one in the Sylmar Basin and one in eastern end of the San Fernando Basin. In these areas of contamination, wells have been removed from service or the groundwater is being blended or treated to meet State Drinking Water Standards as discussed below (LA, 2006a). In the San Fernando Basin, the estimated capacity of all the wells that have been removed from service due to elevated contamination levels is approximately 200 cfs or 396 AF/day. In addition to the contaminants in the San Fernando groundwater basin, one well was removed from service in the Sylmar basin due to elevated TCE levels (LA, 2006a).

As discussed in more detail below, continuing efforts to expand groundwater extraction capability, improve groundwater source quality, and treat extracted groundwater are underway in the basin. The USEPA, the Department of Toxic Substances Control, and the Los Angeles Regional Water Quality Control Board are working with the cities of Los Angeles, Glendale, and Burbank to identify and resolve San Fernando Basin contamination concerns. The City of Los Angeles' Department of Water and Power is currently undertaking a comprehensive study of the San Fernando Basin to fully characterize the extent and composition of known and emerging contaminants.

Figure 2-9
Location of VOC Contaminant Plumes in the ULARA Basins

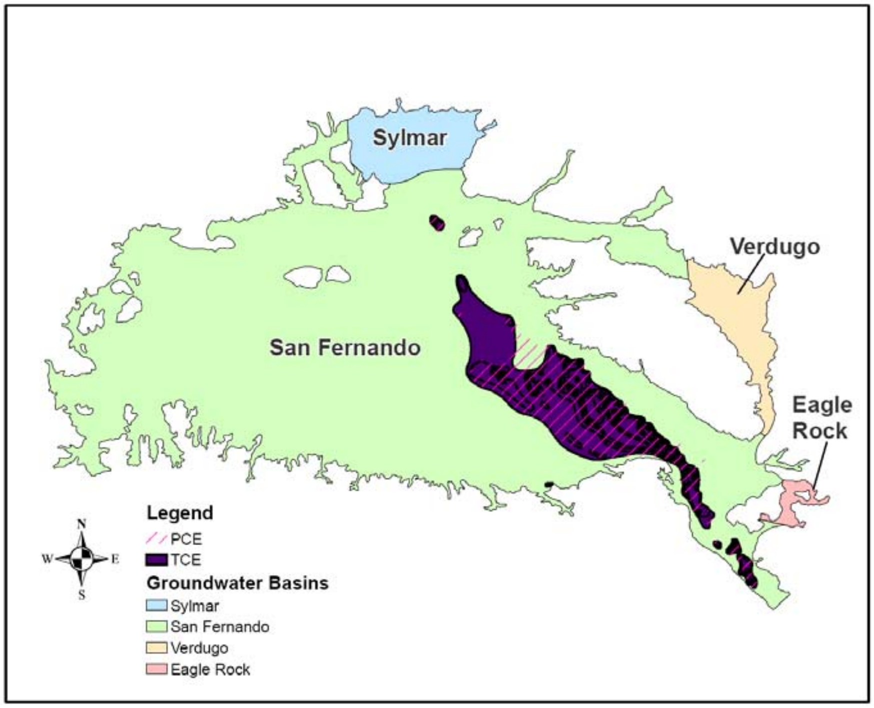


Figure 2-10
Location of Hexavalent Chromium Plumes in the ULARA Basins

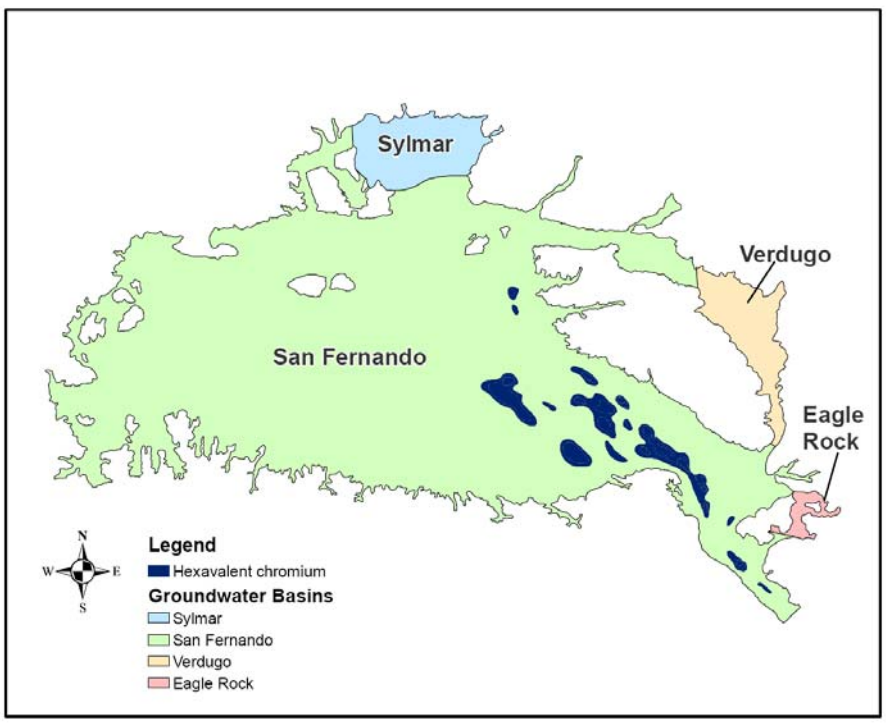
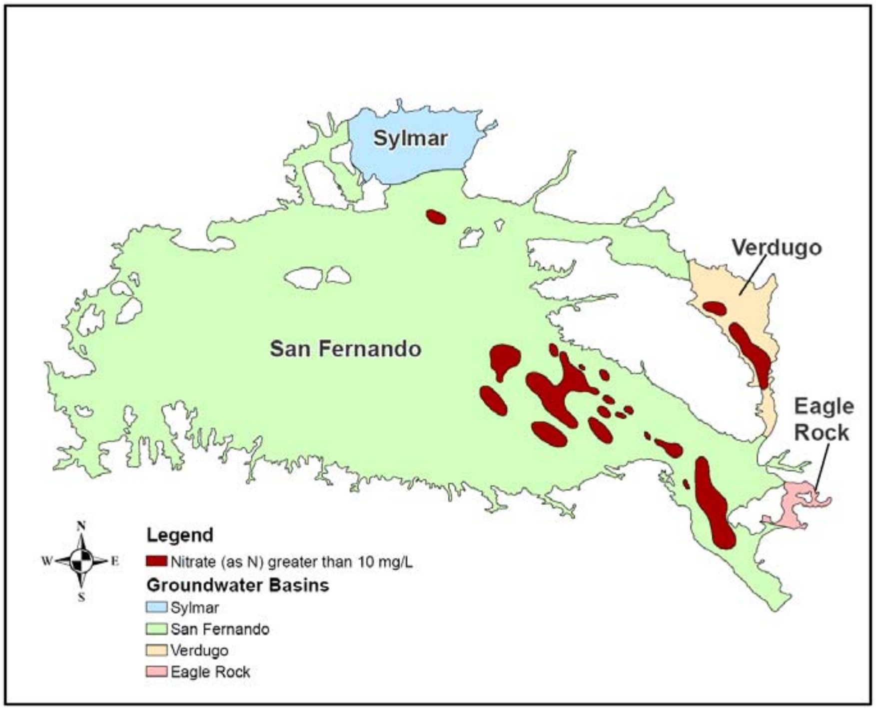


Figure 2-11
Location of Nitrate Plumes in the ULARA Basins



Blending Needs

All the cities and agencies are blending Metropolitan imported water with the groundwater extracted from selected wells to meet water quality standards. For example, the city of Los Angeles has blended imported water with groundwater contaminated with nitrate and VOC extracted from wells within the San Fernando groundwater basin, as summarized below in **Table 2-6**. These data suggest that nearly all the groundwater produced from the San Fernando Basin is blended with other sources of water.

For CVWD, in the Verdugo Basin, imported water purchased from Foothill MWD is received through a connection at the Paschall Blending Station and is blended with groundwater to reduce the nitrate concentration of the delivered water. Imported water is also received via the Briggs Meter Station, and the Ocean View Meter Station. Blending with imported water is used to help manage the nitrate concentration in water delivered to consumers (Geomatrix, 2005).

Groundwater Treatment

The cities of Burbank, Glendale and Los Angeles, and the CVWD are treating groundwater extracted from selected wells to meet water quality standards. For example, the city of Los Angeles operates treatment facilities for VOC-contaminated groundwater from wells in the San Fernando groundwater basin, as summarized below in **Table 2-7** (LA, 2006a). Costs of treatment range from $250 to $288 per AF.

Table 2-5
Summary of Constituents of Concern in the ULARA Basins

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	280 to 729	Highest levels reported in the North Hollywood area of the San Fernando Basin.
Nitrate (as N) Primary MCL = 10	mg/L	2.6 to 79.2	Highest levels reported in the Verdugo Basin and eastern portion of the San Fernando Basin
VOCs **(TCE and PCE)** TCE Primary MCL = 5 PCE Primary MCL = 5	µg/L	<5 to over 100	The highest concentrations in Glendale and Burbank areas of the eastern San Fernando Basin are being treated. Other areas in the San Fernando Basin, which have levels significantly above the MCL, are currently being addressed through treatment or other means, while long-term solutions are being developed.
Total and Hexavalent Chromium Total Cr MCL = 50 Hexavalent Cr MCL = TBD	µg/L	ND to 423	Highest concentrations are in the Burbank and Glendale areas. These areas are currently being investigated. The city of Los Angeles discontinued pumping from one San Fernando Basin production well after total hexavalent chromium levels as high as 423 µg/L were detected.
Perchlorate Notification Level = 6	µg/L	ND to 8.9	Detected in 2 wells above notification level since 2000.

Source: Watermaster, 2006a; Regional Board 2006

In 1987, the USEPA initiated a remedial investigation of VOC (TCE and PCE) contamination in San Fernando and Verdugo basins. Operable Units for long-term groundwater remediation of VOCs have been established in North Hollywood, Burbank, Glendale North, and Glendale South. The operation of these treatment facilities has become more complex with the identification of nearby hexavalent chromium plumes. Remediation treatment facility operations are summarized in **Table 2-7**.

Within the Verdugo Basin, CVWD pumps groundwater from 11 supply wells in Verdugo Basin. Five of the wells pump water to the Glenwood Ion Exchange Nitrate Removal Facility where nitrate is removed from the water (Geomatrix, 2005).

Table 2-6
Summary of Blending Needs in the San Fernando Basin

Agency	Wellfield(s)	Constituent Blended	Average Annual Groundwater Blended (AFY)
City of Los Angeles	Tujunga	Nitrate and VOC(s)	21,778
City of Los Angeles	Rinaldi-Toluca North Hollywood Erwin Verdugo Whitnall	Nitrate and VOC(s)	66,932
City of Los Angeles	Pollock	Nitrate	1,697
Total		**--**	**90,407**

Source: LA, 2006a

Table 2-7
Summary of Groundwater Treatment in the ULARA Basins

Treatment Facility	Constituent Treated	Treatment Type	Amount Treated (AFY)	Comments
North Hollywood Operable Unit	VOC	Air stripping with air phase GAC	1,800 AF in 2002/03 1,228 AF in 2003/04 1,042 AF in 2004/05	Consent decree expired in 2004, but remediation incomplete. Declining water levels resulting in reduced treatment capacity. Concern with intercepting nearby chromium plume.
Burbank Operable Unit	VOC	Aeration and liquid phase GAC	Design capacity of 9,000 gpm 9,660 AF in 2003/04 6,398 AF in 2004/05	Effluent blended with Metropolitan water to reduce nitrate and chromium concentrations Additional well capacity needed to maintain design capacity.
Glendale North and South Operable Units	VOC	Aeration and liquid phase GAC	North: Design capacity of 3,300 gpm South: Design capacity of 1,700 gpm 7,283 AF in 2003/04 7,541 AF in 2004/05	Effluent blended with Metropolitan water

Table 2-7 (continued)
Summary of Groundwater Treatment in the ULARA Basins

Treatment Facility	Constituent Treated	Treatment Type	Amount Treated (AFY)	Comments
Glenwood Nitrate Water Treatment Plant	Nitrate	Ion Exchange	164 AF in 2003/04 782 AF in 2004/05	Operates in Verdugo Basin
Pollock Wells Treatment Plant	VOC	Liquid phase GAC	1,137 AF in 2003/04 1,752 AF in 2004/05	Treats rising groundwater in the Los Angeles River

ULARA Watermaster, 2005, 2006a

CURRENT GROUNDWATER STORAGE PROGRAMS

There are no formal groundwater storage programs in the ULARA Basins. The City of Los Angeles has regularly participated in Metropolitan's in-lieu replenishment program whereby the City takes imported water from Metropolitan at a discounted rate in lieu of pumping groundwater. An average of 10,400 AFY has been recharged via these programs since 1997.

BASIN MANAGEMENT CONSIDERATIONS

Not all of the 3.67 million AF for the storage capacity is usable and limitations are imposed on the volume of extraction. The primary considerations in the management of the ULARA groundwater basins are:

- The 1979 San Fernando Judgment and 1984 Sylmar Basin Stipulation, which limit production from the basin to the native safe yield plus any imported recharge.
- Rising groundwater levels may also increase surface flow losses out of the ULARA through the Los Angeles River Narrows to Central Basin, liquefaction potential and other factors resulting from near surface groundwater levels.
- In the Verdugo Basin, the vadose zone thickness affects the amount of available storage capacity (being reduced during wet periods). The basin's relatively small size and the basin area suitable for recharge also limit the potential storage capacity (Geomatrix, 2005).
- Widespread contamination with VOCs, hexavalent chromium and nitrate may limit the ability to store and extract water in this basin.
- The imbalance between stored water credits and the actual water in storage in the San Fernando Basin is being addressed by the management parties and the Watermaster.

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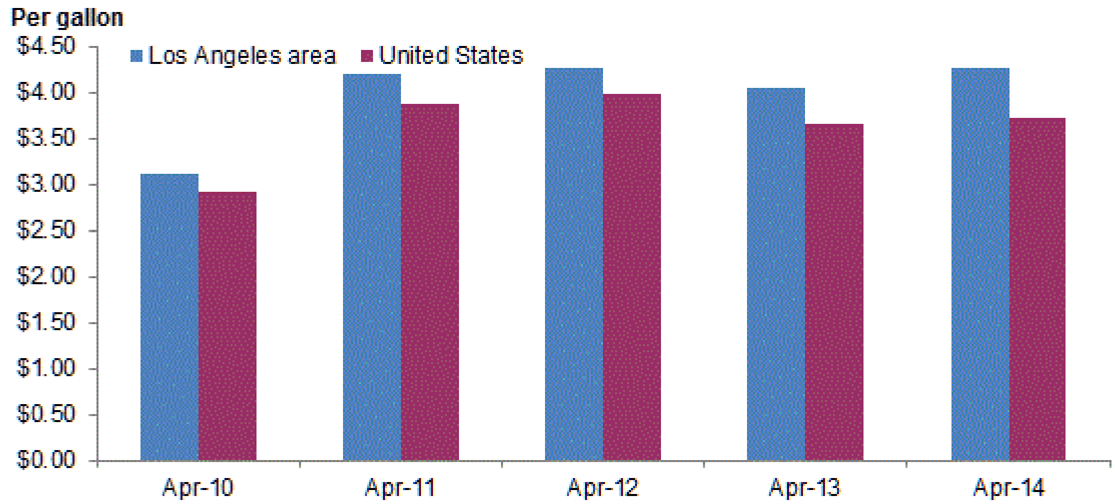
AVERAGE ENERGY PRICES, LOS ANGELES-RIVERSIDE-ORANGE COUNTY APRIL 2014

Gasoline prices averaged $4.263 a gallon in the Los Angeles-Riverside-Orange County area in April 2014, the U.S. Bureau of Labor Statistics reported today. Regional Commissioner Richard J. Holden noted that area gasoline prices were down 22.0 cents compared to last April when they averaged $4.043 per gallon. Los Angeles area households paid an average of 17.8 cents per kilowatt hour (kWh) of electricity in April 2014, down from 21.6 cents per kWh in April 2013. The average cost of utility (piped) gas at $1.211 per therm in April was more than the 1.077 cents per therm spent last year. (Data in this release are not seasonally adjusted; accordingly, over-the-year-analysis is used throughout.)

At $4.263 a gallon, Los Angeles area consumers paid 14.7 percent more than the $3.717 national average in April 2014. A year earlier, consumers in the Los Angeles area paid 10.9 percent more than the national average for a gallon of gasoline. The local price of a gallon of gasoline has exceeded the national average by at least 6 percent in the month of April in each of the past five years. (See chart 1.)

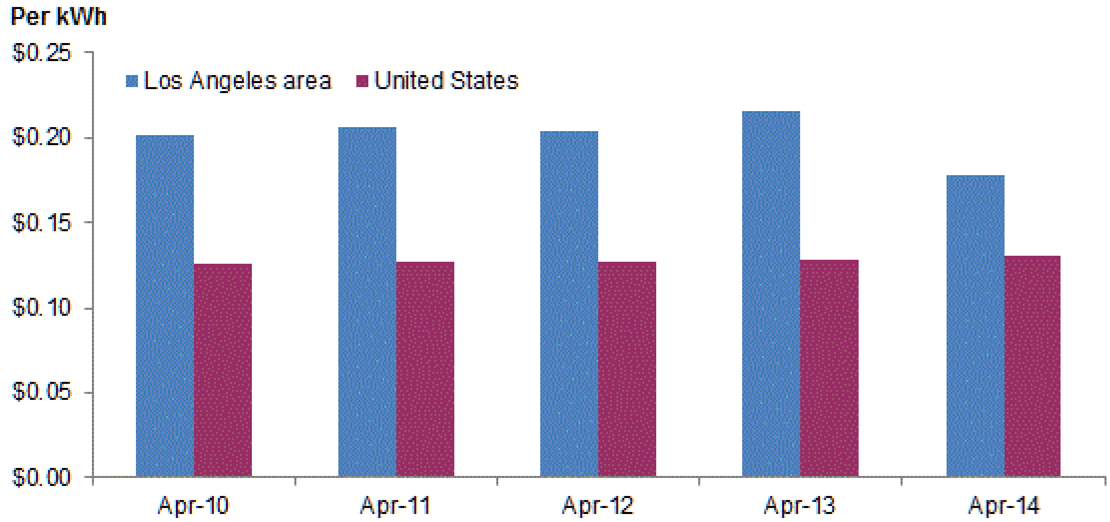
Chart 1. Average prices for gasoline, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)



SOURCE: U.S. Bureau of Labor Statistics.

The 17.8 cents per kWh Los Angeles households paid for electricity in April 2014 was 35.9 percent more than the nationwide average of 13.1 cents per kWh. Last April, electricity costs were 68.8 percent higher in Los Angeles compared to the nation. In the past five years, prices paid by Los Angeles area consumers for electricity exceeded the U.S. average by 35.9 percent or more in the month of April. (See chart 2.)

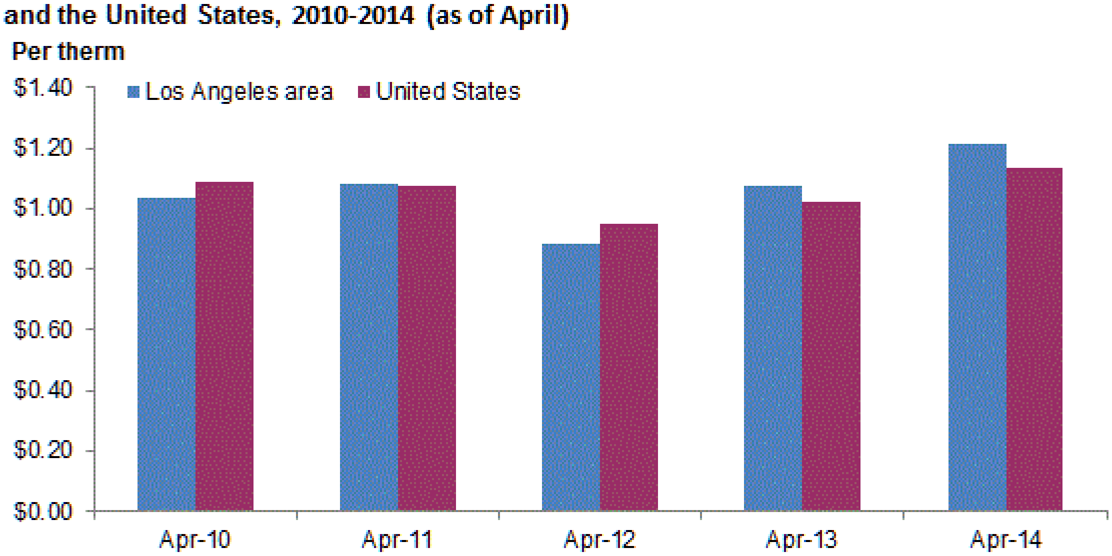
Chart 2. Average prices for electricity, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)



SOURCE: U.S. Bureau of Labor Statistics.

Prices paid by Los Angeles area consumers for utility (piped) gas, commonly referred to as natural gas, were $1.211 per therm, or 6.5 percent more compared to the national average in April 2014 ($1.137 per therm). A year earlier, area consumers paid 5.6 percent more per therm for natural gas compared to the nation. In the Los Angeles area over the past five years, the per therm cost for natural gas in April has varied between 7.2 percent below and 6.5 percent above the U.S. average.
(See chart 3.)

Chart 3. Average prices for utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)



SOURCE: U.S. Bureau of Labor Statistics.

The Los Angeles-Riverside-Orange County, Calif. metropolitan area consists of Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties in California.

Technical Note

Average prices are estimated from Consumer Price Index (CPI) data for selected commodity series to support the research and analytic needs of CPI data users. Average prices for electricity, utility (piped) gas, and gasoline are published monthly for the U.S. city average, the 4 regions, the 3 population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For electricity, average prices per kilowatt-hour (kWh) and per 500 kWh are published. For utility (piped) gas, average prices per therm, per 40 therms, and per 100 therms are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published as well as the average price across all grades.

Price quotes for 40 therms and 100 therms of utility (piped) gas and for 500 kWh of electricity are collected in sample outlets for use in the average price programs only. Since they are for specified consumption amounts, they are not used in the CPI. All other price quotes used for average price estimation are regular CPI data.

With the exception of the 40 therms, 100 therms, and 500 kWh price quotes, all eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity.

The average price per kilowatt-hour represents the total bill divided by the kilowatt-hour usage. The total bill is the sum of all items applicable to all consumers appearing on an electricity bill including, but not limited to, variable rates per kWh, fixed costs, taxes, surcharges, and credits. This calculation also applies to the average price per therm for utility (piped) gas.

Information from this release will be made available to sensory impaired individuals upon request. Voice phone: 202-691-5200, Federal Relay Service: 800-877-8339.

Table 1. Average prices for gasoline, electricty, and utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, April 2013-April 2014, not seasonally adjusted

	Gasoline per gallon		Electricity per kWh		Utillity (piped) gas per therm	
	Los Angeles area	United States	Los Angeles area	United States	Los Angeles area	United States
2013						
April	$4.043	$3.647	$0.216	$0.128	$1.077	$1.020
May	4.060	3.682	0.216	0.131	1.200	1.036
June	4.073	3.693	0.203	0.137	1.275	1.038
July	4.115	3.687	0.203	0.137	1.239	1.025
August	3.955	3.658	0.203	0.137	1.230	1.003
September	4.008	3.616	0.203	0.137	1.183	1.000
October	3.767	3.434	0.215	0.132	1.175	0.999
November	3.651	3.310	0.215	0.130	1.113	0.999
December	3.661	3.333	0.220	0.131	1.109	0.998
2014						
January	3.665	3.378	0.215	0.134	1.195	1.040
February	3.812	3.422	0.215	0.134	1.236	1.078
March	4.046	3.590	0.215	0.135	1.321	1.154
April	4.263	3.717	0.178	0.131	1.211	1.137

Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

Note to Readers

This report for West Basin Municipal Water District is an update and revision of an analysis and report by Robert Wilkinson, Fawzi Karajeh, and Julie Mottin (Hannah) conducted in April 2005. The earlier report, *Water Sources "Powering" Southern California: Imported Water, Recycled Water, Ground Water, and Desalinated Water*, was undertaken with support from the California Department of Water Resources, and it examined the energy intensity of water supply sources for both West Basin and Central Basin Municipal Water Districts. This analysis focuses exclusively on West Basin, and it includes new data for ocean desalination based on new engineering developments that have occurred over the past year and a half.

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Overview

Southern California relies on imported and local water supplies for both potable and non-potable uses. Imported water travels great distances and over significant elevation gains through both the California State Water Project (SWP) and Colorado River Aqueduct (CRA) before arriving in Southern California, consuming a large amount of energy in the process. Local sources of water often require less energy to provide a sustainable supply of water. Three water source alternatives which are found or produced locally and could reduce the amount of imported water are desalinated ocean water, groundwater, and recycled water. Groundwater and recycled water are significantly less energy intensive than imports, while ocean desalination is getting close to the energy intensity of imports.

Energy requirements vary considerably between these four water sources. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from the varying processes needed to produce water to meet appropriate standards. This study examines the energy needed to complete each process for the waters supplied by West Basin Municipal Water District (West Basin).

Specific elements of energy inputs examined in this study for each water source are as follows:

- Energy required to **import water** includes three processes: pumping California SWP and CRA supplies to water providers; treating water to applicable standards; and distributing it to customers.
- **Desalination of ocean water** includes three basic processes: 1) pumping water from the ocean or intermediate source (e.g. a powerplant) to the desalination plant; 2) pre-treating and then desalting water including discharge of concentrate; and 3) distributing water from the desalination plant to customers.
- **Groundwater** usage requires energy for three processes: pumping groundwater from local aquifers to treatment facilities; treating water to applicable standards; and distributing water from the treatment plant to customers. Additional injection energy is sometimes needed for groundwater replenishment.
- Energy required to **recycle water** includes three processes: pumping water from secondary treatment plants to tertiary treatment plants; tertiary treatment of the water, and distributing water from the treatment plant to customers.

The energy intensity results of this study are summarized in the table on the following page. They indicate that recycled water is among the least energy-intensive supply options available, followed by groundwater that is naturally recharged and recharged with recycled water. Imported water and ocean desalination are the most energy intensive water supply options in California. East Branch State Water Project water is close in energy intensity to desalination figures based on current technology, and at some points along the system, SWP supplies exceed estimated ocean desalination energy intensity. The following table identifies energy inputs to each of the water supplies including estimated energy requirements for desalination. Details describing the West Basin system operations are included in the water source sections. Note that the Title 22 recycled water energy figure reflects only the *marginal* energy required to treat secondary effluent wastewater which has been processed to meet legal discharge requirements, along with the energy to convey it to user

Energy Intensity of Water Supplies for West Basin Municipal Water District

	af/yr	Percentage of Total Source Type	kWh/af Conveyance Pumping	kWh/af MWD Treatment	kWh/af Recycled Treatment	kWh/af Groundwater Pumping	kWh/af Groundwater Treatment	kWh/af Desalination	kWh/af WBMWD Distribution	Total kWh/af	Total kWh/year
Imported Deliveries											
State Water Project (SWP) [1]	57,559	43%	3,000	44	NA	NA	NA	NA	0	3,044	175,209,596
Colorado River Aqueduct (CRA) [1] (other that replenishment water)	76,300	57%	2,000	44	NA	NA	NA	NA	0	2,044	155,957,200
Groundwater[2]											
natural recharge	19,720	40%	NA	NA	NA	350	0	NA	0	350	6,902,030
replenished with (injected) SWP water [1]	9,367	19%	3,000	44	NA	350	0	NA	0	3,394	31,791,598
replenished with (injected) CRA water [1]	11,831	24%	2,000	44	NA	350	0	NA	0	2,394	28,323,432
replenished with (injected) recycled water	8,381	17%	205	0	790	350	0	NA	220	1,565	13,116,278
Recycled Water											
West Basin Treatment, Title 22	21,506	60%	205	NA	0	NA	NA	NA	285	490	10,537,940
West Basin Treatment, RO	14,337	40%	205	NA	790	NA	NA	NA	285	1,280	18,351,360
	35,843										
Ocean Desalination	20,000	100%	200	NA	NA	NA	NA	3,027	460	3,687	82,588,800

Notes:

NA Not applicable

1 Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

2 Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

Energy Intensity of Water

Water treatment and delivery systems in California, including extraction of "raw water" supplies from natural sources, conveyance, treatment and distribution, end-use, and wastewater collection and treatment, account for one of the largest energy uses in the state.[1] The California Energy Commission estimated in its 2005 Integrated Energy Policy Report that approximately 19% of California's electricity is used for water related purposes including delivery, end-uses, and wastewater treatment.[2] The total energy embodied in a unit of water (that is, the amount of energy required to transport, treat, and process a given amount of water) varies with location, source, and use within the state. In many areas, the energy intensity may increase in the future due to limits on water resource extraction, and regulatory requirements for water quality, and other factors.[3] Technology improvements may offset this trend to some extent.

> ***Energy intensity*** is the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location.

The Water-Energy Nexus

Water and energy systems are interconnected in several important ways in California. Water systems both provide energy – through hydropower – and consume large amounts of energy, mainly through pumping. Critical elements of California's water infrastructure are highly energy-intensive. Moving large quantities of water long distances and over significant elevation gains, treating and distributing it within the state's communities and rural areas, using it for various purposes, and treating the resulting wastewater, accounts for one of the largest uses of electrical energy in the state.[4]

Improving the efficiency with which water is used provides an important opportunity to increase related energy efficiency. (*"Efficiency"* as used here describes the useful work or service provided by a given amount of water.) Significant potential economic as well as environmental benefits can be cost-effectively achieved in the energy sector through efficiency improvements in the state's water systems and through shifting to less energy intensive local sources. The California Public Utilities Commission is currently planning to include water efficiency improvements as a means of achieving energy efficiency benefits for the state.[5]

Overview of Energy Inputs to Water Systems

There are four principle energy elements in water systems:

1. primary water extraction and supply delivery (imported and local)
2. treatment and distribution within service areas
3. on-site water pumping, treatment, and thermal inputs (heating and cooling)

4. wastewater collection, treatment, and discharge

Pumping water in each of these four stages is energy-intensive. Other important components of embedded energy in water include groundwater pumping, treatment and pressurization of water supply systems, treatment and thermal energy (heating and cooling) applications at the point of end-use, and wastewater pumping and treatment.[6]

1. ***Primary water extraction and supply delivery***
   Moving water from near sea-level in the Sacramento-San Joaquin Delta to the San Joaquin-Tulare Lake Basin, the Central Coast, and Southern California, and from the Colorado River to metropolitan Southern California, is highly energy intensive. Approximately 3,236 kWh is required to pump one acre-foot of SWP water to the end of the East Branch in Southern California, and 2,580 kWh for the West Branch. About 2,000 kWh is required to pump one acre foot of water through the CRA to southern California.[7] Groundwater pumping also requires significant amounts of energy depending on the depth of the source. (Data on groundwater is incomplete and difficult to obtain because California does not systematically manage groundwater resources.)

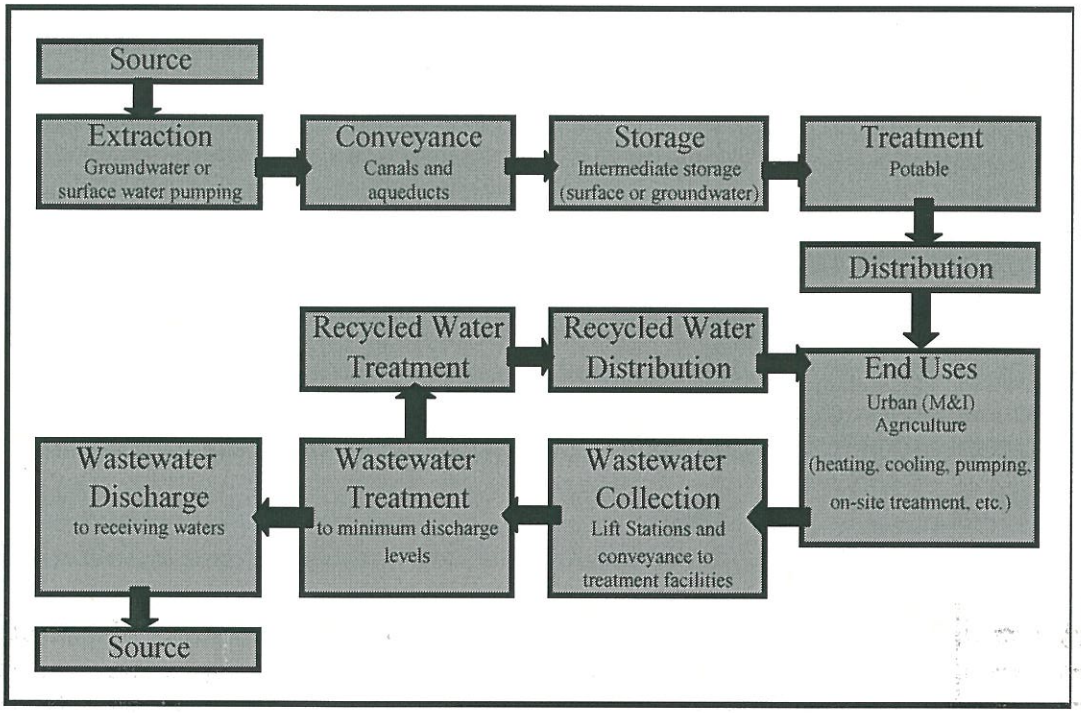
2. ***Treatment and distribution within service areas***
   Within local service areas, water is treated, pumped, and pressurized for distribution. Local conditions and sources determine both the treatment requirements and the energy required for pumping and pressurization.

3. ***On-site water pumping, treatment, and thermal inputs***
   Individual water users use energy to further treat water supplies (e.g. softeners, filters, etc.), circulate and pressurize water supplies (e.g. building circulation pumps), and heat and cool water for various purposes.

4. ***Wastewater collection, treatment, and discharge***
   Finally, wastewater is collected and treated by a wastewater authority (unless a septic system or other alternative is being used). Wastewater is often pumped to treatment facilities where gravity flow is not possible, and standard treatment processes require energy for pumping, aeration, and other processes. (In cases where water is reclaimed and re-used, the calculation of total energy intensity is adjusted to account for wastewater as a *source* of water supply. The energy intensity generally includes the additional energy for treatment processes beyond the level required for wastewater discharge, plus distribution.)

The simplified flow chart below illustrates the steps in the water system process. A spreadsheet computer model is available to allow cumulative calculations of the energy inputs embedded at each stage of the process. This methodology is consistent with that applied by the California Energy Commission in its analysis of the energy intensity of water.

Simplified Flow Diagram of Energy Inputs to Water Systems



Source: Robert Wilkinson, UCSB[8]

Calculating Energy Intensity

Total energy intensity, or the amount of energy required to facilitate the use of a given amount of water in a specific location, may be calculated by accounting for the summing the energy requirements for the following factors:

- imported supplies
- local supplies
- regional distribution
- treatment
- local distribution
- on-site thermal (heating or cooling)
- on-site pumping
- wastewater collection
- wastewater treatment

Water pumping, and specifically the long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity as noted above. Water use (based on embedded energy) is the next largest consumer of electricity in a typical Southern California home after refrigerators and air conditioners. Electricity required to support water service in the typical home in Southern California is estimated at between 14% to 19% of total residential energy demand.[9] If air conditioning is not a factor the figure is even higher. Nearly three quarters of this energy demand is for pumping imported water.

Interbasin Transfers

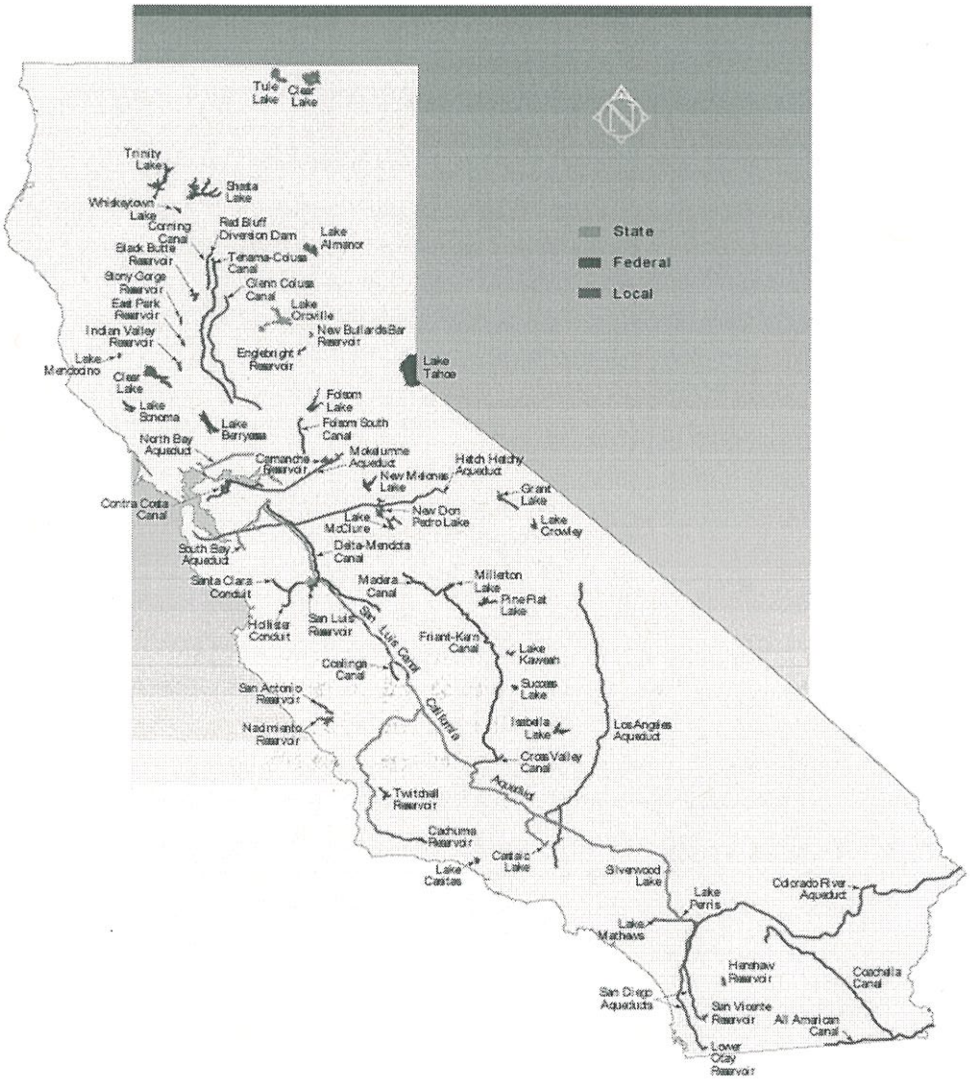
Some of California's water systems are uniquely energy-intensive, relative to national averages, due to the pumping requirements of major conveyance systems which move large volumes of water long distances and over thousands of feet in elevation lift. Some of the interbasin transfer systems (systems that move water from one watershed to another) are net energy producers, such as the San Francisco and Los Angeles aqueducts. Others, such as the SWP and the CRA require large amounts of electrical energy to convey water. On *average*, approximately 3,000 kWh is necessary to pump one AF of SWP water to southern California,[10] and 2,000 kWh is required to pump one AF of water through the CRA to southern California.[11]

Total energy savings for reducing the full embedded energy of *marginal* (e.g. imported) supplies of water used indoors in Southern California is estimated at about 3,500 kWh/af.[12] Conveyance over long distances and over mountain ranges accounts for this high marginal energy intensity. In addition to avoiding the energy and other costs of pumping additional water supplies, there are environmental benefits through reduced extractions from stressed ecosystems such as the delta.

Imported Water:
The State Water Project and the Colorado River Aqueduct

Water diversion, conveyance, and storage systems developed in California in the 20th century are remarkable engineering accomplishments. These water works move millions of AF of water around the state annually. The state's 1,200-plus reservoirs have a total storage capacity of more than 42.7 million acre feet (maf).[13] West Basin receives imported water from Northern California through the State Water Project and Colorado River water via the Colorado River Aqueduct. The Metropolitan Water District of Southern California delivers both of these imported water supplies to the West Basin.

California's Major Interbasin Water Projects



The State Water Project

The State Water Project (SWP) is a state-owned system. It was built and is managed by the California Department of Water Resources (DWR). The SWP provides supplemental water for agricultural and urban uses.[14] SWP facilities include 28 dams and reservoirs, 22 pumping and generating plants, and nearly 660 miles of aqueducts.[15] Lake Oroville on the Feather River, the project's largest storage facility, has a total capacity of about 3.5 maf.[16] Oroville Dam is the tallest and one of the largest earth-fill dams in the United States.[17]

Water is pumped out of the delta for the SWP at two locations. In the northern Delta, Barker Slough Pumping Plant diverts water for delivery to Napa and Solano counties through the North Bay

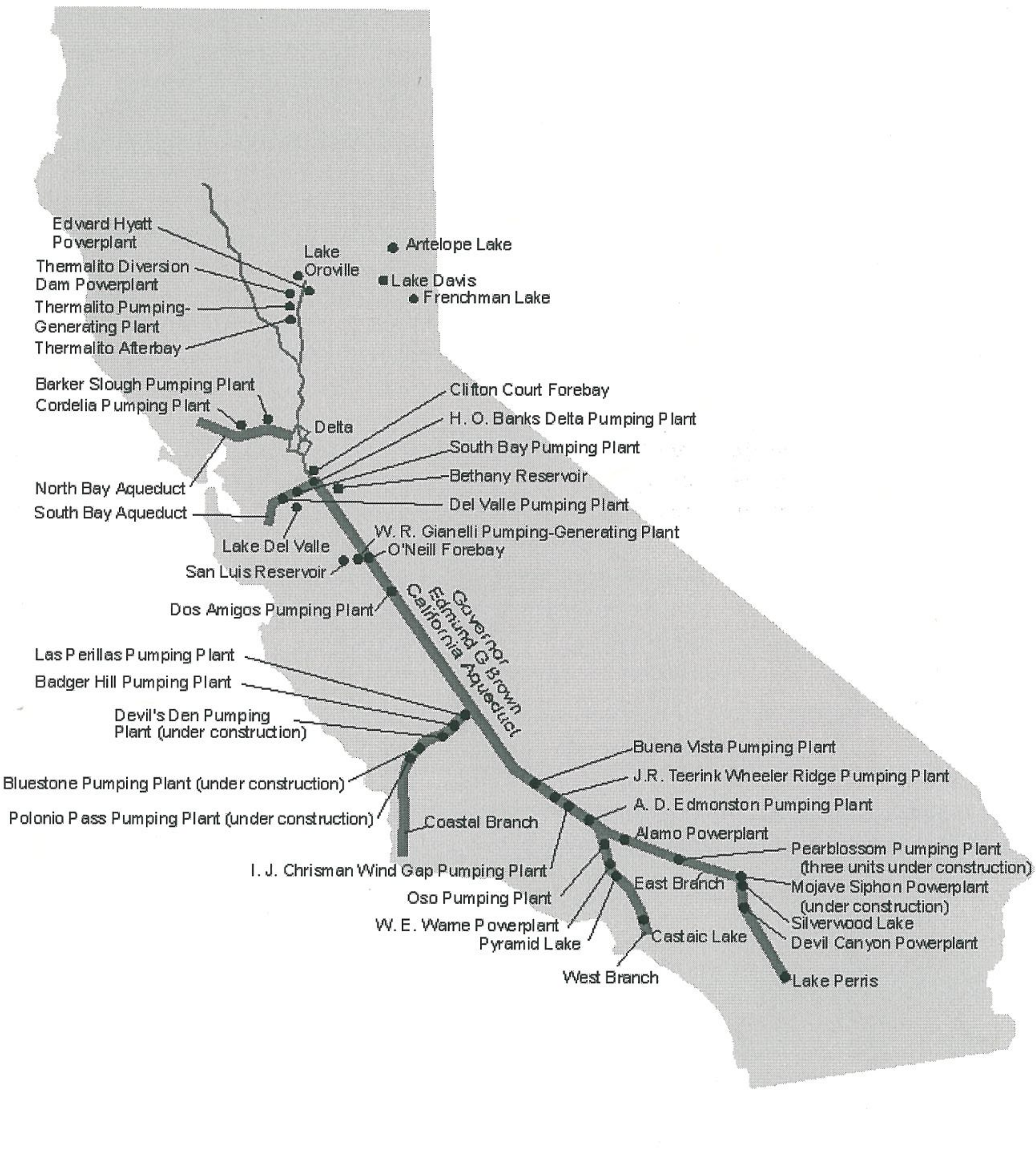
Aqueduct.[18] Further south at the Clifton Court Forebay, water is pumped into Bethany Reservoir by the Banks Pumping Plant. From Bethany Reservoir, the majority of the water is conveyed south in the 444-mile-long Governor Edmund G. Brown California Aqueduct to agricultural users in the San Joaquin Valley and to urban users in Southern California. The South Bay Pumping Plant also lifts water from the Bethany Reservoir into the South Bay Aqueduct. [19]

The State Water Project is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year.[20] The energy required to operate the SWP is provided by a combination of DWR's own hydroelectric and other generation plants and power purchased from other utilities. The project's eight hydroelectric power plants, including three pumping-generating plants, and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power.

Energy requirements would be considerably higher if the SWP was delivering full contract volumes of water. The project delivered an average of approximately 2.0 mafy, or half its contracted volumes, throughout the 1980s and 1990s.[21] Since 2000 the volumes of imported water have generally increased.

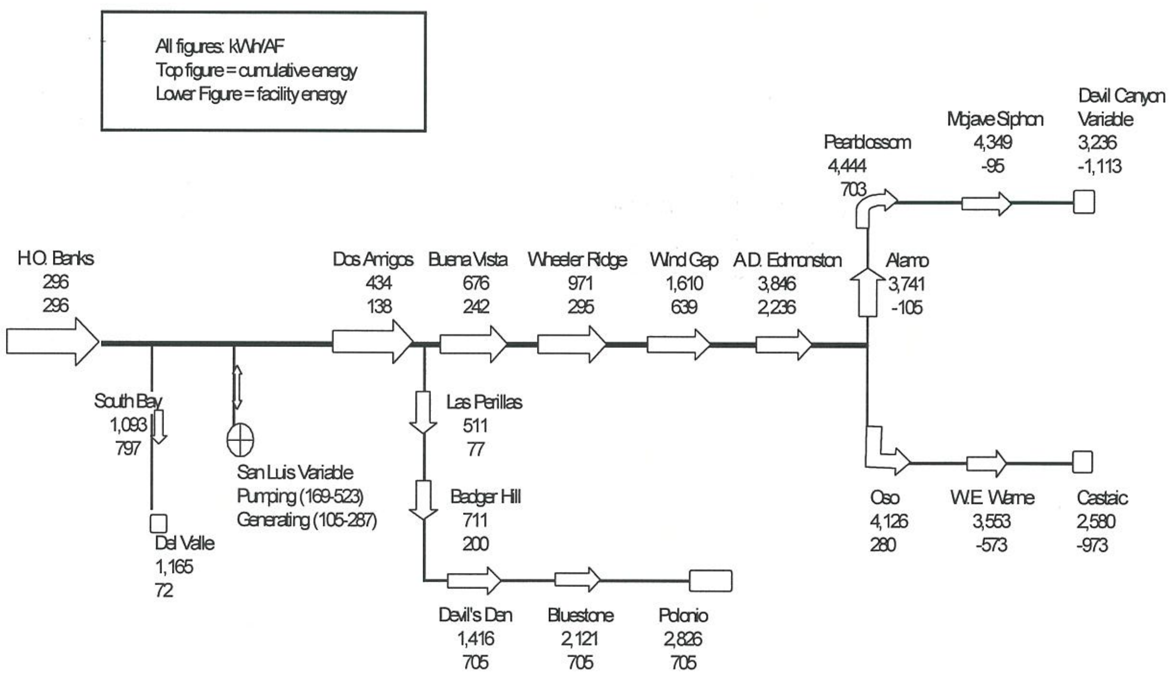
The following map indicates the location of the pumping and power generation facilities on the SWP.

Names and Locations of Primary State Water Delivery Facilities



The following schematic shows each individual pumping unit on the State Water Project, along with data for both the individual and cumulative energy required to deliver an AF of water to that point in the system. Note that the figures include energy recovery in the system, but they do not account for losses due to evaporation and other factors. These losses may be in the range of 5% or more. While more study of this issue is in order, it is important to observe that the energy intensity numbers are conservative (e.g. low) in that they assume that all of the water originally pumped from the delta reaches the ends of the system without loss.

State Water Project
Kilowatt-Hours per Acre Foot Pumped
(Includes Transmission Losses)



Source: Wilkinson, based on data from: California Department of Water Resources, State Water Project Analysis Office, Division of Operations and Maintenance, *Bulletin 132-97*, 4/25/97.

The Colorado River Aqueduct

Significant volumes of water are imported to the Los Angeles Basin and San Diego in Southern California from the Colorado River via the Colorado River Aqueduct (CRA). The aqueduct was built by the Metropolitan Water District of Southern California (MWD). Though MWD's allotment of the Colorado River water is 550,000 afy, it has historically extracted as much as 1.3 mafy through a combination of waste reduction arrangements with Imperial Irrigation District (IID) (adding about 106,000 afy) and by using "surplus" water.[22] The Colorado River water supplies require about 2,000 kWh/af for conveyance to the Los Angeles basin.

The Colorado River Aqueduct extends 242 miles from Lake Havasu on the Colorado River to its terminal reservoir, Lake Mathews, near Riverside. The CRA was completed in 1941 and expanded in 1961 to a capacity of more than 1 MAF per year. Five pumping plants lift the water 1,616 feet, over several mountain ranges, to southern California. To pump an average of 1.2 maf of water per year into the Los Angeles basin requires approximately 2,400 GWh of energy for the CRA's five pumping plants.[23] On average, the energy required to import Colorado River water is about 2,000 kWh/AF. The aqueduct was designed to carry a flow of 1,605 cfs (with the capacity for an additional 15%).

The sequence for CRA pumping is as follows: The Whitsett Pumping Plant elevates water from Lake Havasu 291 feet out of the Colorado River basin. At "mile 2," Gene pumping plant elevates water 303 feet to Iron Mountain pumping plant at mile 69, which then boosts the water another 144 feet. The last two pumping plants provide the highest lifts - Eagle Mountain, at mile 110, lifts the water 438 feet, and Hinds Pumping Plant, located at mile 126, lifts the water 441 feet.[24]

MWD has recently improved the system's energy efficiency. The average energy requirement for the CRA was reduced from approximately 2,100 kWh /af to about 2,000 kWh /af "through the increase in unit efficiencies provided through an energy efficiency program." The energy required to pump each acre foot of water through the CRA is essentially constant, regardless of the total annual volume of water pumped. This is due to the 8-pump design at each pumping plant. The average pumping energy efficiency does not vary with the number of pumps operated, and MWD states that the same 2,000 kWh/af estimate is appropriate for both the "Maximum Delivery Case" and the "Minimum Delivery Case."[25]

It appears that there are limited opportunities to shift pumping off of peak times on the CRA. Due to the relatively steep grade of the CRA, limited active water storage, and transit times between plants, the system does not generally lend itself to shifting pumping loads from on-peak to off-peak. Under the Minimum Delivery Case, the reduced annual water deliveries would not necessarily bring a reduction in annual peak load, since an 8-pump flow may still need to be maintained in certain months.

Electricity to run the CRA pumps is provided by power from hydroelectric projects on the Colorado River as well as off-peak power purchased from a number of utilities. The Metropolitan Water District has contractual hydroelectric rights on the Colorado River to "more than 20 percent of the firm energy and contingent capacity of the Hoover power plant and 50 percent of the energy and capacity of the Parker power plant."[26] Energy purchased from utilities makes up approximately 25 percent of the remaining energy needed to power the Colorado River Aqueduct.[27]

Minimizing the Need for Inter-Basin Transfers

For over 100 years, California has sought to transfer water from one watershed for use in another. The practice has caused a number of problems. As of 2001, California law requires that the state examine ways to "*minimize the need to import water from other hydrologic regions*" and report on these approaches in the official State Water Plan.[28] A new focus and priority has been placed on developing *local* water supply sources, including efficiency, reuse, recharge, and desalination. The law directs the Department of Water Resources as follows:[29]

> The department, as a part of the preparation of the department's Bulletin 160-03, shall include in the California Water Plan a report on the development of regional and local water projects within each hydrologic region of the state, as described in the department's Bulletin 160-98, to improve water supplies to meet municipal, agricultural, and environmental water needs and *minimize the need to import water from other hydrologic regions*.

(Note that Bulletin 160-03 became Bulletin 160-05 due to a slip in the completion schedule.)

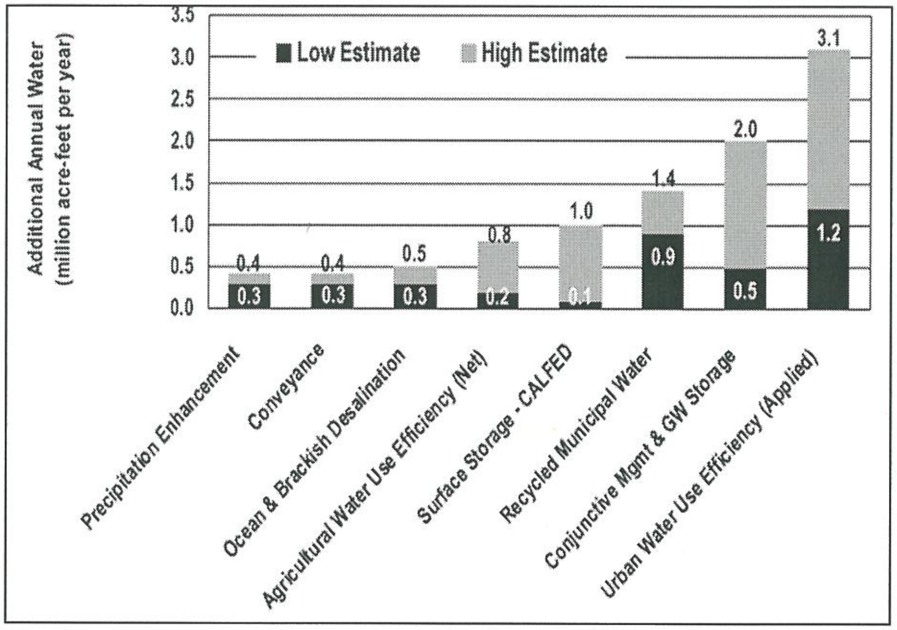
The legislation set forth the range of local supply options to be considered:

> The report shall include, but is not limited to, regional and local water projects that use technologies for desalting brackish groundwater and ocean water, reclaiming water for use within the community generating the water to be reclaimed, the construction of improved potable water treatment facilities so that water from sources determined to be unsuitable can be used, and the construction of dual water systems and brine lines, particularly in connection with new developments and when replacing water piping in developed or redeveloped areas.

This law calls for a thorough consideration in the state's official water planning process of work that is already going on in various areas of the state. The significance of the legislation is that for the first time, local supply development is designated as a priority in order to minimize inter-basin transfers.

The Department of Water Resources State Water Plan (Bulletin 160-05) reflects this new direction for the state in its projection of water supply options for the next quarter century. The following graph clearly indicates the importance of local water supplies from various sources in the future.

California State Water Plan 2005
Water Management and Supply Options for the Next 25 Years



Source: *California Water Plan Update 2005.*[30]

Energy Requirements for Treatment of State Water Project and the Colorado River Aqueduct Supplies

Imported SWP and CRA supplies require an estimated 44 kWh/af for treatment before it enters the local distribution systems. Water pressure from MWD's system is sufficient to move supplies through the West Basin distribution system without requiring additional pressure.

Groundwater and Recycled Water at West Basin MWD

Nearly half of the water used in the service area of the Metropolitan Water District of Southern California (from Ventura to Mexico) is secured from *local* sources, and the percentage of total supplies provided by local sources is growing steadily.[31] This figure is up from approximately one-third of the supply provided by local resources in the mid-1990s.[32] MWD has encouraged local supply development through support for recycling, groundwater recovery, conservation, groundwater storage, and most recently, ocean desalination.

Groundwater and recycled water are important and growing supply sources for West Basin. Water flows through natural hydrologic cycles continuously. The water we use today has made the journey many times. In water recycling programs, water is treated and re-used for various purposes including recharging groundwater aquifers. The treatment processes essentially short-circuit the longer-term process of natural evaporation and precipitation. In cities around the world water is used and then returned to natural water systems where it flows along to more users down stream. It is often used again and again before it flows to the ocean or to a terminal salt sink.

Groundwater at West Basin MWD

Groundwater reservoirs in West Basin are replenished with four water sources; natural recharge, SWP supplies, CRA supplies, and recycled water supplies. The largest portion (approximately 40%) of groundwater supplies is derived from natural recharge. The energy associated with recovering this naturally recharged supply is estimated at 350 kWh/af for groundwater pumping.

Imported water, from both the SWP and CRA, is injected into the groundwater supply in West Basin. The imported water remains at sufficient pressure for injection, so no additional energy is required. The energy requirements for importing water are significant, however, primarily due to the energy associated with importing the water from northern California and the Colorado River. The imported water also passes through MWD's treatment plant, incurring additional energy requirements. The total energy intensity for West Basin's imported water used for recharge of groundwater storage from the SWP is 3,394 kWh/af and from the CRA is 2,394 kWh/af.

Recycled water is also used to recharge groundwater in the basin. West Basin replenishes groundwater by injecting RO treated recycled water from the West Basin Water Recycling Facility (WBWRF). The total energy use is 1,565 kWh/af. Details for the recycled water energy are described in the next section.

Recycled Water at West Basin MWD

Many cities in California are using advanced processes and filtering technology to treat wastewater so it can be re-used for irrigation, industry, and other purposes. In response to increasing demands for water, limitations on imported water supplies, and the threat of drought, West Basin has developed state-of-the-art regional water recycling programs. Water is increasingly being used more than once within systems at both the end-use level and at the municipal level. This is because scarce water resources (and wastewater discharges) are increasing in cost and because cost-effective technologies and techniques for re-using water have been developed that meet health and safety requirements. At the end-use, water is recycled within processes such as cooling towers and industrial processes prior to entering the wastewater system. Once-through systems are increasingly being replaced by re-use technologies. At the municipal level, water re-use has become a significant source of supplies for both landscape irrigation and for commercial and industrial processes. MWD of Southern California is supporting 33 recycling programs in which treated wastewater is used for non-potable purposes. [33]

West Basin provides customers with recycled water used for municipal, commercial and industrial applications. Approximately 27,000 AF of recycled water is annually distributed to more than 210 sites in the South Bay. These sites use recycled water for a wide range of non-potable applications. Based in El Segundo, California, the WBWRF is among the largest projects of its kind in the nation, producing five qualities of recycled water with the capacity at full build-out to recycle 100,000 AF per year of wastewater from the Los Angeles Hyperion Treatment Plant.

In 1998, West Basin began to construct the nation's only regional high-purity water treatment facility, the Carson Regional Water Recycling Facility (CRWRF). A pipeline stretching through five South Bay communities connects the CRWRP to West Basin's El Segundo facility. At the CRWRF, West Basin ultra-purifies the recycled water it gets from the El Segundo facility. From the CRWRF, West Basin uses service lines to transport two types of purified water to the BP Refinery in Carson. The West Basin expansion also includes a new disposal pipeline to carry brine reject water from the CRWRF to a Los Angeles County Sanitation District's outfall.

In order to provide perspective on the energy requirements for the WBWRF, two water qualities and associated energy intensity are presented. "Title 22" water, produced by a gravity filter treatment system, requires conveyance pumping energy from Hyperion to WBWRF at 205 kWh/af. The water flows through the filters via gravity, thus no additional energy is required for treatment. The final energy requirement is 285 kWh/af for distribution with a total energy requirement of 490 kWh/af. This is the lowest grade of recycled water that WBWRF produces. Contrasting the Title 22 water, WBWRF produces RO water with a total energy requirement of 1,280 kWh/af. This includes 205 kWh/af for conveyance from Hyperion, 790 kWh/af for treatment with RO, and 285 kWh/af for distribution.

More than 210 South Bay sites use 9 billion gallons of West Basin's recycled water for applications including irrigation, industrial processes, indirect potable uses, and seawater barrier injection. West Basin has been successful in changing the perception of recycled water from merely a conservation tool with minimal applications to a cost-effective business tool that can reduce costs and improve reliability.

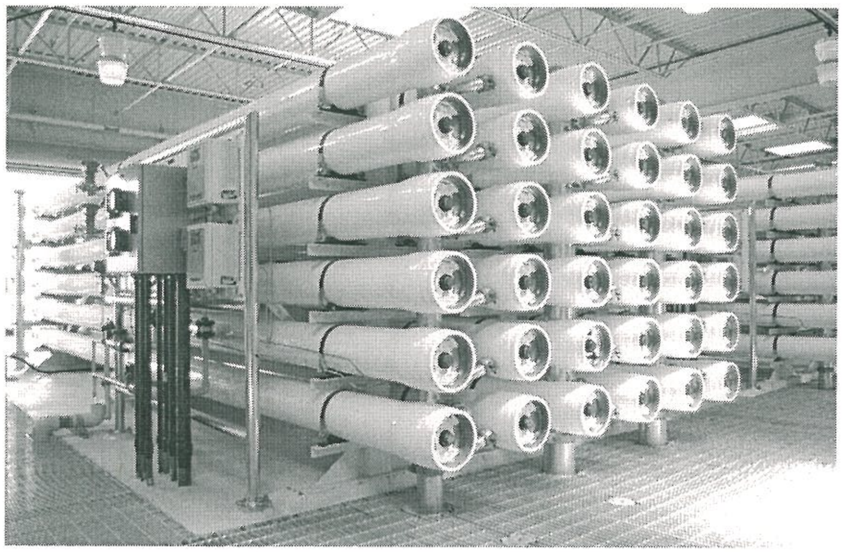
Local oil refineries are major customers for West Basin's recycled water. The Chevron Refinery in El Segundo, the Exxon-Mobile refinery in Torrance, and the BP refinery in Carson use recycled water for cooling towers and in the boiler feed systems.

Ocean Water Desalination Development

Desalination technologies are in use around the world. A number of approaches work well and produce high quality water. Many workable and proven technology options are available to remove salt from water. During World War Two, desalination technology was developed as a water source for military operations.[34] Grand plans for nuclear-driven desalination systems in California were drawn up after the war, but they were never implemented due to cost and feasibility problems.

Desalination techniques range from distillation to "reverse osmosis" (RO) technologies. Current applications around the world are dominated by the "multistage flash distillation" process (at about 44% of the world's applications), and RO, (at about 42%).[35] Other desalting technologies include electrodialysis (6%), vapor compression (4%), multi-effect distillation (4%), and membrane softening (2%) to remove salts.[36] All of the ocean desalination projects currently in place or proposed for municipal water supply in California employ RO technology.

Reverse Osmosis Membranes



A recent inventory of desalination facilities world-wide indicated that as of the beginning of 1998, a total of 12,451 desalting units with a total capacity of 6.72 afy[37] had been installed or contracted worldwide.[38] (Note that *capacity* does not indicate actual operation.) Non-seawater desalination plants have a capacity 7,620 af/d[39], whereas the seawater desalination plant capacity reached 10,781af/d.[40]

Desalination systems are being used in over 100 countries, but 10 countries are responsible for 75 percent of the capacity.[41] Almost half of the desalting capacity is used to desalt seawater in the Middle East and North Africa. Saudi Arabia ranks first in total capacity (about 24 percent of the world's capacity) followed by the United Arab Emirates and Kuwait, with most of the capacity being made up of seawater desalting units that use the distillation process.[42]

The salinity of ocean water varies, with the average generally exceeding 30 grams per liter (g/l).[43] The Pacific Ocean is 34-38 g/l, the Atlantic Ocean averages about 35 g/l, and the Persian Gulf is 45 g/l. Brackish water drops to 0.5 to 3.0 g/l.[44] Potable water salt levels should be below 0.5 g/l.

Reducing salt levels from over 30 g/l to 0.5 g/l and lower (drinking water standards) using existing technologies requires considerable amounts of energy, either for thermal processes or for the pressure to drive water through extremely fine filters such as RO, or for some combination of thermal and pressure processes. Recent improvements in energy efficiency have reduced the amount of thermal and pumping energy required for the various processes, but high energy intensity is still an issue. The energy required is in part a function of the degree of salinity and the temperature of the water.

West Basin is in the process of developing plans to construct an ocean desalinating plant. Estimated energy requirements have been calculated by Gerry Filteau of Separation Processes, Inc for each step in the process.[45] The values presented for desalination are based on his work. Since the proposed plant will tap the source water at the power plant, there is no ocean intake pumping required. The source water is estimated to require 200 kWh/af this energy will bring ocean water from the power plant to the desalination system, approximately one quarter of a mile in distance. Pre-treatment of the source water is estimated at 341 kWh/af. This figure includes microfiltration and transfer to the RO units via a 5-10 micron cartridge filter. The RO process requires 2,686 kWh/af if operated at the most energy-efficient level. A slightly less efficient but more cost-effective level of operation would require 2,900 kWh/af, or 214 kWh/af additional energy input according to Filteau. Finally, an estimated 460 kWh/af is required to deliver the product water to the distribution system, including elevation gain, conveyance over distance, and pressurization to 90 psi. No additional energy is required to discharge the brine, as it flows back to the ocean outfall line by gravity.

The energy intensity figures presented here for desalination are lower than previous estimates. This is mainly due to improved membrane technologies, efficiency improvements for high pressure pumps, and pressure recovery systems. It should be noted that the figures provided here are based on engineering estimates, not on actual plant operations.

The total energy required to desalinate the ocean water, including each of the steps above, is estimated to be 3,687 kWh/af. If the energy intensity is increased slightly to improve cost-effectiveness, the total figure increases to 3,901 kWh/af.

Summary

This study examined the energy intensity of imported and local water supplies (ocean water, groundwater, and recycled water) for both potable and non-potable uses for West Basin. All water sources require pumping, treatment, and distribution. Differences in energy requirements arise from varying pumping, treatment, and distribution processes needed to produce water to meet appropriate standards for different uses.

The key findings of this study are: 1) the marginal energy required to treat and deliver recycled water is among the *least* energy intensive supply options available, 2) naturally recharged groundwater is low in energy intensity, though replenishment with imported water is not, and 3) current ocean desalination technology is getting close to the level of energy intensity of imported supplies.

Further refinement of the data in this study, such as applying an agency's own energy values, may provide a more accurate basis for decision-making tailored to a unique water system. The information presented, however, provides a reasonable basis for water managers to explore energy (and cost) benefits of increased use of local water sources, and it indicates that desalination of ocean water is getting close to the energy intensity of existing supplies.

Sources

[1] Water systems account for roughly 7% of California's electricity use: See Wilkinson, Robert C., 2000. Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[2] California Energy Commission, 2005. *Integrated Energy Policy Report*, November 2005, CEC-100-2005-007-CMF.

[3] Franklin Burton, in a recent study for the Electric Power Research Institute (EPRI), includes the following elements in water systems: "Water systems involve the transportation of water from its source(s) of treatment plants, storage facilities, and the customer. Currently, most of the electricity used is for pumping; comparatively little is used in treatment. For most surface sources, treatment is required consisting usually of chemical addition, coagulation and settling, followed by filtration and disinfection. In the case of groundwater (well) systems, the treatment may consist only of disinfection with chlorine. In the future, however, implementation of new drinking water regulations will increase the use of higher energy consuming processes, such as ozone and membrane filtration." Burton, Franklin L., 1996, *Water and Wastewater Industries: Characteristics and Energy Management Opportunities.* (Burton Engineering) Los Altos, CA, Report CR-106941, Electric Power Research Institute Report, p.3-1.

[4] Wilkinson, Robert C., 2000. *Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures*, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[5] California Public Utilities Commission, Order Instituting Rulemaking Regarding to Examine the Commission's post-2005 Energy Efficiency Policies, Programs, Evaluation, Measurement and Verification, and Related Issues, Rulemaking 06-04-010 (Filed April 13, 2006)

[6] An AF of water is the volume of water that would cover one acre to a depth of one foot. An AF equals 325,851 gallons, or 43,560 cubic feet, or 1233.65 cubic meters.

[7] Metropolitan Water District of Southern California, *Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations*, 1996, p.5.

[8] This schematic, based on the original analysis by Wilkinson (2000) has been refined and improved with input from Gary Wolff, Gary Klein, William Kost, and others. It is the basic approach reflected in the CEC IEPR and other analyses.

[9]QEI, Inc., 1992, *Electricity Efficiency Through Water Efficiency*, Report for the Southern California Edison Company, p. 24.

[10] Figures cited are *net* energy requirements (gross energy for pumping minus energy recovered through generation).

[11] Metropolitan Water District of Southern California, *Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations*, 1996, p.5.

[12] Wilkinson, Robert C., 2000. *Methodology For Analysis of The Energy Intensity of California's Water Systems, and an Assessment of Multiple Potential Benefits Through Integrated Water-Energy Efficiency Measures*, Exploratory Research Project, Ernest Orlando Lawrence Berkeley Laboratory, California Institute for Energy Efficiency.

[13] California Department of Finance. California Statistical Abstract. Tables G-2, "Gross Capacities of Reservoirs by Hydrographic Region," and G-3 "Major Dams and Reservoirs of California." January 2001. (http://www.dof.ca.gov/html/fs_data/stat-abs/toc.htm)

[14] "The SWP, managed by the Department of Water Resources, is the largest state-built, multi-purpose water project in the country. Approximately 19 million of California's 32 million residents receive at least part of their water from the SWP. SWP water irrigates approximately 600,000 acres of farmland. The SWP was designed and built to deliver water, control floods, generate power, provide recreational opportunities, and enhance habitats for fish and wildlife." California Department of Water Resources, *Management of the California State Water Project*. Bulletin 132-96. p.xix.

[15] California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.p.xix.

[16] Three small reservoirs upstream of Lake Oroville — Lake Davis, Frenchman Lake, and Antelope Lake — are also SWP facilities. California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.

[17] California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96. Power is generated at the Oroville Dam as water is released down the Feather River, which flows into the Sacramento River, through the Sacramento-San Joaquin Delta, and to the ocean through the San Francisco Bay.

[18] The North Bay Aqueduct was completed in 1988. (California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.)

[19] The South Bay Aqueduct provided initial deliveries for Alameda and Santa Clara counties in 1962 and has been fully operational since 1965. (California Department of Water Resources, 1996, *Management of the California State Water Project*. Bulletin 132-96.)

[20] Carrie Anderson, 1999, "Energy Use in the Supply, Use and Disposal of Water in California", Process Energy Group, Energy Efficiency Division, California Energy Commission, p.1.

[21] Average deliveries for 1980-89 were just under 2.0 mafy, deliveries for 1990-99 were just over 2.0 mafy. There is disagreement regarding the ability of the SWP to deliver the roughly 4.2 mafy that has been contracted for.

[22] According to MWD, "Metropolitan's annual dependable supply from the Colorado River is approximately 656,000 AF -- about 550,000 AF of entitlement and at least 106,000 AF obtained through a conservation program Metropolitan funds in the Imperial Irrigation District in the southeast corner of the state. However, Metropolitan has been allowed to take up to 1.3 maf of river water a year by diverting either surplus water or the unused portions of other agencies' apportionments." Metropolitan Water District of Southern California, 1999, "Fact Sheet" at: http://www.mwd.dst.ca.us/docs/fctsheet.htm.

[23] Metropolitan Water District of Southern California, 1999, http://www.mwd.dst.ca.us/pr/powres/summ.htm.

[24] The five pumping plants each have nine pumps. The plants are designed for a maximum flow of 225 cubic feet per second (cfs). The CRA is designed to operate at full capacity with eight pumps in operation at each plant (1800 cfs). The ninth pump operates as a spare to facilitating maintenance, emergency operations, and repairs. Metropolitan Water District of Southern California, 1999, Colorado River Aqueduct: http://aqueduct.mwd.dst.ca.us/areas/desert.htm, 08/01/99.

[25] Metropolitan Water District of Southern California, 1996, "Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations", 1996, p.5.

[26] Metropolitan Water District of Southern California, 1999, "Summary of Metropolitan's Power Operation". February, 1999, p.1, http://aqueduct.mwd.dst.ca.us/areas/desert.htm.

[27] Metropolitan Water District of Southern California, 1999, http://www.mwd.dst.ca.us/pr/powres/summ.htm. MWD provides further important system information as follows: Metropolitan owns and operates 305 miles of 230 kV transmission lines from the Mead Substation in southern Nevada. The transmission system is used to deliver power from Hoover and Parker to the CRA pumps. Additionally, Mead is the primary interconnection point for Metropolitan's economy energy purchases. Metropolitan's transmission system is interconnected with several utilities at multiple

interconnection points. Metropolitan's CRA lies within Edison's control area. Resources for the load are contractually integrated with Edison's system pursuant to a Service and Interchange Agreement (Agreement), which terminates in 2017. Hoover and Parker resources provide spinning reserves and ramping capability, as well as peaking capacity and energy to Edison, thereby displacing higher cost alternative resources. Edison, in turn, provides Metropolitan with exchange energy, replacement capacity, supplemental power, dynamic control and use of Edison's transmission system.

[28] SB 672, Machado, 2001. California Water Plan: Urban Water Management Plans. (The law amended Section 10620 of, and adds Section 10013 to, the Water Code) September 2001.

[29] SEC. 2. Section 10013 to the Water Code, 10013. (a) SB 672, Machado. California Water Plan: Urban Water Management Plans. September 2001, (Emphasis added.)

[30] California Department of Water Resources, 2005. California Water Plan Update 2005. Bulletin 160-05, California Department of Water Resources, Sacramento, CA.

[31] Metropolitan Water District of Southern California, 2000. *The Regional Urban Water Management Plan for the Metropolitan Water District of Southern California*, p.A.2-3.

[32] "About 1.36 maf per year (34 percent) of the region's average supply is developed locally using groundwater basins and surface reservoirs and diversions to capture natural runoff." Metropolitan Water District of Southern California, 1996, "Integrated Resource Plan for Metropolitan's Colorado River Aqueduct Power Operations", 1996, Vol.1, p.1-2.

[33] MWD estimates that reclaimed water will ultimately produce 190,000 AF of water annually. Metropolitan Water District of Southern California, 1999, "Fact Sheet" at: http://www.mwd.dst.ca.us/docs/fctsheet.htm.

[34] Buros notes that "American government, through creation and funding of the Office of Saline Water (OSW) in the early 1960s and its successor organizations like the Office of Water Research and echnology (OWRT), made one of the most concentrated efforts to develop the desalting industry. The American government actively funded research and development for over 30 years, spending about $300 million in the process. This money helped to provide much of the basic investigation of the different technologies for desalting sea and brackish waters." Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5. This very useful summary is available at http://www.ida.bm/PDFS/Publications/ABCs.pdf

[35] Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5. This very useful summary is available at http://www.ida.bm/PDFS/Publications/ABCs.pdf See also; Buros et al.1980. *The USAID Desalination Manual.* Produced by CH2M HILL International for the U.S. Agency for International Development.

[36] Wangnick,Klaus.1998 *IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts, p.5.

[37] Desalination systems with a unit size of 100 m3/d or more. Figures in original cited as 6,000 mgd.

[38] Wangnick Consulting GMBH (http://www.wangnick.com) maintains a permanent desalting plants inventory and publishes the results biennially in co-operation with the International Desalination Association, as the IDA Worldwide Desalting Plants Inventory Report. Thus far, fifteen reports have been published, with the latest report having data through the end of 1997; and see Wangnick,Klaus.*1998 IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association. The data cited are as of December 31, 1997.

[39] Cited in original as 9,400,000 m3/d.

[40] Wangnick,Klaus.*1998 IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association. (Cited in original in m3d (13,300,000 m3/d).

[41] Wangnick,Klaus.1998 *IDA Worldwide Desalting Plants Inventory Report No.15.*Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts. The United States ranks second in over-all capacity (16 %) with most of the capacity in the RO process used to treat brackish water. The largest plant, at Yuma, Arizona, is not in use.

[42] Wangnick,Klaus.1998. *IDA Worldwide Desalting Plants Inventory Report No.15.* Produced by Wangnick Consulting for International Desalination Association; and Buros, O.K., 2000. *The ABCs of Desalting, International Desalination Association*, Topfield, Massachusetts.

[43] Salinity levels referenced in metric units.

[44] OTV. 1999. "Desalinating seawater." Memotechnique, Planete Technical Section, No. 31 (February), p.1; and Gleick, Peter H. 2000. *The World's Water: 2000-2001*, Island Press, Covelo, p.94.

[45] Gerry Filteau, Separation Processes, Inc., 2386 Faraday Ave., Suite 100, Calsbad, CA 92008, www.spi-engineering.com

California Climate Action Registry General Reporting Protocol

Reporting Entity-Wide Greenhouse Gas Emissions

Version 3.1 | January 2009

Thus, regional/power pool emission factors for electricity consumption can be used to determine emissions based on electricity consumed. If you can obtain verified emission factors specific to the supplier of your electricity, you are encouraged to use those factors in calculating your indirect emissions from electricity generation. If your electricity provider reports an electricity delivery metric under the California Registry's Power/Utility Protocol, you may use this factor to determine your emissions, as it is more accurate than the default regional factor. Utility-specific emission factors are available in the Members-Only section of the California Registry website and through your utility's Power/Utility Protocol report in CARROT.

This Protocol provides power pool-based carbon dioxide, methane, and nitrous oxide emission factors from the U.S. EPA's eGRID database (see Figure III.6.1), which are provided in Appendix C, Table C.2. These are updated in the Protocol and the California Registry's reporting tool, CARROT, as often as they are updated by eGRID.

To look up your eGRID subregion using your zip code, please visit U.S. EPA's "Power Profiler" tool at www.epa.gov/cleanenergy/energy-and-you/how-clean.html.

Fuel used to generate electricity varies from year to year, so emission factors also fluctuate. When possible, you should use emission factors that correspond to the calendar year of data you are reporting. CO_2, CH_4, and N_2O emission factors for historical years are available in Appendix E. If emission factors are not available for the year you are reporting, use the most recently published figures.

U.S. EPA Emissions and Generation Resource Integrated Database (eGRID)

The Emissions & Generation Resource Integrated Database (eGRID) provides information on the air quality attributes of almost all the electric power generated in the United States. eGRID provides search options, including information for individual power plants, generating companies, states, and regions of the power grid. eGRID integrates 24 different federal data sources on power plants and power companies, from three different federal agencies: EPA, the Energy Information Administration (EIA), and the Federal Energy Regulatory Commission (FERC). Emissions data from EPA are combined with generation data from EIA to produce values like pounds per megawatt-hour (lbs/MWh) of emissions, which allows direct comparison of the environmental attributes of electricity generation. eGRID also provides aggregated data to facilitate comparison by company, state or power grid region. eGRID's data encompasses more than 4,700 power plants and nearly 2,000 generating companies. eGRID also documents power flows and industry structural changes.
www.epa.gov/cleanenergy/egrid/index.htm.

Figure III.6.1 eGRID Subregions

Source: eGRID2007 Version 1.1, December 2008 (Year 2005 data).

Project 2

Mission Well Improvement

Project Supporting Documents

ANNUAL REPORT

Upper Los Angeles River Area Watermaster

Re: City of Los Angeles vs. City of San Fernando, et al.

Superior Court Case No. 650079 – County of Los Angeles

WATERMASTER SERVICE

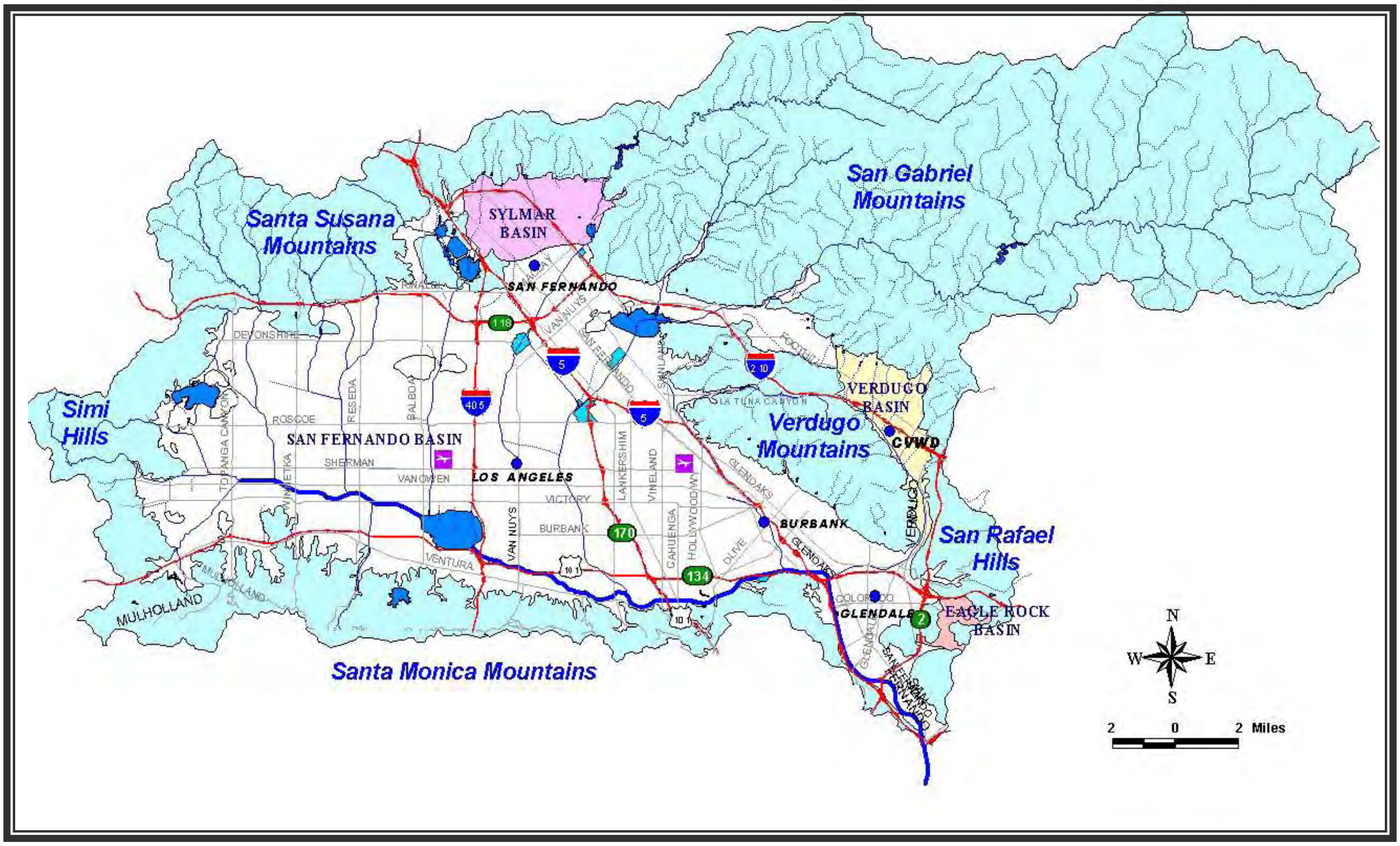
IN THE

UPPER LOS ANGELES RIVER AREA

LOS ANGELES COUNTY, CALIFORNIA

2011-12 WATER YEAR

OCTOBER 1, 2011 – SEPTEMBER 30, 2012



MAY 2013

ANNUAL REPORT
UPPER LOS ANGELES RIVER AREA WATERMASTER

RE: CITY OF LOS ANGELES VS. CITY OF SAN FERNANDO, ET AL.
CASE NO. 650079 - COUNTY OF LOS ANGELES

WATERMASTER SERVICE
IN THE
UPPER LOS ANGELES RIVER AREA (ULARA)
LOS ANGELES COUNTY, CALIFORNIA

2011-12 WATER YEAR
OCTOBER 1, 2011 - SEPTEMBER 30, 2012

ULARA WATERMASTER
Richard C. Slade, PG
Richard C. Slade & Associates LLC

ASSISTANT WATERMASTER
Anthony Hicke, CHG
Richard C. Slade & Associates LLC

GROUNDWATER HYDROLOGY/MODELING STAFF
Hadi Jonny, PE
LADWP

WATERMASTER STAFF AT LADWP

Gregory Reed, PE	Acting Waterworks Engineer
Fatema Akhter	Civil Engineering Associate
Jean Prendergast, PE	Civil Engineering Associate
Araceli Carrillo	Management Analyst
Billie Washington	Clerk Typist

Copies of this report may be viewed and downloaded from the ULARA Watermaster website located at http://ularawatermaster.com/

MAY 2013

TABLE 2-9B: SUMMARY OF 2011-12 WATER SUPPLY AND DISPOSAL SYLMAR BASIN

(Acre-feet)

Water Source and Use	City of Los Angeles	City of San Fernando	All Others	Total
Total Extractions	1,093	3,202	0 [1]	4,295
Imports				
LA Aqueduct Water	4,678	--	--	4,678
MWD Water	4,638	10	--	4,648
Total	**9,316**	**10**	**0**	**9,326**
Exports - Groundwater to San Fernando Basin	1,093	2,914	0	4,007
Total Delivered Water	9,316	298	0	9,614
Water Outflow				
Storm Runoff	5,000 [2]	--	--	5,000
Subsurface	250 [3]	--	--	250
Total	**5,250**	**0**	**0**	**5,250**

1. Pumping for landscape irrigation by Santiago Estates. The well was capped in 1999.
2. Surface outflow is not measured. Estimate based on Mr. F. Laverty – SF Exhibits 57 and 64.
3. Estimated in the Report of Referee, and later revised by the Watermaster.

TABLE 2-9C: SUMMARY OF 2011-12 WATER SUPPLY AND DISPOSAL VERDUGO BASIN

(Acre-feet)

Water Source and Use	Crescenta Valley Water District	City of Glendale	La Canada Irrigation District	City of Los Angeles	Other	Total
Total Extractions	3,090	1,982	---	---	10	5,082
Imports						
LA Aqueduct Water	---	---	---	320		320
MWD Water	1,534	1,966	1,090	317		4,907
Total	1,534	1,966	1,090	637		5,227
Exports to San Fernando Basin	0	316	0	0		316
Delivered Reclaimed Water		261				261
Total Delivered Water	4,624	3,893	1,090	637	10	10,254
Water Outflow						
Storm Runoff (Sta. F-252)					2,662	2,662
Rising Groundwater (Sta. F-252)					2,068	2,068
Subsurface to:						
Monk Hill Basin	---	---	---	---	300	300
San Fernando Basin	---	---	---	---	80	80
Total	**0**	**0**	**0**	**0**	**5,110**	**5,110**

1. Private party extractions.
2. Estimated.
3. Includes rising groundwater.

TABLE 2-10A: CALCULATION OF 2012-13 EXTRACTION RIGHTS SAN FERNANDO BASIN

(Acre-feet)

	City of Burbank	City of Glendale	City of Los Angeles
Total Delivered Water, 2011-12.	20,584	24,491	243,067
Water Delivered to Hill and Mountain Areas, 2011-12	---	---	46,044
Water Delivered to Valley Fill, 2011-12	20,584	24,491	197,023
Percent Recharge Credit	20.0%	20.0%	20.8%
Return Water Extraction Right	4,117	4,898	40,981
Native Safe Yield Credit	---	---	43,660
Annual Extraction Right for the 2012-13 Water Year[1]	**4,117**	**4,898**	**84,641**

1. Does not include Stored Water Credit and Physical Solution.

TABLE 2-10B: CALCULATION OF 2012-13 EXTRACTION RIGHTS SYLMAR BASIN

(Acre-feet)

	City of Los Angeles	City of San Fernando	All Others
Annual Extraction Right for the 2012-13 Water Year[1]	3,570	3,570	--- [2]

1. Does not include Stored Water Credit. The safe yield of the Sylmar Basin was increased to 7,140 AFY effective October 1, 2012. Effective October 1, 1984 safe yield less pumping by Santiago Estates is equally shared by Los Angeles and San Fernando.
2. Santiago Estates (Home Owners Group) capped well in 1999.

TABLE 2-11B: CALCULATION OF "FROZEN" STORED WATER CREDITS SYLMAR BASIN

(Acre-feet)

	City of Los Angeles	City of San Fernando
1. "Frozen" Water Credit (as of Oct. 1, 2011)	9,014	404
2. Extraction Right for the 2011-12 Water Year [1]	3,570	3,570
3. Total 2011-12 Extractions	1,093	3,202
Santiago Estates[2]	0.0	0.0
4. Total Extractions Less Extraction Right (= Item 3 - Item 2)	(2,477)	(368)
5. Remaining "Frozen" Water Credits[3] (as of Oct. 1, 2012)	**9,014**	**404**

1. The safe yield of the Sylmar Basin was increased to 7,140 AFY as of 10/1/12.
2. Santiago Estates pumping is subtracted equally from the rights of San Fernando and Los Angeles. Santiago Estates capped well in 1999.
3. If Item 4 > 0, then Item 4 is deducted from "Frozen" Water Credits, otherwise, "Frozen" Water Credits remain unchanged. Per the Sylmar Basin Safe Yield re-evaluation, "Frozen" Stored Water Credits no longer accumulate, and can only be consumed (See Appendix L)

TABLE 2-11C: CALCULATION OF STORED WATER CREDIT, 5-YEAR METHOD SYLMAR BASIN

(Acre-feet)

Party	Water Year	Annual Extraction Right (AF)	Total Extractions (AF)	Credits Consumed Due to Previous Year Overpumpage	Annual Volume of Accrued Credits (AF)	Remarks
City of Los Angeles	2007-08	3405	2996	0	409	Total extraction was less than annual extraction right.
	2008-09	3405	868	0	2537	Total extraction was less than annual extraction right.
	2009-10	3405	2544	0	861	Total extraction was less than annual extraction right.
	2010-11	3405	964	0	2441	Total extraction was less than annual extraction right.
	2011-12	3570	1093	0	2477	Total extraction was less than annual extraction right.
			STORED WATER CREDITS (5-Year Method) =	8725		
City of San Fernando	2007-08	3405	3670	0	0	Total extraction exceeded annual extraction right by 256 AF.
	2008-09	3405	3473	(256)	0	Total extraction exceeded annual extraction right by 68 AF.
	2009-10	3405	3143	(68)	262	Total extraction was less than annual extraction right.
	2010-11	3405	3082	0	323	Total extraction was less than annual extraction right.
	2011-12	3570	3202	0	368	Total extraction was less than annual extraction right.
			STORED WATER CREDITS (5-Year Method) =	629		

Note: Stored water credits in Table 2-11C are calculated by summing the "Annual Volume of Accrued Credits" column and subtracting the sum of the "Credits Consumed due to Previous Year Overpumpage" column.

f. If a Party plans to pump in excess of its "new" safe yield value in any year, then that Party must notify the Watermaster in advance, or as is reasonably practical. In an emergency situation (such as unusual weather conditions or water system operations problems), and if a Party has no remaining credits, then the Watermaster may consider granting permission to that Party, in writing, to pump in excess of its safe yield so long as the unusual circumstances persist. However, when the unusual circumstances cease, the accumulated overextractions shall be replaced by underpumping within a 6-year period.

g. Pumping by either Party in any given single year cannot exceed its "new" safe yield value of 3570 AF by more than 600 AF. For the sole purpose of consuming "frozen" credits, either Party may exceed its own 600-acre foot allotment in a given year with the prior approval of the Watermaster. However, the sum of the overage extraction by both Parties in any given year must not exceed 1200 AF.

   As part of the determination process, the Watermaster may also communicate between the two Parties to obtain additional facts and information on such issues as the intent and ability of each Party to pump above its safe yield in a given Water Year.

   Based on the available facts, the Watermaster can make a decision to approve with or without conditions, or deny the request. The Watermaster may present the preliminary decision to both Parties and provide an opportunity for the Parties to respond with possible comments. This would be followed by a final, written determination by the Watermaster.

h. Static (non-pumping) water levels must continue to be monitored on a regular basis in all existing wells owned by LADWP and the City of San Fernando, and also in the 2 City-owned groundwater monitoring wells and in the other privately-owned monitoring wells at/near Sylmar notch.

i. Total groundwater production by each city must continue to be monitored on a regular basis in each active well, via a properly installed and accurately calibrated totalizer flow dial near each wellhead.

j. The acquired data are to be reviewed on a regular basis by the Watermaster and then analyzed for possible trends versus total groundwater extractions in the basin and also versus the accumulative rainfall departure curve.

MISSION WELLS FACILITY IMPROVEMENT PROJECT
PHASE II

SCOPE OF WORK DOCUMENT

August 2011

Prepared by:
Los Angeles Department of Water and Power,
Water Engineering and Technical Services Division,
Water Master Planning

2. Design and Construction Plan of Action for New Production Wells
   WQD has selected AECOM to prepare design drawings and specifications for the new groundwater production wells. Design drawings will include a generalized production well configuration diagram showing the expected borehole depth, diameter, well casing and screen locations, filter pack envelopes and annulus grout, and sanitary seal. Specific design parameters for each well will be determined in the field by the on-site hydrogeologist at the time of construction based on geophysical logs of the pilot borehole. The design and specification prepared by AECOM will include all components required below the wellhead, and this package will be advertised by WQD to procure the services of a well drilling contractor. This portion of the work will be managed separately by the Groundwater Management Group.

3. Submersible Pumps
   The three production wells will have an estimated flow rate of 4 cfs per well. Water Operations, Repair and Construction Engineering will be responsible for the selection, procurement, and installation of the submersible pump, motor, cable, and pipe column for each well.

4. Lines and Appurtenances
   Discharge lines which will connect each well to the collector line are shown in Attachment 2. The discharge lines will include required appurtenances such as check valves, isolation valves, and flow meters. The discharge line shall provide the length of uninterrupted pipe section required to ensure accurate measurements by the flow meter. Other ports used to install devices for measuring flow meter accuracy (e.g. pitot tube) shall also be included. Tees will also be installed on each line, with blind flanges, to accommodate connections to future wellhead treatment units.

5. Well Abandonment/Destruction
   Well No. 7 will be destroyed to remove a major contributor of TCE to the blend point for this wellfield. Inactive production Well No. 5 will also be destroyed to reduce the potential for cross contamination and migration of groundwater from the unconfined aquifer into the confined region; other inactive wells may also be destroyed for this same reason. The water quality profile at the blend point for this wellfield should greatly improve as a result of these actions. Water Operations, Repair and Construction Engineering will be responsible for the destruction of these wells.

6. Future Groundwater Treatment
   If contaminants are detected in the future, LADWP may pursue a separate project to install groundwater treatment facilities. This effort will require the completion of California Department of Public Health's

Miluska Propersi

Subject: FW: GLAC P84, Round 3 - RMC Follow-Up Request for Information

---

From: Repp, Chris [mailto:Chris.Repp@ladwp.com]
Sent: Tuesday, June 10, 2014 4:36 PM
To: Miluska Propersi; Ching, Mark
Cc: Lamacchia, Chad; Brian Dietrick; Romy Sharafi; Reed, Greg; Lacombe, Sarah
Subject: RE: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Miluska/Brian,

I spoke with the individual group within LADWP that provides rough estimates on the breakdown between purchased SWP water vs. CRA water. The average is about 85% (SWP) / 15% (CRA).

Regards, Chris (213)367-4736

From: Ching, Mark [mailto:Mark.Ching@ladwp.com]
Sent: Monday, June 09, 2014 8:25 AM
To: Miluska Propersi
Cc: Repp, Chris; Lamacchia, Chad; Brian Dietrick
Subject: RE: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Hi Miluska,

Regarding the conference call, would you like to combine the call with Romy and the Burbank Interconnect Project? It is also our team that is working on that project and we may benefit from hearing each other's questions and concerns.

We are available this afternoon or tomorrow morning for the call, let us know what works for you. If neither, we can try to arrange for another time later this week. Thank you.

Regards,

Mark Ching
213.367.0794

From: Miluska Propersi [mailto:MPropersi@rmcwater.com]
Sent: Friday, June 06, 2014 1:37 PM
To: Ching, Mark
Cc: Repp, Chris; Lamacchia, Chad; Brian Dietrick
Subject: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Dear Mark,

Thank you for working with our team the past couple of weeks to provide information for the Prop. 84, Round 3 grant application. We understand that it can be overwhelming. Because of your responsiveness, we have made incredible progress; and we anticipate that we will have drafts for you to review by mid-June. Note that this is a little later than originally planned.

The reasons we are delaying have to do with the Final PSP that was released on Monday. First, the application deadline has been moved to July 21st (from July 3rd). And second, the Final PSP indicates a few additional items that we will need to develop the best possible grant application.

To help make your life as easy as possible, **I would like to schedule a conference call at your earliest convenience** to walk through this additional request for information and answer any questions you may have. Please let me know when you are available.

The additional information we will need is summarized below:

1. **Detailed Budget** (template and example attached) – Originally we thought this would not be needed until Conditional Acceptance (expected Fall 2014), but now we are realizing that it would be prudent to confirm and document all cost information now. We only need to provide a budget summary by July 21st yet the summary is highly dependent on the detailed costs and reference documents (all of which need to be consistent).
2. **Reference Documents for Detailed Budget –** needed so that RMC can double-check all Budget information
3. **Drought Impacts information** (template attached) – the Final PSP gives more clarification on what DWR is expecting, so we have developed an approach that we could use your input on
4. **Specific Questions Related to the Manhattan Wells Improvement Project**:
    a. What is the percent blend of imported water for your agency (i.e., % SWP and % CRA)?
    b. Can you provide more detail on the container packaged treatment unit. Is this part of a second phase of the project? We want to clarify what the project is and guarantee that benefits will be provided, especially since we say that part of the reason the GW rights aren't used is because of contamination.
    c. How come WRD is administering the contract if LADWP is implementing the project?
    d. For the annual benefits, you indicated a portion (16.7%) will start in 2017 and full benefits will start in 2018. Since construction ends in October 2016, why don't we have the full benefits starting in 2017?
    e. In the "Watermaster Service in the Central Basin, 2009-2013, Table 1" reference, it is not clearly indicated that LADWP pumped 8,920 afy of groundwater from 2009-2013. Is there another table or reference that shows LADWP's pumping amount from 2009-2013 and the APA of 15,000 AFY?

Thanks again for your patience and cooperation in this very important grant process!

Sincerely,

Miluska

Miluska Propersi, P.E.
Water Resources Engineer

RMC Water and Environment
2400 Broadway, Suite 300
Santa Monica, CA 90404
P: 310.566.6460

mpropersi@rmcwater.com | www.rmcwater.com

Complex Challenges | Innovative Solutions

Groundwater Assessment Study

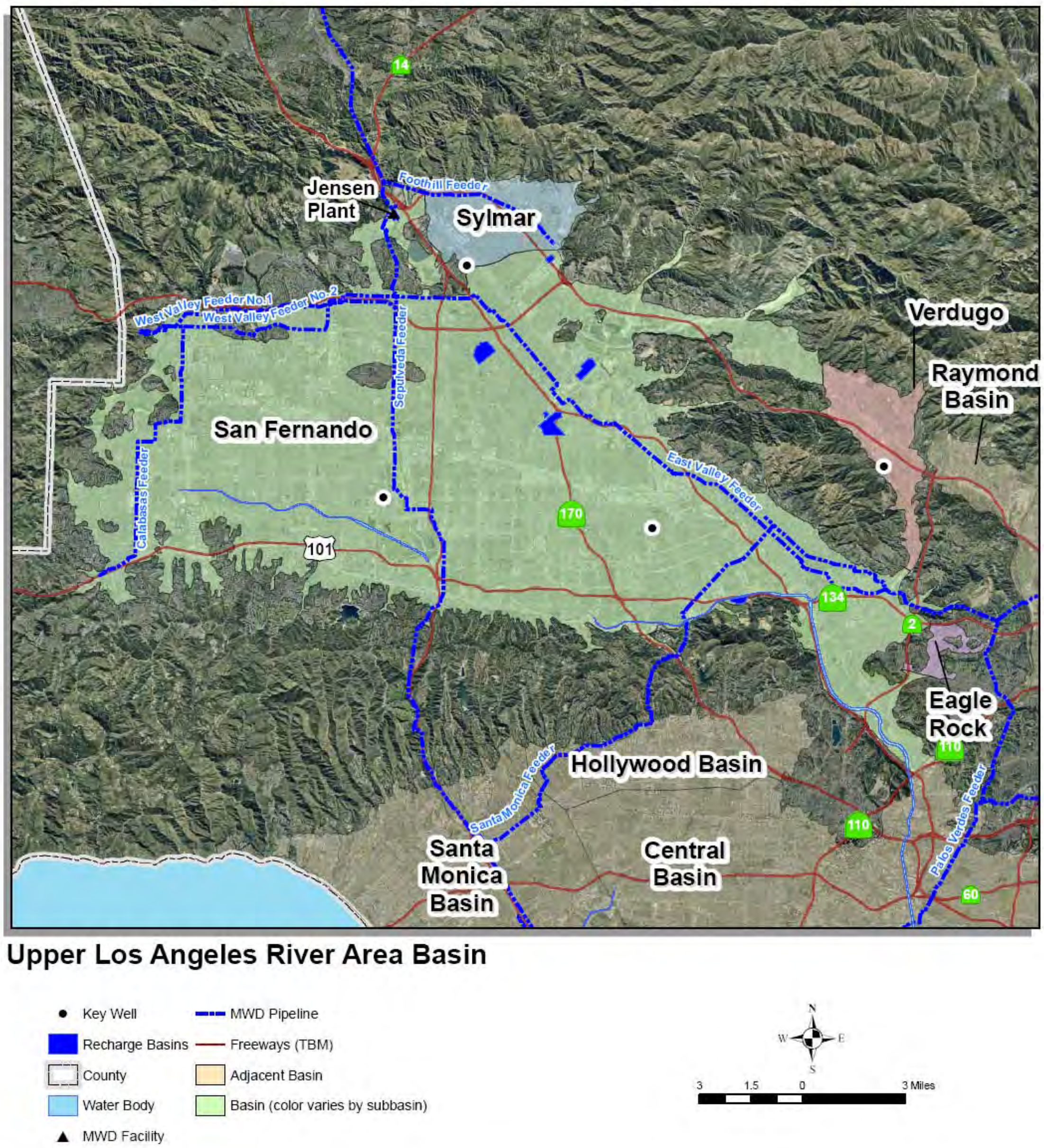
A Status Report on the Use of Groundwater in the Service Area of the Metropolitan Water District of Southern California

Report Number 1308

September 2007

The Upper Los Angeles River Area (ULARA) Basins are located within Los Angeles River Watershed in Los Angeles County. The ULARA Basins include the San Fernando, Sylmar, Verdugo and Eagle Rock Basins and underlie the Metropolitan member agencies of the cities of Los Angeles, San Fernando, Burbank, and Glendale and Foothill Municipal Water District (Foothill MWD). A map of the basins with the ULARA is provided in **Figure 2-1**.

Figure 2-1
Map of the ULARA Basins



BASIN CHARACTERIZATION

The following section provides a physical description of the groundwater basins within the ULARA including their location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The groundwater basins within ULARA are nearly surrounded by impermeable sedimentary, granitic and metamorphic bedrock underlying the surrounding San Gabriel and Santa Monica mountains. **Table 2-1** provides a summary of the characteristics of the ULARA Basins.

The San Fernando Basin, the largest of the four basins within the ULARA, is an unconfined aquifer contained by the Santa Monica Mountains on the south, the Simi Hills to the West, the Santa Susana Mountains to the northwest, and the San Gabriel Mountains and Verdugo Hills on the northeast with a relatively thin finger extending eastward into the Tujunga Canyon between the San Gabriel Mountains and the Verdugo Hills. The Sylmar Basin, is a confined aquifer system separated from the San Fernando Basin by the Sylmar Fault Zone in the underlying geology. The Verdugo Basin is located in Crescenta Valley, a down-dropped block between the San Gabriel Mountains to the northeast, and the Verdugo Mountains to the southwest and east of the groundwater divide that separates it from the finger of the San Fernando Basin in Tujunga Canyon. In contrast to the other nearby groundwater basins, the Verdugo Basin (1) is relatively small in area and relatively steeply sloping, (2) the aquifer units are relatively thin, and (3) the aquifer units have relatively low hydraulic conductivity (Geomatrix, 2005). The smallest basin within the ULARA and least significant in terms of groundwater storage is the Eagle Rock basin, located in the extreme southeastern edge of the San Fernando Basin.

The State Water Rights Board in the Report of the Referee for the Judgment over the ULARA estimated approximately 3.2 million AF of total groundwater storage capacity in the San Fernando Basin. The estimated storage capacities of the Sylmar and Verdugo Basins are 310,000 AF and 160,000 AF, respectively. Considering the relatively insignificant total storage capacity of the Eagle Rock groundwater basin, these combined volumes lead to an estimated total of about 3.67 million AF for the storage capacity of the groundwater basins within the ULARA.

Safe Yield/Long Term Balance of Recharge and Discharge

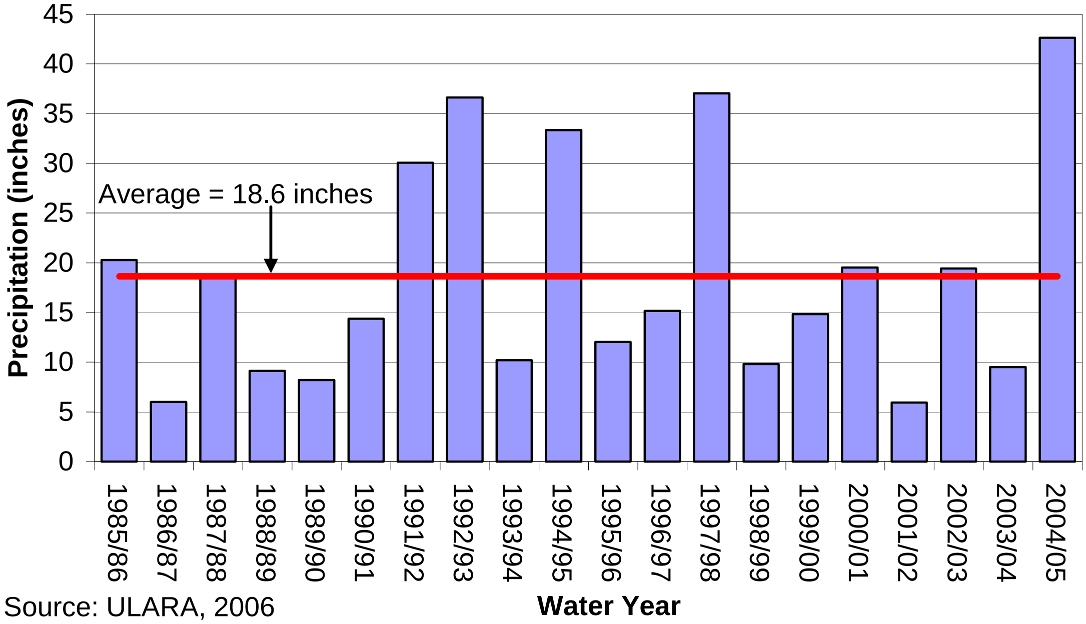
The primary inflows to the ULARA groundwater basins are imported water and natural precipitation and runoff during the rain season. Because the runoff is seasonal in nature, natural recharge is limited. **Figure 2-2** provides the historical precipitation data from the San Fernando Basin between the 1985/86 to 2004/05 water years. Over this time period, rainfall varied between 6 to about 43 inches per year, with an average of about 18.6 inches per year. The data on **Figure 2-2** shows above average precipitation between 1991 and 1993, in 1994/95, in 1997/98, with the highest of about 43 inches occurring in the 2004/05 water year. In contrast, the historical annual precipitation for water years 1949 through 2003 in the Verdugo Basin has ranged from 8.95 to 55.16 inches with a long-term average of 23.37 inches (Geomatrix, 2005).

Table 2-1
Summary of the Hydrogeologic Parameters of the ULARA Basins

Parameter	**Description**
Structure	
Aquifer(s)	Unconfined to confined
Depth of groundwater basin	San Fernando: 0 to 1,200 feet Sylmar: 50 to 6,000 feet Verdugo: 40 to 400 feet Eagle Rock: Data not available
Depth of producing zones or screen intervals	San Fernando: 58 to 800 feet Sylmar: 64 to 435 feet Verdugo: 150 to 400 feet Eagle Rock: Data not available
Yield and Storage	
Native Safe Yield	San Fernando: 43,660 AFY
Safe Yield	San Fernando: 90,680 AFY Sylmar: 6.810 AFY [2] Verdugo: 7,150 AFY Eagle Rock: Negligible
Extraction Rights [1] (2005-06 water year)	San Fernando: 96,838 AFY Sylmar: 6,510 AFY Verdugo: 7,150 AFY Eagle Rock: Negligible
Total Storage	San Fernando: 3.2 million AF Sylmar: 310,000 AF Verdugo: 160,000 AF Eagle Rock: Negligible
Unused Storage Space	Data not available
Portion of Unused Storage Available for Storage.(Following the 2004/05 water year)	San Fernando: 504,475 AF Sylmar: Limited Verdugo: Limited Eagle Rock: Negligible

Source: Watermaster 2006a and Watermaster, 2006b
[1]Does not include stored water credits or physical solution water
[2]Safe yield of Sylmar Basin was increased from 6,510 to 6,810 AFY in December 2006.

Figure 2-2
Historical Precipitation in the ULARA Basins

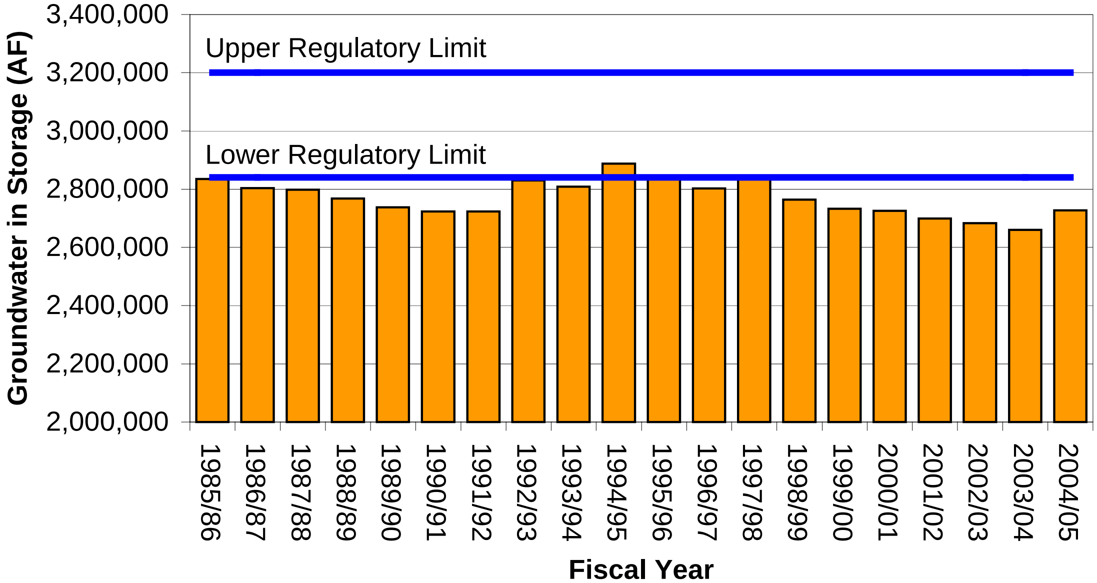


Source: ULARA, 2006

The native safe yield for the ULARA Basins is summarized in **Table 2-1**. These amounts have been fixed by the adjudication of the basins, as discussed below. In the San Fernando Basin, the Judgment (described below) distinguishes between native safe yield (portion of safe yield derived from native waters) and safe yield (includes return flows from imported water), and divides annual extraction rights based on native and imported water origins. The annual extraction right, which is also summarized in **Table 2-1**, includes the native safe yield plus imported water return credits in the San Fernando Basin. The total extraction rights within the ULARA Basins for water year 2005/06 were 110,498 AF (Watermaster, 2006a). At the end of the 2004/05 water year, there were nearly 419,000 AF in stored water credits in the ULARA Basins, increasing the allowable pumping to more than 529,000 AF. As discussed below, stored groundwater can be extracted by the parties in excess of annual pumping rights with approval of the Watermaster.

Figure 2-3 provides a summary of the groundwater in storage in the San Fernando Basin, the largest of the ULARA Basins, from water year 1985/86 to 2004/05. The State Water Rights Board derived a regulatory storage requirement of 360,000 AF for the San Fernando Basin, spanning the interval of 210,000 AF above and 150,000 AF below amount of water in storage in 1954 (2.99 million AF). Despite the heavy rains of the 2004/05 water year, the storage volume at the end of water year 2004/05 was about 113,000 AF below the lowest level of the regulatory storage requirement. Due to the currently depleted groundwater in the San Fernando Basin it is estimated that approximately 504,475 AF (decline in storage since 1928) is available as additional storage capacity (Watermaster, 2006a).

Figure 2-3
Historical Groundwater in Storage Estimates for the San Fernando Basin



GROUNDWATER MANAGEMENT

The following section describes how the ULARA Basins are managed. This discussion includes a brief description of the governing structure and the relationship with other groundwater basins.

Basin Governance

The ULARA Basins are adjudicated. Groundwater production in the ULARA Basins is constrained by the 1979 Final San Fernando Judgment (1979 Judgment) and the 1984 Sylmar Basin Stipulation (1984 Stipulation). This adjudication limits groundwater extraction from all four groundwater basins and established a court appointed Watermaster and Administrative Committee to administer the Court's rulings. The Administrative Committee, as summarized in **Table 2-2,** is made up of a representative from each of the five public agencies overlying the ULARA.

The 1979 Judgment upheld the Pueblo Water Rights of the city of Los Angeles to all groundwater in the San Fernando Basin derived from precipitation within the ULARA and all surface and groundwater underflows from the Sylmar and Verdugo basins (Watermaster, 2005). Furthermore the cities of Burbank, Glendale and Los Angeles were given rights to all San Fernando groundwater derived from water imported by these cities from outside the ULARA and either spread or delivered within the San Fernando Basin. Return credits are granted in the San Fernando Basin. The city of San Fernando was not granted return flow rights in the San Fernando Basin because they where not able to import water until becoming a member of Metropolitan in 1971. The Judgment also contains provisions and stipulations regarding storage of water, stored water credit and arrangements for physical solution water for certain parties (Watermaster, 2006a). There are no storage rights in either the Verdugo or the Eagle Rock Basins.

Under the 1984 Stipulation, the cities of Los Angeles and San Fernando were assigned equal rights to the safe yield of the Sylmar Basin. In 1996, the safe yield was increased from 6,210 AFY to 6,510 AFY. In addition, the safe yield was increased again in December 2006 to 6,810 AFY. These cities also have the right to store groundwater via in-lieu methods and the right to extract equivalent amounts.

Table 2-2
Summary of Management Agencies in the ULARA Basins

Agency	Role
ULARA Watermaster	Overall management authority under the California Superior Court
The City of Burbank	MWD member agency, water retailer and ULARA administrative committee member
The City of Glendale	MWD member agency, water retailer and ULARA administrative committee member
The City of Los Angeles	MWD member agency, water retailer and ULARA administrative committee member. Owns Tujunga Spreading Grounds
The City of San Fernando	MWD member agency, water retailer and ULARA administrative committee member
The Crescenta Valley Water District (CVWD)	Water retailer and ULARA administrative committee member
Los Angeles County Public Works (LACDPW)	Owns and operates spreading facilities

Interactions with Adjoining Basins

Groundwater outflow from the Verdugo Basin into the San Fernando Basin occurs beneath Verdugo Wash at the extreme eastern edge of the ULARA. Groundwater outflow from the ULARA occurs through the Los Angeles River Narrows in the southeast corner of the San Fernando Basin where approximately 400 AF of underflow passes downstream into the Central Basin. In addition, approximately 2,000 to 4,000 AFY of rising groundwater leaves the San Fernando Basin as surface flow into the Central Basin (Watermaster, 2007). An average of about 300 to 400 AF of underflow passes into the Raymond Basin from the Verdugo Basin (DWR, 2004 and Geomatrix, 2005). These flows are accounted for in each basin's adjudication so there are no separate agreements regarding these flows.

WATER SUPPLY FACILITIES AND OPERATIONS

The following section describes the existing water supply facilities in the ULARA Basins. These include 146 groundwater production wells and 314 acres of recharge ponds for groundwater recharge.

Active Production Wells

There are 146 active production wells within the ULARA Basins. A total of 77,995 AF were pumped from the ULARA groundwater basins during the 2004/05 water year. Approximately 94 percent or 73,500 AF of the total volume was pumped from municipal production with the remaining production from private wells. A summary of production from these wells is provided in **Table 2-3**. Historical production is also summarized on **Figure 2-4**.

Table 2-3
Summary of Production Wells in the ULARA Basins

Basin	Number of Wells	Estimated Production Capacity (AFY) [1]	Average Production 1985-2004 (AFY)	Well Operation Cost [2] ($/AF)
San Fernando	122	220,000	88,370	$24 to $165 Average $63 (2004)
Sylmar	6	8,700	5,770	
Verdugo	17	7,400	5,090	Data not available
Eagle Rock	3	230	224	Data not available
Total	**146**	**236,330**	**99,454**	--

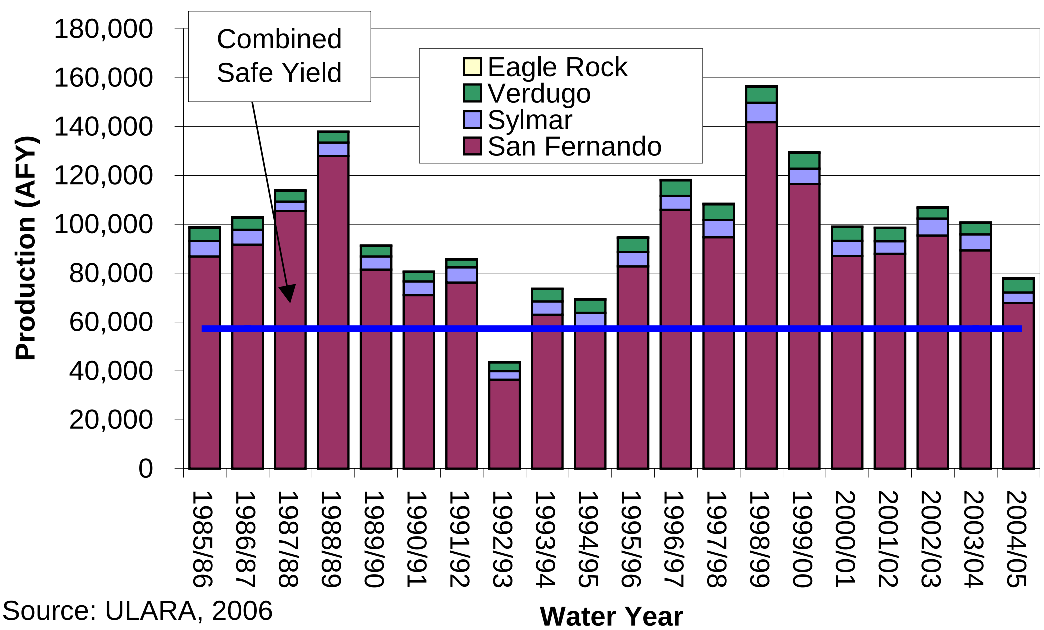
Source: Watermaster, 2006a and 2006b; LA, 2006c
1. Based on maximum annual basin production over the past 5 years for Eagle Rock Basin; Other Basins Watermaster, 2006c, LA, 2006c based upon 10 month per year operation.
2. LA, 2006a

Within the Verdugo Basin, CVWD groundwater production has generally declined since the late-1990s, from about 4,000 AFY in 1999 to about 3,000 AFY in 2002 (Geomatrix, 2005). CVWD pumps groundwater from 11 supply wells in Verdugo Basin. Five wells (6, 8, 10, 12, and 14) pump water to the Glenwood Ion Exchange Nitrate Removal Facility where nitrate is removed from the water. Discharge from five other wells (1, 5, 7, 9, and 11) is pumped without nitrate treatment into the CVWD system. Well 2 is used for standby or emergency supply and is not pumped on an ongoing basis (Geomatrix, 2005).

In the ULARA groundwater basins there were a total of 75 inactive wells. The City of Los Angeles reports that 8 of the inactive wells in the San Fernando groundwater basin are planned to be online within the next 5 years (LA, 2006a).

Table 2-3 also summarizes the general pumping and disinfection costs of municipal production wells in the San Fernando Basin. These costs do not include annual maintenance.

Figure 2-4
Historical Groundwater Production in the ULARA Basins



Source: ULARA, 2006

Other Production

The relatively small percentage of the total production is from private or non-municipal wells as summarized in **Table 2-3**.

ASR Wells

There are no ASR wells reported in the ULARA Basins.

Spreading Basins

Approximately 314 acres of recharge spreading basins are located over the San Fernando Basin with an estimated total capacity of approximately 104,000 AFY, as summarized in **Table 2-4**. The locations of the spreading areas are shown on **Figure 2-1**.

Table 2-4
Summary of Spreading Basins in the ULARA Basins

Spreading Basins	Area (acres)	Recharge Capacity (cfs) [1]	Recharge Capacity (AFY) [1]	Source Water	Owner
Hansen	105	49	35,000	Runoff	LACDPW
Pacoima	107	40	23,000	Runoff	LACDPW
Lopez	12	7	2,000	Runoff	LACDPW
Branford	7	1	1,000	Runoff	LACDPW
Tujunga	83	99	43,000	Runoff	LADWP
Total	**314**	**196**	**104,000**	**--**	**--**

Source: LA, 2006a.

These basins are used for spreading both imported water and surface water diversions, through mostly surface water runoff from the Pacoima, Big Tujunga and Hansen Dams which are operated by LACDPW both as flood control dams as well as to regulate storm flows to allow recapture of the flows in the downstream spreading basins (LA, 2006a; ULARA, 2005).

Figure 2-5 provides a summary of the spreading of surface water runoff to recharge groundwater in the ULARA Basins, principally the San Fernando Basin, over the 1985/86 to 2004/05 water years.

Recharge spreading basins do not currently exist in the Sylmar, Verdugo or Eagle Rock groundwater basins. However, within the Verdugo Basin, modifications and improvements to existing debris basins are being considered in order to retain water and increase the rate of recharge (Geomatrix, 2005).

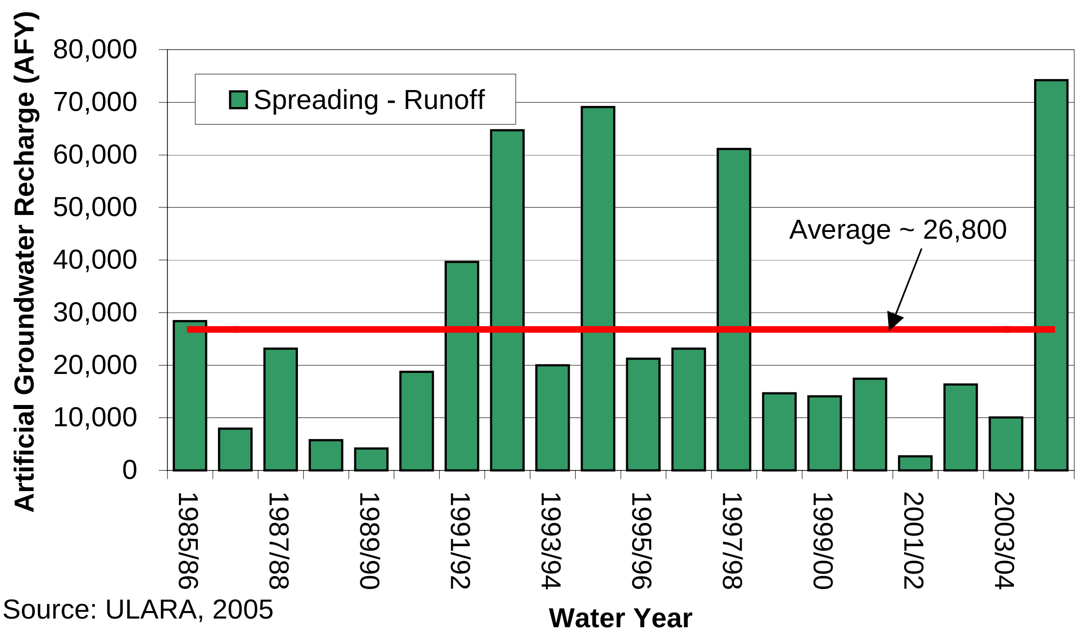
Seawater Intrusion Barriers

There are no seawater intrusion barriers in the ULARA Basins.

Desalters

There are no desalters in the ULARA Basins.

Figure 2-5
Summary of Groundwater Recharge in the ULARA Basins



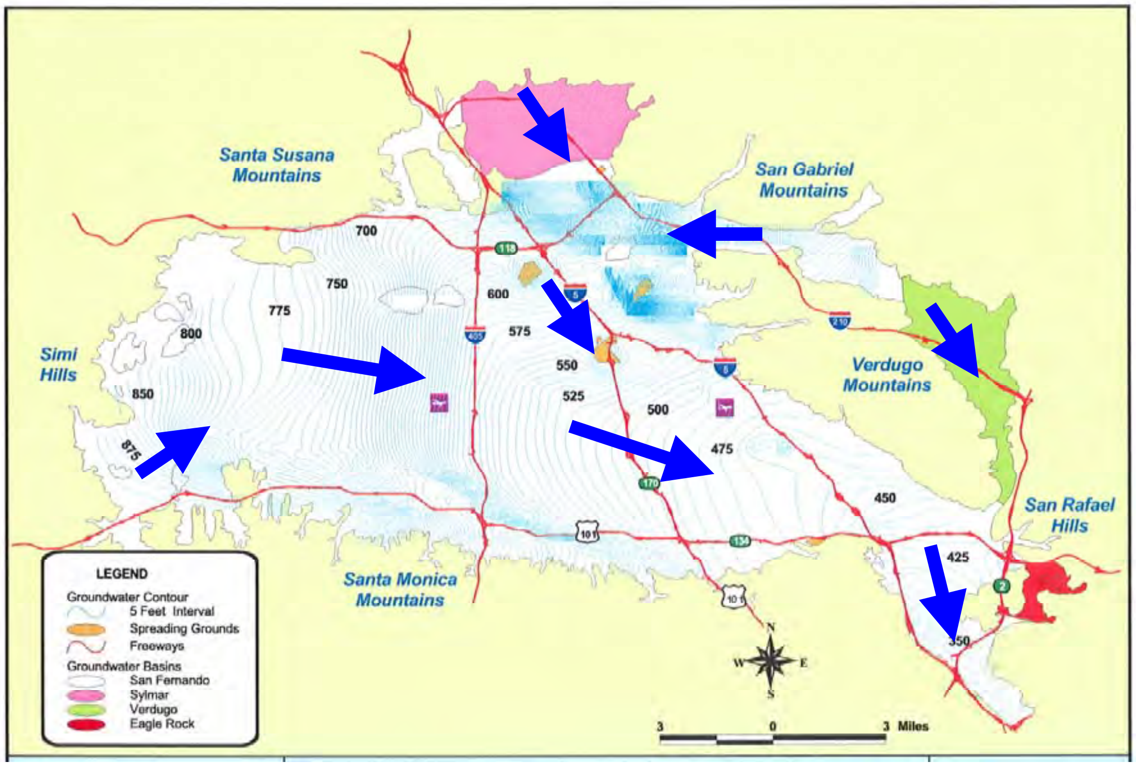
Source: ULARA, 2005

GROUNDWATER LEVELS

The depth to groundwater in the San Fernando, Sylmar, and Verdugo basins range between 24 to 400 feet, 50 to 115 feet, and 17 to 190 feet bgs, respectively. Shallow groundwater conditions are encountered in the western end of the San Fernando Basin. These areas are subject to rising groundwater and high liquefaction potential. However, because of finer sediments and naturally occurring high TDS in this portion of the basin, these areas are not produced. A groundwater contour map during the spring of 2005 is shown in **Figure 2-6**. Groundwater flow is generally from west to east across the majority of the San Fernando Basin. Groundwater flows turns southward in the eastern and southeastern portion of the basin where groundwater flows into the Central Basin. Groundwater flow is generally toward the south-southeast into the San Fernando Basin from the Verdugo and Sylmar Basins as water levels are substantially higher in these basins.

Figures 2-7 and 2-8 show the changes in groundwater level in representative areas within the ULARA from 1985 to 2004. Locally, groundwater levels have risen or remained reasonably constant due to reduction in specific well field production. In other areas, groundwater levels have fallen due to increased production from specific well fields and/or diminished recharge from specific spreading grounds. However, in general, groundwater storage has been steadily declining since the early 1980s in the San Fernando Basin due to heavy pumping, limited artificial recharge and low precipitation. Due to the heavy rains and decreased pumping during water year 2004/05, water levels in the basin have begun to recover, but this effect may be temporary. Despite a positive balance in stored water credits in the San Fernando Basin, groundwater levels and storage continued to decline. This imbalance is being addressed by the pumping parties and the Watermaster.

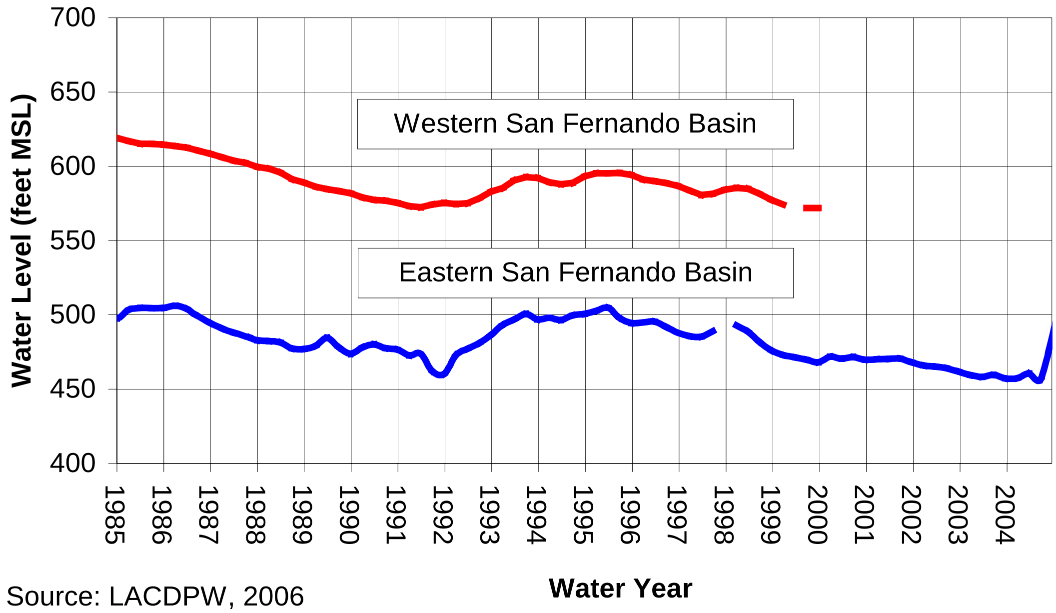
Figure 2-6
Groundwater Contour Map in the ULARA Basins – Spring 2005



Source: ULARA, 2006a

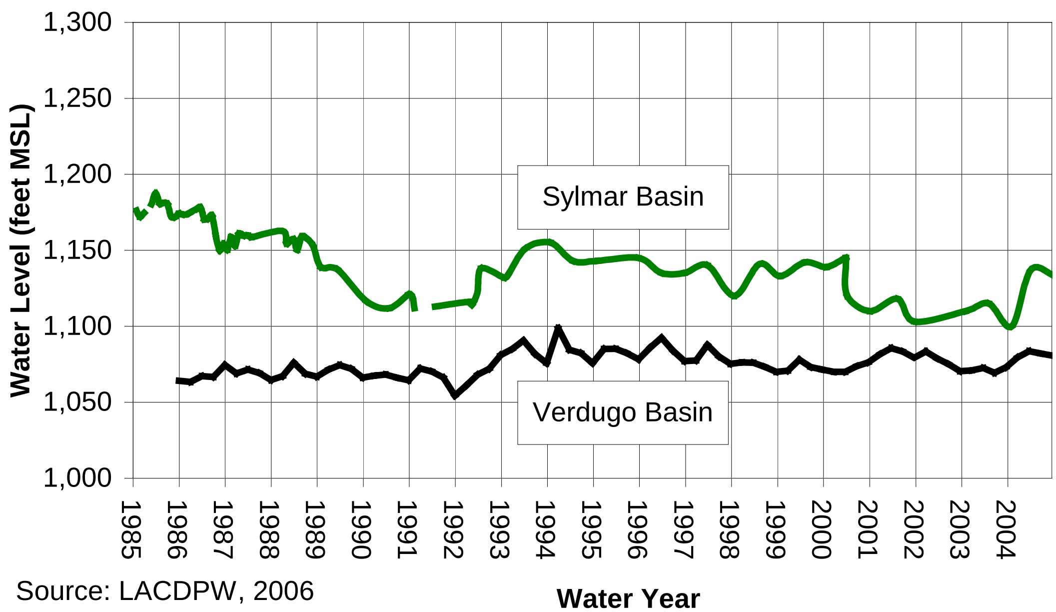
Groundwater levels show seasonal variation in response to precipitation, runoff and pumping. In the Verdugo Basin, depth to groundwater ranged from about 17 to approximately 190 feet below ground surface between 1981 and 2002. Between 1983 and 1992, groundwater level elevations declined following a prolonged dry period and cessation of septic system recharge. A significant rise occurred between 1992 and 1995, along with wetter climatic conditions. Since 1995 groundwater elevations have gradually declined throughout the basin. Water levels in the basin declined in recent years due to lower precipitation and increases in groundwater pumping (Geomatrix, 2005).

Figure 2-7
Historical Water Levels in the San Fernando Basin



Source: LACDPW, 2006

Figure 2-8
Historical Water Levels in the Verdugo and Sylmar Basins



Source: LACDPW, 2006

GROUNDWATER QUALITY

The following provides a brief description of the groundwater quality issues in the ULARA Basins.

Groundwater Quality Monitoring

The various cities and agencies operating municipal wells and responsible parties remediating contaminated groundwater are sampling their wells for water quality on a regular basis and the results are submitted to the California Department of Health Services (DHS) (LA, 2006a). The USEPA also samples approximately 100 monitoring wells in the eastern portion of the San Fernando Basin on a quarterly and annual basis (LA, 2006a). The results are also cataloged and monitored by the ULARA Watermaster and the Regional Board.

Groundwater Contaminants

Groundwater in the ULARA Basins has significant contamination issues. A number of the groundwater production wells are located with the bounds of a Superfund area. Elevated concentrations of volatile organic compounds (VOCs), such as trichloroethylene (TCE) and tetrachloroethylene (PCE), as well as other contaminants, such as hexavalent chromium have prompted the city of Los Angeles to discontinue pumping at numerous production wells. Maps depicting the locations of these plumes and nitrate are shown in **Figure 2-9** through **Figure 2-11** (LA, 2006a and Watermaster, 2006). Emerging contaminants, such as 1,4 dioxane, have also been found in concentrations high enough to necessitate the alteration of groundwater pumping operations. **Table 2-5** summarizes the constituents of concern within the ULARA Basins.

In addition, perchlorate, a constituent of regional concern has been detected in 2 wells above the notification level of 6 µg/L, one in the Sylmar Basin and one in eastern end of the San Fernando Basin. In these areas of contamination, wells have been removed from service or the groundwater is being blended or treated to meet State Drinking Water Standards as discussed below (LA, 2006a). In the San Fernando Basin, the estimated capacity of all the wells that have been removed from service due to elevated contamination levels is approximately 200 cfs or 396 AF/day. In addition to the contaminants in the San Fernando groundwater basin, one well was removed from service in the Sylmar basin due to elevated TCE levels (LA, 2006a).

As discussed in more detail below, continuing efforts to expand groundwater extraction capability, improve groundwater source quality, and treat extracted groundwater are underway in the basin. The USEPA, the Department of Toxic Substances Control, and the Los Angeles Regional Water Quality Control Board are working with the cities of Los Angeles, Glendale, and Burbank to identify and resolve San Fernando Basin contamination concerns. The City of Los Angeles' Department of Water and Power is currently undertaking a comprehensive study of the San Fernando Basin to fully characterize the extent and composition of known and emerging contaminants.

Figure 2-9
Location of VOC Contaminant Plumes in the ULARA Basins

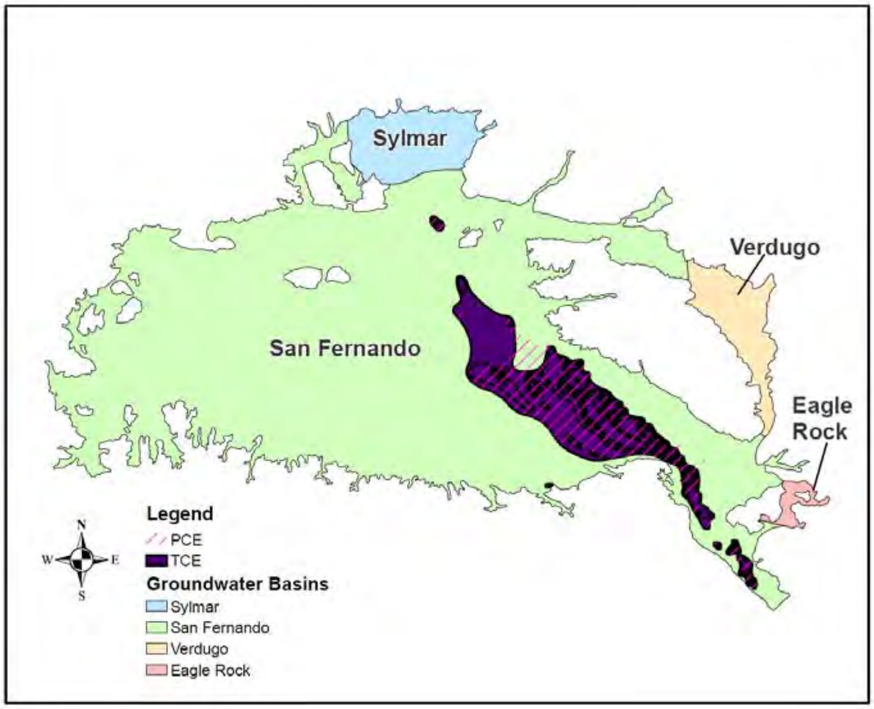


Figure 2-10
Location of Hexavalent Chromium Plumes in the ULARA Basins

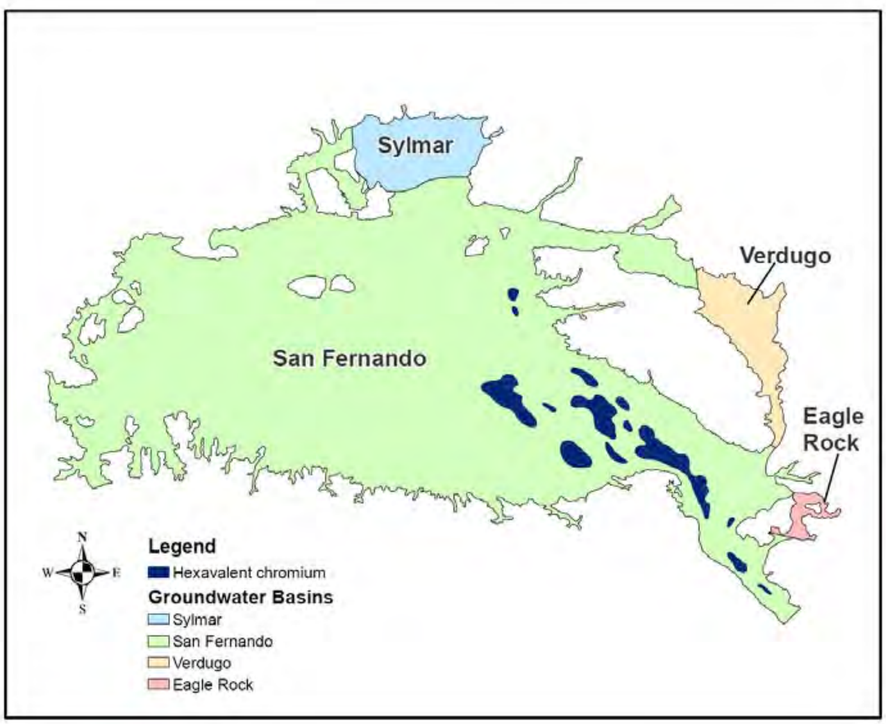
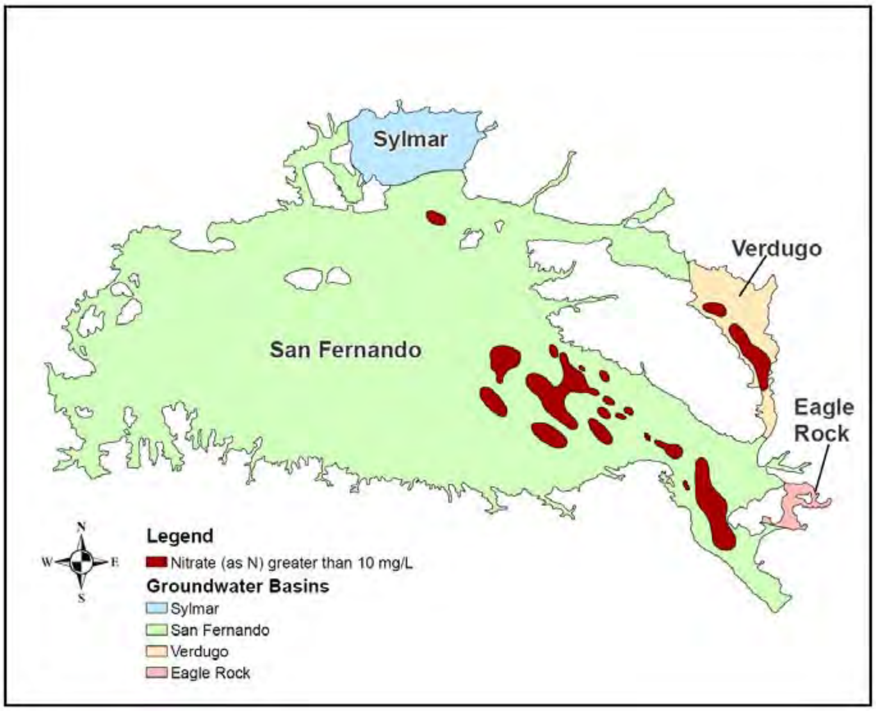


Figure 2-11
Location of Nitrate Plumes in the ULARA Basins



Blending Needs

All the cities and agencies are blending Metropolitan imported water with the groundwater extracted from selected wells to meet water quality standards. For example, the city of Los Angeles has blended imported water with groundwater contaminated with nitrate and VOC extracted from wells within the San Fernando groundwater basin, as summarized below in **Table 2-6**. These data suggest that nearly all the groundwater produced from the San Fernando Basin is blended with other sources of water.

For CVWD, in the Verdugo Basin, imported water purchased from Foothill MWD is received through a connection at the Paschall Blending Station and is blended with groundwater to reduce the nitrate concentration of the delivered water. Imported water is also received via the Briggs Meter Station, and the Ocean View Meter Station. Blending with imported water is used to help manage the nitrate concentration in water delivered to consumers (Geomatrix, 2005).

Groundwater Treatment

The cities of Burbank, Glendale and Los Angeles, and the CVWD are treating groundwater extracted from selected wells to meet water quality standards. For example, the city of Los Angeles operates treatment facilities for VOC-contaminated groundwater from wells in the San Fernando groundwater basin, as summarized below in **Table 2-7** (LA, 2006a). Costs of treatment range from $250 to $288 per AF.

Table 2-5
Summary of Constituents of Concern in the ULARA Basins

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	280 to 729	Highest levels reported in the North Hollywood area of the San Fernando Basin.
Nitrate (as N) Primary MCL = 10	mg/L	2.6 to 79.2	Highest levels reported in the Verdugo Basin and eastern portion of the San Fernando Basin
VOCs **(TCE and PCE)** TCE Primary MCL = 5 PCE Primary MCL = 5	µg/L	<5 to over 100	The highest concentrations in Glendale and Burbank areas of the eastern San Fernando Basin are being treated. Other areas in the San Fernando Basin, which have levels significantly above the MCL, are currently being addressed through treatment or other means, while long-term solutions are being developed.
Total and Hexavalent Chromium Total Cr MCL = 50 Hexavalent Cr MCL = TBD	µg/L	ND to 423	Highest concentrations are in the Burbank and Glendale areas. These areas are currently being investigated. The city of Los Angeles discontinued pumping from one San Fernando Basin production well after total hexavalent chromium levels as high as 423 µg/L were detected.
Perchlorate Notification Level = 6	µg/L	ND to 8.9	Detected in 2 wells above notification level since 2000.

Source: Watermaster, 2006a; Regional Board 2006

In 1987, the USEPA initiated a remedial investigation of VOC (TCE and PCE) contamination in San Fernando and Verdugo basins. Operable Units for long-term groundwater remediation of VOCs have been established in North Hollywood, Burbank, Glendale North, and Glendale South. The operation of these treatment facilities has become more complex with the identification of nearby hexavalent chromium plumes. Remediation treatment facility operations are summarized in **Table 2-7**.

Within the Verdugo Basin, CVWD pumps groundwater from 11 supply wells in Verdugo Basin. Five of the wells pump water to the Glenwood Ion Exchange Nitrate Removal Facility where nitrate is removed from the water (Geomatrix, 2005).

Table 2-6
Summary of Blending Needs in the San Fernando Basin

Agency	Wellfield(s)	Constituent Blended	Average Annual Groundwater Blended (AFY)
City of Los Angeles	Tujunga	Nitrate and VOC(s)	21,778
City of Los Angeles	Rinaldi-Toluca North Hollywood Erwin Verdugo Whitnall	Nitrate and VOC(s)	66,932
City of Los Angeles	Pollock	Nitrate	1,697
Total		**--**	**90,407**

Source: LA, 2006a

Table 2-7
Summary of Groundwater Treatment in the ULARA Basins

Treatment Facility	Constituent Treated	Treatment Type	Amount Treated (AFY)	Comments
North Hollywood Operable Unit	VOC	Air stripping with air phase GAC	1,800 AF in 2002/03 1,228 AF in 2003/04 1,042 AF in 2004/05	Consent decree expired in 2004, but remediation incomplete. Declining water levels resulting in reduced treatment capacity. Concern with intercepting nearby chromium plume.
Burbank Operable Unit	VOC	Aeration and liquid phase GAC	Design capacity of 9,000 gpm 9,660 AF in 2003/04 6,398 AF in 2004/05	Effluent blended with Metropolitan water to reduce nitrate and chromium concentrations Additional well capacity needed to maintain design capacity.
Glendale North and South Operable Units	VOC	Aeration and liquid phase GAC	North: Design capacity of 3,300 gpm South: Design capacity of 1,700 gpm 7,283 AF in 2003/04 7,541 AF in 2004/05	Effluent blended with Metropolitan water

Table 2-7 (continued)
Summary of Groundwater Treatment in the ULARA Basins

Treatment Facility	Constituent Treated	Treatment Type	Amount Treated (AFY)	Comments
Glenwood Nitrate Water Treatment Plant	Nitrate	Ion Exchange	164 AF in 2003/04 782 AF in 2004/05	Operates in Verdugo Basin
Pollock Wells Treatment Plant	VOC	Liquid phase GAC	1,137 AF in 2003/04 1,752 AF in 2004/05	Treats rising groundwater in the Los Angeles River

ULARA Watermaster, 2005, 2006a

CURRENT GROUNDWATER STORAGE PROGRAMS

There are no formal groundwater storage programs in the ULARA Basins. The City of Los Angeles has regularly participated in Metropolitan's in-lieu replenishment program whereby the City takes imported water from Metropolitan at a discounted rate in lieu of pumping groundwater. An average of 10,400 AFY has been recharged via these programs since 1997.

BASIN MANAGEMENT CONSIDERATIONS

Not all of the 3.67 million AF for the storage capacity is usable and limitations are imposed on the volume of extraction. The primary considerations in the management of the ULARA groundwater basins are:

- The 1979 San Fernando Judgment and 1984 Sylmar Basin Stipulation, which limit production from the basin to the native safe yield plus any imported recharge.
- Rising groundwater levels may also increase surface flow losses out of the ULARA through the Los Angeles River Narrows to Central Basin, liquefaction potential and other factors resulting from near surface groundwater levels.
- In the Verdugo Basin, the vadose zone thickness affects the amount of available storage capacity (being reduced during wet periods). The basin's relatively small size and the basin area suitable for recharge also limit the potential storage capacity (Geomatrix, 2005).
- Widespread contamination with VOCs, hexavalent chromium and nitrate may limit the ability to store and extract water in this basin.
- The imbalance between stored water credits and the actual water in storage in the San Fernando Basin is being addressed by the management parties and the Watermaster.

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Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

Energy Intensity of Water Supplies for West Basin Municipal Water District

	af/yr	Percentage of Total Source Type	kWh/af Conveyance Pumping	kWh/af MWD Treatment	kWh/af Recycled Treatment	kWh/af Groundwater Pumping	kWh/af Groundwater Treatment	kWh/af Desalination	kWh/af WBMWD Distribution	Total kWh/af	Total kWh/year
Imported Deliveries											
State Water Project (SWP) [1]	57,559	43%	3,000	44	NA	NA	NA	NA	0	3,044	175,209,596
Colorado River Aqueduct (CRA) [1] (other that replenishment water)	76,300	57%	2,000	44	NA	NA	NA	NA	0	2,044	155,957,200
Groundwater[2]											
natural recharge	19,720	40%	NA	NA	NA	350	0	NA	0	350	6,902,030
replenished with (injected) SWP water [1]	9,367	19%	3,000	44	NA	350	0	NA	0	3,394	31,791,598
replenished with (injected) CRA water [1]	11,831	24%	2,000	44	NA	350	0	NA	0	2,394	28,323,432
replenished with (injected) recycled water	8,381	17%	205	0	790	350	0	NA	220	1,565	13,116,278
Recycled Water											
West Basin Treatment, Title 22	21,506	60%	205	NA	0	NA	NA	NA	285	490	10,537,940
West Basin Treatment, RO	14,337	40%	205	NA	790	NA	NA	NA	285	1,280	18,351,360
	35,843										
Ocean Desalination	20,000	100%	200	NA	NA	NA	NA	3,027	460	3,687	82,588,800

Notes:

NA Not applicable

1 Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

2 Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

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NEWS RELEASE

WEST INFORMATION OFFICE
San Francisco, Calif.

For release Tuesday, May 20, 2014 **14-910-SAN**

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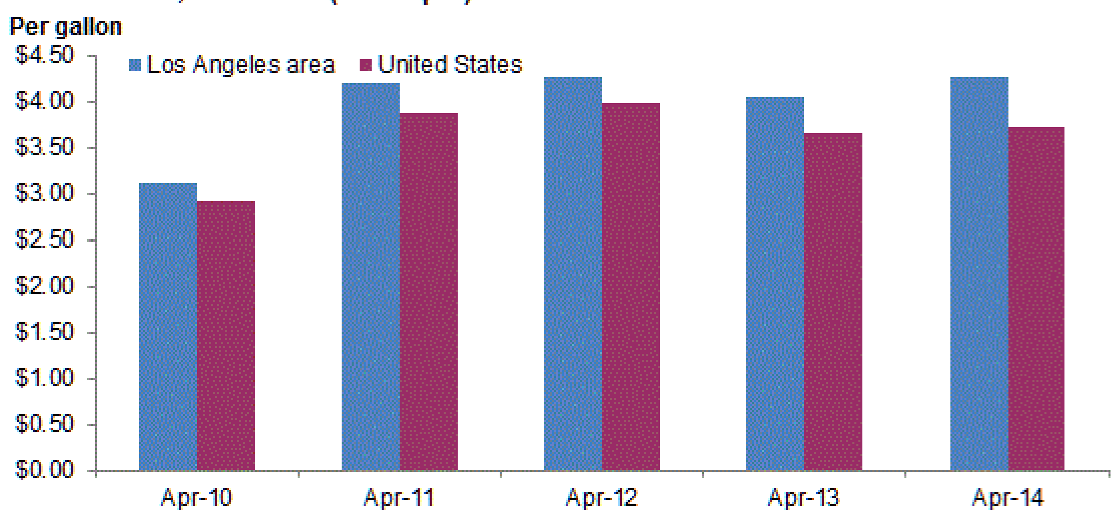
AVERAGE ENERGY PRICES, LOS ANGELES-RIVERSIDE-ORANGE COUNTY APRIL 2014

Gasoline prices averaged $4.263 a gallon in the Los Angeles-Riverside-Orange County area in April 2014, the U.S. Bureau of Labor Statistics reported today. Regional Commissioner Richard J. Holden noted that area gasoline prices were down 22.0 cents compared to last April when they averaged $4.043 per gallon. Los Angeles area households paid an average of 17.8 cents per kilowatt hour (kWh) of electricity in April 2014, down from 21.6 cents per kWh in April 2013. The average cost of utility (piped) gas at $1.211 per therm in April was more than the 1.077 cents per therm spent last year. (Data in this release are not seasonally adjusted; accordingly, over-the-year-analysis is used throughout.)

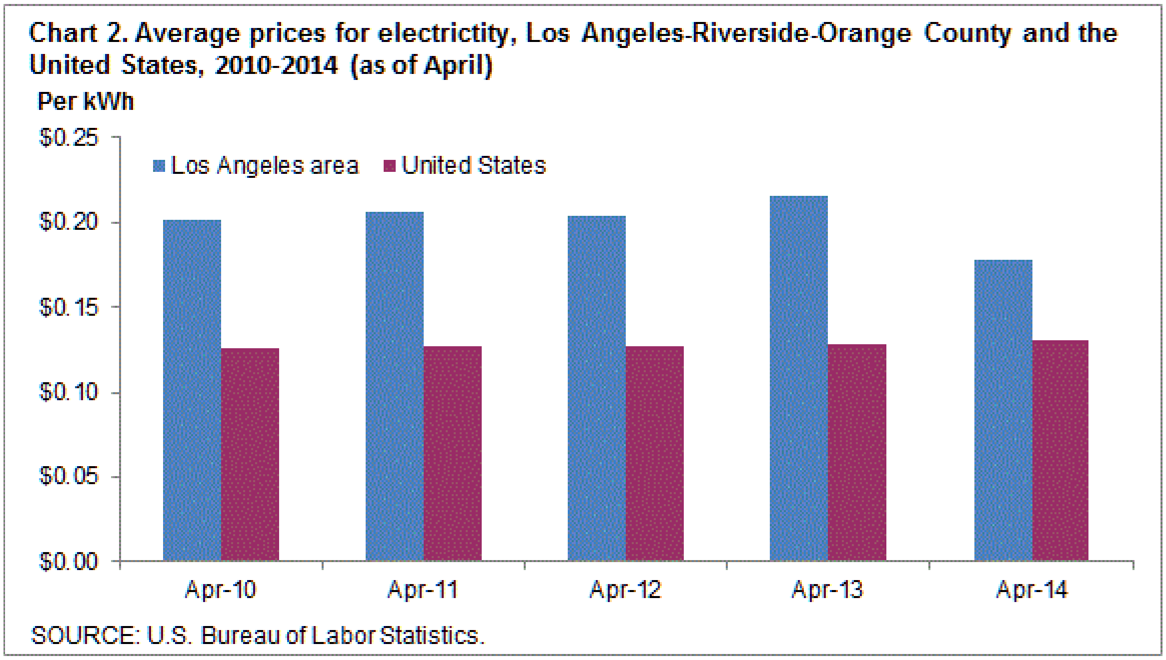
At $4.263 a gallon, Los Angeles area consumers paid 14.7 percent more than the $3.717 national average in April 2014. A year earlier, consumers in the Los Angeles area paid 10.9 percent more than the national average for a gallon of gasoline. The local price of a gallon of gasoline has exceeded the national average by at least 6 percent in the month of April in each of the past five years. (See chart 1.)

Chart 1. Average prices for gasoline, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)

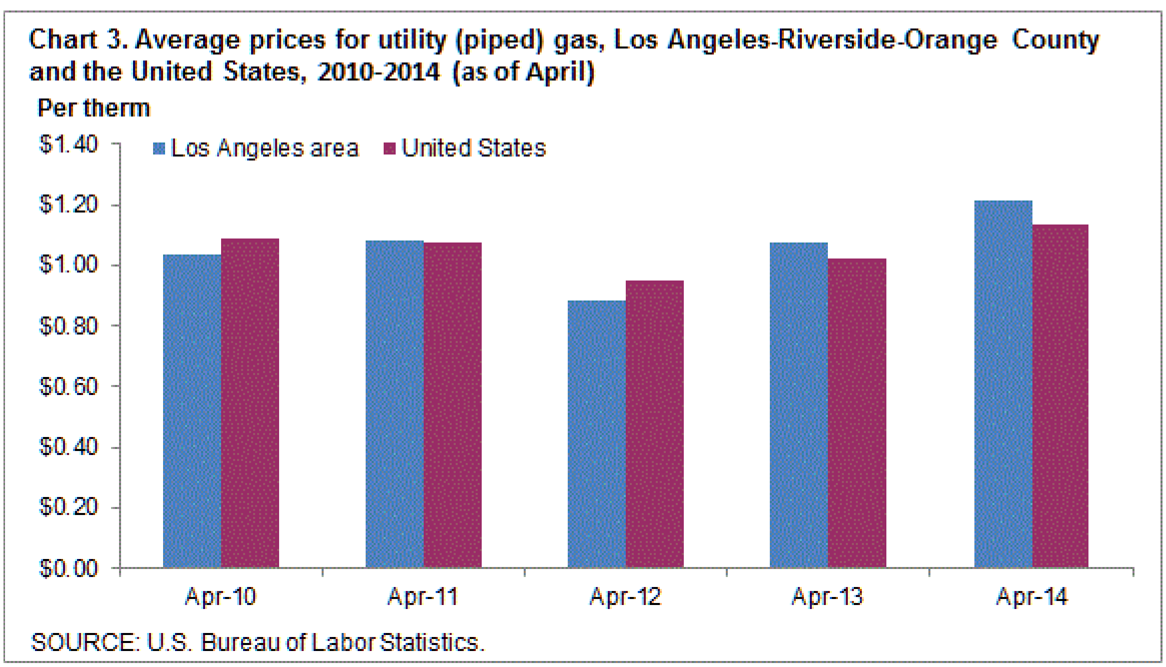


SOURCE: U.S. Bureau of Labor Statistics.

The 17.8 cents per kWh Los Angeles households paid for electricity in April 2014 was 35.9 percent more than the nationwide average of 13.1 cents per kWh. Last April, electricity costs were 68.8 percent higher in Los Angeles compared to the nation. In the past five years, prices paid by Los Angeles area consumers for electricity exceeded the U.S. average by 35.9 percent or more in the month of April. (See chart 2.)



Prices paid by Los Angeles area consumers for utility (piped) gas, commonly referred to as natural gas, were $1.211 per therm, or 6.5 percent more compared to the national average in April 2014 ($1.137 per therm). A year earlier, area consumers paid 5.6 percent more per therm for natural gas compared to the nation. In the Los Angeles area over the past five years, the per therm cost for natural gas in April has varied between 7.2 percent below and 6.5 percent above the U.S. average.
(See chart 3.)



The Los Angeles-Riverside-Orange County, Calif. metropolitan area consists of Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties in California.

Technical Note

Average prices are estimated from Consumer Price Index (CPI) data for selected commodity series to support the research and analytic needs of CPI data users. Average prices for electricity, utility (piped) gas, and gasoline are published monthly for the U.S. city average, the 4 regions, the 3 population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For electricity, average prices per kilowatt-hour (kWh) and per 500 kWh are published. For utility (piped) gas, average prices per therm, per 40 therms, and per 100 therms are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published as well as the average price across all grades.

Price quotes for 40 therms and 100 therms of utility (piped) gas and for 500 kWh of electricity are collected in sample outlets for use in the average price programs only. Since they are for specified consumption amounts, they are not used in the CPI. All other price quotes used for average price estimation are regular CPI data.

With the exception of the 40 therms, 100 therms, and 500 kWh price quotes, all eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity.

The average price per kilowatt-hour represents the total bill divided by the kilowatt-hour usage. The total bill is the sum of all items applicable to all consumers appearing on an electricity bill including, but not limited to, variable rates per kWh, fixed costs, taxes, surcharges, and credits. This calculation also applies to the average price per therm for utility (piped) gas.

Information from this release will be made available to sensory impaired individuals upon request. Voice phone: 202-691-5200, Federal Relay Service: 800-877-8339.

Table 1. Average prices for gasoline, electricty, and utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, April 2013-April 2014, not seasonally adjusted

	Gasoline per gallon		Electricity per kWh		Utillity (piped) gas per therm	
	Los Angeles area	United States	Los Angeles area	United States	Los Angeles area	United States
2013						
April	$4.043	$3.647	$0.216	$0.128	$1.077	$1.020
May	4.060	3.682	0.216	0.131	1.200	1.036
June	4.073	3.693	0.203	0.137	1.275	1.038
July	4.115	3.687	0.203	0.137	1.239	1.025
August	3.955	3.658	0.203	0.137	1.230	1.003
September	4.008	3.616	0.203	0.137	1.183	1.000
October	3.767	3.434	0.215	0.132	1.175	0.999
November	3.651	3.310	0.215	0.130	1.113	0.999
December	3.661	3.333	0.220	0.131	1.109	0.998
2014						
January	3.665	3.378	0.215	0.134	1.195	1.040
February	3.812	3.422	0.215	0.134	1.236	1.078
March	4.046	3.590	0.215	0.135	1.321	1.154
April	4.263	3.717	0.178	0.131	1.211	1.137

Mission Wells Improvement Project - Energy Calculations

Table 1 (3,077 AFY)	Sylmar Basin			Reference/Notes
Information	Groundwater Pumping Cost (2004):	$63	per acre-foot	http://www.mwdh2o.com/mwdh2o/pages/yourwater/supply/groundwater/gwas.html
	Groundwater Pumping Cost (2014):	$86	per acre-foot	
	Average Annual Imported Water Offset	3,077	AFY	
	From SWP	2,615	85%	Per LADWP Communication
	From CRA	462	15%	Per LADWP Communication
	Lifespan of Project	50	Years	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	SWP Energy Required for Conveyance and Pumping	3,000	kWh/AF	
	CRA Energy Required for Conveyance and Pumping	2,000	kWh/AF	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
Calculated	Energy Required to Pump GW	483.1	kWh/AF	
	Net Energy Savings	2,367	kWh/AF	
	Energy Conserved with Project Annually	7,282,810	kWh/year	Column d; 2014-2031
	Energy Used to Import Water (Without Project)	8,769,450	kWh/year	Column b
	Energy Used to Pump GW (With Project)	1,486,640	kWh/year	Column c; 2014-2031
	Energy Conserved over Lifespan	364,140,478	kWh	

Table 2 (2,477 AFY)	Sylmar Basin			
Information	Groundwater Pumping Cost (2004):	$63	per acre-foot	
	Groundwater Pumping Cost (2014):	$86	per acre-foot	
	Average Annual Imported Water Offset	2,477	AFY	
	From SWP	2,105	85%	Per LADWP Communication
	From CRA	372	15%	Per LADWP Communication
	Lifespan of Project	50	Years	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	SWP Energy Required for Conveyance and Pumping	3,000	kWh/AF	
	CRA Energy Required for Conveyance and Pumping	2,000	kWh/AF	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
Calculated	Energy Required to Pump GW	483.1	kWh/AF	
	Net Energy Savings	2,367	kWh/AF	
	Energy Conserved with Project Annually	5,862,697	kWh/year	
	Energy Used to Import Water (Without Project)	7,059,450	kWh/year	
	Energy Used to Pump GW (With Project)	1,196,753	kWh/year	Part of Column c; 2032-2066
	Energy Conserved over Lifespan	293,134,860	kWh	

Table 3 (600 AFY)	Sylmar Basin			
Information	Groundwater Pumping Cost (2004):	$63	per acre-foot	
	Groundwater Pumping Cost (2014):	$86	per acre-foot	
	Average Annual Imported Water Offset	600	AFY	
	From SWP	510	85%	Per LADWP Communication
	From CRA	90	15%	Per LADWP Communication
	Lifespan of Project	50	Years	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	SWP Energy Required for Conveyance and Pumping	3,000	kWh/AF	
	CRA Energy Required for Conveyance and Pumping	2,000	kWh/AF	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
Calculated	Energy Required to Pump GW	483.1	kWh/AF	
	Net Energy Savings	2,367	kWh/AF	
	Energy Conserved with Project Annually	1,420,112	kWh/year	
	Energy Used to Import Water (Without Project)	1,710,000	kWh/year	Part of Column c; 2032-2066
	Energy Used to Pump GW (With Project)	289,888	kWh/year	
	Energy Conserved over Lifespan	71,005,618	kWh	

		kWh/AF	
Without Project	Energy to import 3077 AFY	8,769,450	See Table 1
2017-2031	Energy to pump 3077 AFY	1,486,640	See Table 1
	Energy to import 600 AFY	1,710,000	See Table 3
2032-2066	Energy to pump 2477 AFY	1,196,753	See Table 2
	Total energy Used	2,906,753	

			kWh/AF
2017-2031 Energy Saved	7,282,810	Saved for 15 years	109,242,143
2032-2066 Energy Saved	5,862,697	Saved for 35 years	205,194,402
			314,436,545

Mission Wells Improvement Project - Greenhouse Gas Calculations

Table 1 (3,077 AFY)	Sylmar Basin			Reference/Notes
Given Information	Groundwater Pumping Cost:	$63.0	per acre-foot	
	Groundwater Pumping Cost (2014):	$86.0	per acre-foot	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	See energy calcs
	Average Annual Imported Water Offset	3,077	AFY	
	Lifespan of Project	50	Years	
	Energy Required to Pump GW	483.1	kWh/AF	
	Conversion Factor	0.724	lbs of CO_2/kWh	
	Net Energy Savings	2,367	kWh/AF	
GHG Emissions Avoided	Net Energy Savings x Conversion Factor	1,714	lbs CO_2/AF	
	Net Energy Savings Converted to Metric Tons	0.777	metric tons/AF	
	Avoided Carbon Emissions Annually	2,392	metric tons	
	Avoided Emissions Over Lifespan	119,583	metric tons	
GHG Emissions to Import Water	Energy Required for Importing x Conv. Factor	2,063	lbs CO_2/AF	
	Energy Required for Importing Conv. To Met Tons	0.936	metric tons/AF	
	GHG Emissions to Import Water Annually (Without Project)	2,880	metric tons	Column b
GHG Emissions to Pump GW	Energy Required for GW Pumping x Conv Factor	350	lbs CO_2/AF	
	Energy Required for GW Pumping Conv. to Met Tons	0.159	metric tons/AF	
	GHG Emissions to Pump GW Annually (With Project)	488	metric tons	Column c (2017-2031)

Table 2 (2,477 AFY)	Sylmar Basin			
Given Information	Groundwater Pumping Cost:	$63.0	per acre-foot	
	Groundwater Pumping Cost (2014):	$86.0	per acre-foot	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
	Average Annual Imported Water Offset	2,477	AFY	
	Lifespan of Project	50	Years	
	Energy Required to Pump GW	483.1	kWh/AF	
	Conversion Factor	0.724	lbs of CO_2/kWh	
	Net Energy Savings	2,367	kWh/AF	
GHG Emissions Avoided	Net Energy Savings x Conversion Factor	1,714	lbs CO_2/AF	
	Net Energy Savings Converted to Metric Tons	0.777	metric tons/AF	
	Avoided Carbon Emissions Annually	2,392	metric tons	
	Avoided Emissions Over Lifespan	119,583	metric tons	
GHG Emissions to Import Water	Energy Required for Importing x Conv. Factor	2,063	lbs CO_2/AF	
	Energy Required for Importing Conv. To Met Tons	0.936	metric tons/AF	
	GHG Emissions to Import Water Annually (Without Project)	2,318	metric tons	
GHG Emissions to Pump GW	Energy Required for GW Pumping x Conv Factor	350	lbs CO_2/AF	
	Energy Required for GW Pumping Conv. to Met Tons	0.159	metric tons/AF	
	GHG Emissions to Pump GW Annually (With Project)	393	metric tons	Part of Column c; 2032-2066

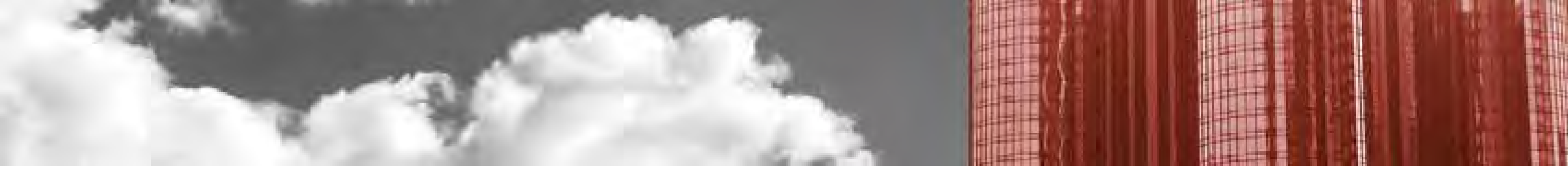
Table 3 (600 AFY)	Sylmar Basin			
Given Information	Groundwater Pumping Cost:	$63.0	per acre-foot	
	Groundwater Pumping Cost (2014):	$86.0	per acre-foot	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
	Average Annual Imported Water Offset	600	AFY	
	Lifespan of Project	50	Years	
	Energy Required to Pump GW	483.1	kWh/AF	
	Conversion Factor	0.724	lbs of CO_2/kWh	
	Net Energy Savings	2,367	kWh/AF	
GHG Emissions Avoided	Net Energy Savings x Conversion Factor	1,714	lbs CO_2/AF	
	Net Energy Savings Converted to Metric Tons	0.777	metric tons/AF	
	Avoided Carbon Emissions Annually	2,392	metric tons	
	Avoided Emissions Over Lifespan	119,583	metric tons	
GHG Emissions to Import Water	Energy Required for Importing x Conv. Factor	2,063	lbs CO_2/AF	
	Energy Required for Importing Conv. To Met Tons	0.936	metric tons/AF	
	GHG Emissions to Import Water Annually (Without Project)	562	metric tons	Part of Column c; 2032-2066
GHG Emissions to Pump GW	Energy Required for GW Pumping x Conv Factor	350	lbs CO_2/AF	
	Energy Required for GW Pumping Conv. to Met Tons	0.159	metric tons/AF	
	GHG Emissions to Pump GW Annually (With Project)	95	metric tons	

		metric tons		
Without Project	GHG emitted to import 3077 AFY	2,880	See Table 1	
2017-2031	GHG emitted to pump 3077 AFY	488	See Table 1	
2032-2066	GHG emitted to import 600 AFY	562	See Table 3	
	GHG emitted to pump 2477 AFY	393	See Table 2	
	Total GHGs emitted	955		
				metric tons
	2017-2031 GHG not emitted	2,392	Saved for 35 years	35,875
	2032-2066 GHG not emitted	1,925	Saved for 15 years	67,386
				103,261


California Climate Action Registry General Reporting Protocol

Reporting Entity-Wide Greenhouse Gas Emissions

Version 3.1 | January 2009



Thus, regional/power pool emission factors for electricity consumption can be used to determine emissions based on electricity consumed. If you can obtain verified emission factors specific to the supplier of your electricity, you are encouraged to use those factors in calculating your indirect emissions from electricity generation. If your electricity provider reports an electricity delivery metric under the California Registry's Power/Utility Protocol, you may use this factor to determine your emissions, as it is more accurate than the default regional factor. Utility-specific emission factors are available in the Members-Only section of the California Registry website and through your utility's Power/Utility Protocol report in CARROT.

This Protocol provides power pool-based carbon dioxide, methane, and nitrous oxide emission factors from the U.S. EPA's eGRID database (see Figure III.6.1), which are provided in Appendix C, Table C.2. These are updated in the Protocol and the California Registry's reporting tool, CARROT, as often as they are updated by eGRID.

To look up your eGRID subregion using your zip code, please visit U.S. EPA's "Power Profiler" tool at www.epa.gov/cleanenergy/energy-and-you/how-clean.html.

Fuel used to generate electricity varies from year to year, so emission factors also fluctuate. When possible, you should use emission factors that correspond to the calendar year of data you are reporting. CO_2, CH_4, and N_2O emission factors for historical years are available in Appendix E. If emission factors are not available for the year you are reporting, use the most recently published figures.

U.S. EPA Emissions and Generation Resource Integrated Database (eGRID)

The Emissions & Generation Resource Integrated Database (eGRID) provides information on the air quality attributes of almost all the electric power generated in the United States. eGRID provides search options, including information for individual power plants, generating companies, states, and regions of the power grid. eGRID integrates 24 different federal data sources on power plants and power companies, from three different federal agencies: EPA, the Energy Information Administration (EIA), and the Federal Energy Regulatory Commission (FERC). Emissions data from EPA are combined with generation data from EIA to produce values like pounds per megawatt-hour (lbs/MWh) of emissions, which allows direct comparison of the environmental attributes of electricity generation. eGRID also provides aggregated data to facilitate comparison by company, state or power grid region. eGRID's data encompasses more than 4,700 power plants and nearly 2,000 generating companies. eGRID also documents power flows and industry structural changes.
www.epa.gov/cleanenergy/egrid/index.htm.

Figure III.6.1 eGRID Subregions

Source: eGRID2007 Version 1.1, December 2008 (Year 2005 data).

Project 3

Manhattan Well Improvement Project

Supporting Documents

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2002 - June 30, 2003

October 2003

GRAY DAVIS Governor State of California	MARY D. NICHOLS Secretary for Resources The Resources Agency	MICHAEL J. SPEARS Interim Director Department of Water Resources

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2002-03 (acre-feet)

Party	(1) Sales * 2002-03	(2) Allowed Pumping Allocation 2002-03	(3) Carryover from 2001-02	(4) Leases* With Flex	(5) Leases* Without Flex	(6) Allowable Extraction (2) thru (5)	(7) Amount Pumped	(8) In-Lieu	(9) Balance (6)-(7)-(8)	Allowable Carryover into 2003-04 Drought	Allowable Carryover into 2003-04 Normal	Allowable Carryover into 2003-04 Total	
Emoto, John H		2.00	20.00			22.00	0.00		22.00		20.00	20.00	
Engler Rentals I		8.00	0.00	-8.00		0.00	0.00		0.00		0.00	0.00	
Equilon Enterprises, LLC		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Farmers & Merchants Trust Co of L B		14.00	14.00			28.00	0.00		28.00		20.00	20.00	
Filtrol Corp		456.00	0.00			456.00	0.00		456.00		91.20	91.20	
Flesch, Elizabeth, et al		14.00	0.00			14.00	0.00		14.00		14.00	14.00	
Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00	
Frampton, William H		25.00	36.42			61.42	14.55		46.87	16.42	20.00	36.42	
G N B, Inc		62.00	20.00			82.00	0.00		82.00		20.00	20.00	
Golden West Refining Co	-60.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	c/
Gordon, Robert E		4.00	14.89			18.89	0.68		18.21	0.80	17.41	18.21	
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
Great Western Malting Co	-358.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	b/
Harada Brothers		6.00	0.00			6.00	0.00		6.00		6.00	6.00	
Hathaway, John J	8.00	8.00	0.00			8.00	0.00		8.00		8.00	8.00	d/
Hathaway, J Benjamin & NTBCA, Trustees	-8.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	d/
Hathaway, Julian I & Helen M, Trustees		8.00	20.00			28.00	1.15		26.85		20.00	20.00	
Hathaway Family Qtip Trust		11.11	0.00			11.11	0.00		11.11		11.11	11.11	
Hathaway Family Survivor's Trust		11.11	0.00			11.11	0.00		11.11		11.11	11.11	
Huntington Park, City of		3,853.00	-148.41		630.00	4,334.59	4,664.67		-330.08		-330.08	-330.08	
Inglewood Park Cemetery		317.00	20.00	-317.00		20.00	0.00		20.00		20.00	20.00	
Jefferson Smurfit Corp (US)		1,058.00	254.57			1,312.57	780.44		532.13	42.97	211.60	254.57	
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
Kal Kan Foods, Inc		140.00	0.00			140.00	0.00		140.00		28.00	28.00	
King Kelly Marmalade Co, Inc		22.00	17.48	-15.00		24.48	9.56		14.92		14.92	14.92	
Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00		0.00	0.00	
La Habra Heights County Water District		2,498.00	124.38			2,622.38	2,607.95		14.43		14.43	14.43	
La Hacienda Water Co		1.00	0.00			1.00	0.00		1.00		1.00	1.00	
Lakewood, City of	60.00	9,423.00	1,556.13			10,979.13	9,102.07		1,877.06	0.59	1,876.47	1,877.06	c/
Lincoln Memorial Park, Inc		34.00	72.16			106.16	21.85		84.31	52.16	20.00	72.16	
Little Lake Cemetery District		14.00	11.42			25.42	10.20		15.22		15.22	15.22	
Long Beach, City of		32,684.00	6,598.09	285.00		39,567.09	27,750.79	6,866.30	4,950.00	4.29	4,945.71	4,950.00	
Los Angeles, City of		15,000.00	3,000.00			18,000.00	9,495.75		8,504.25		3,000.00	3,000.00	
Los Angeles County Rancho Los Amigos		490.00	98.00			588.00	492.26		95.74		95.74	95.74	
Los Angeles Paper Box and Board Mills		257.00	3.19			260.19	175.08		85.11		51.40	51.40	
Lunday-Thagard Oil Co		212.00	22.40			234.40	86.56		147.84		42.40	42.40	
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
Lynwood, City of		5,337.00	249.76			5,586.76	4,949.16		637.60		637.60	637.60	
Lynwood Park Mutual Water Co #		222.00	-146.02		80.00	155.98	228.54		-72.56		-72.56	-72.56	
McLaren, Velma and Arline K Nuzum		9.00	0.00	-9.00		0.00	0.00		0.00		0.00	0.00	
Martin, Mary		28.00	0.00	-28.00		0.00	0.00		0.00		0.00	0.00	
Maywood Mutual Water Co No 1		741.00	109.92			850.92	749.60		101.32		101.32	101.32	
Maywood Mutual Water Co No 2		912.00	491.03			1,403.03	889.52		513.51	316.96	182.40	499.36	
Maywood Mutual Water Co No 3		1,407.00	184.37			1,591.37	1,456.53		134.84		134.84	134.84	

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2003 - June 30, 2004

October 2004

ARNOLD SCHWARZENEGGER	**MIKE CHRISMAN**	**LESTER A. SNOW**
Governor	**Secretary for Resources**	**Director**
State of California	**The Resources Agency**	**Department of Water Resources**

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2003-04 (acre-feet)

Party	Sales * 2003-04	Allowed Pumping Allocation 2003-04	Carryover from 2002-03	Leases* With Flex	Leases* Without Flex	Leases* Net Lease *	Allowable Extraction (2) thru (5)	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2004-05 Drought	Allowable Carryover into 2004-05 Normal	Allowable Carryover into 2004-05 Total
Emoto, John H		2.00	20.00				22.00	0.00		22.00		20.00	20.00
Engler Rentals I		8.00	0.00	-8.00		-8.00	0.00	0.00		0.00		0.00	0.00
Equilon Enterprises, LLC		6.00	20.00				26.00	0.00		26.00		20.00	20.00
Farmers & Merchants Trust Co of L B		14.00	20.00				34.00	0.00		34.00		20.00	20.00
Filtrol Corp		456.00	91.20				547.20	0.00		547.20		91.20	91.20
Flesch, Elizabeth, et al		14.00	14.00				28.00	0.00		28.00		20.00	20.00
Ford Motor Co		4.50	20.00				24.50	0.00		24.50		20.00	20.00
Frampton, Harvey		10.00	20.00				30.00	0.00		30.00		20.00	20.00
Frampton, William H		25.00	36.42				61.42	16.30		45.12	16.42	20.00	36.42
G N B, Inc		62.00	20.00	-62.00		-62.00	20.00	0.00		20.00		20.00	20.00
Gordon, Robert E		4.00	18.21				22.21	0.68		21.53	0.80	20.00	20.80
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		-6.00	0.00	0.00		0.00		0.00	0.00
Harada Brothers		6.00	6.00				12.00	0.00		12.00		12.00	12.00
Hathaway, John J		8.00	8.00				16.00	0.00		16.00		16.00	16.00
Hathaway, Julian I & Helen M, Trustees		8.00	20.00				28.00	1.49		26.51		20.00	20.00
Hathaway Family Qtip Trust		11.11	11.11				22.22	0.00		22.22		20.00	20.00
Hathaway Family Survivor's Trust		11.11	11.11				22.22	0.00		22.22		20.00	20.00
Huntington Park, City of		3,853.00	-330.08				3,522.92	3,946.84		-423.92		-423.92	-423.92
Inglewood Park Cemetery		317.00	20.00	-317.00		-317.00	20.00	0.00		20.00		20.00	20.00
Jefferson Smurfit Corp (US)		1,058.00	254.57				1,312.57	682.67		629.90	42.97	211.60	254.57
Jones Co, The		70.00	0.00	-70.00		-70.00	0.00	0.00		0.00		0.00	0.00
Kal Kan Foods, Inc		140.00	28.00	-140.00		-140.00	28.00	0.00		28.00		20.00	20.00
King Kelly Marmalade Co, Inc		22.00	14.92	-9.00		-9.00	27.92	8.30		19.62		19.62	19.62
Kotake, Masao		27.97	0.00	-27.97		-27.97	0.00	0.00		0.00		0.00	0.00
La Habra Heights County Water District		2,498.00	14.43				2,512.43	2,477.40		35.03		35.03	35.03
La Hacienda Water Co		1.00	1.00				2.00	0.00		2.00		2.00	2.00
Lakewood, City of		9,423.00	1,877.06	-170.00		-170.00	11,130.06	9,463.68		1,666.38	0.59	1,665.79	1,666.38
Lincoln Memorial Park, Inc		34.00	72.16				106.16	44.77		61.39	52.16	9.23	61.39
Little Lake Cemetery District		14.00	15.22				29.22	12.02		17.20		17.20	17.20
Long Beach, City of		32,684.00	4,950.00	685.00		685.00	38,319.00	21,172.63		17,146.37	4.29	6,673.80	6,678.09
Los Angeles, City of		15,000.00	3,000.00				18,000.00	13,790.97		4,209.03		3,000.00	3,000.00
Los Angeles County Rancho Los Amigos		490.00	95.74				585.74	424.87		160.87		98.00	98.00
Los Angeles Paper Box and Board Mills		257.00	51.40				308.40	217.28		91.12		51.40	51.40
Lunday-Thagard Oil Co		212.00	42.40	-120.00		-120.00	134.40	109.73		24.67		20.00	20.00
Lussman, Paul H Jr, et al		7.00	20.00				27.00	0.24		26.76		20.00	20.00
Lynwood, City of		5,337.00	637.60				5,974.60	5,229.04		745.56		745.56	745.56
Lynwood Park Mutual Water Co #		222.00	-72.56		80.00	80.00	229.44	221.11		8.33		8.33	8.33
McLaren, Velma and Arline K Nuzum		9.00	0.00	-9.00		-9.00	0.00	0.00		0.00		0.00	0.00
Martin, Mary		28.00	0.00				28.00	0.00		28.00		20.00	20.00
Maywood Mutual Water Co No 1		741.00	101.32				842.32	755.75		86.57		86.57	86.57
Maywood Mutual Water Co No 2		912.00	499.36				1,411.36	896.94		514.42	316.96	182.40	499.36
Maywood Mutual Water Co No 3		1,407.00	134.84				1,541.84	1,465.51		76.33		76.33	76.33

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2004 - June 30, 2005

October 2005

ARNOLD SCHWARZENEGGER	MIKE CHRISMAN	LESTER A. SNOW
Governor	Secretary for Resources	Director
State of California	Resources Agency	Department of Water

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2004-05 (acre-feet)

Party	Sales * 2004-05	Allowed Pumping Allocation 2004-05	Carryover from 2003-04	Leases* With Flex	Leases* Without Flex	Extraction Allowable	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2005-06 Drought	Allowable Carryover into 2005-06 Normal	Allowable Carryover into 2005-06 Total
Emoto, John H		2.00	20.00			22.00	0.00		22.00		20.00	20.00
Engler Rentals I		8.00	0.00	-8.00		0.00	0.00		0.00		0.00	0.00
Equilon Enterprises, LLC		6.00	20.00			26.00	0.00		26.00		20.00	20.00
Farmers & Merchants Trust Co of L B		14.00	20.00			34.00	0.00		34.00		20.00	20.00
Filtrol Corp		456.00	91.20			547.20	0.00		547.20		91.20	91.20
Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00
Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00
Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00
Frampton, William H		25.00	36.42			61.42	14.50		46.92	16.42	20.00	36.42
G N B, Inc		62.00	20.00			82.00	0.00		82.00		20.00	20.00
Gordon, Robert E		4.00	20.80			24.80	0.68		24.12	0.80	20.00	20.80
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00
Harada Brothers		6.00	12.00			18.00	0.00		18.00		18.00	18.00
Hathaway, John J		8.00	16.00			24.00	0.00		24.00		20.00	20.00
Hathaway, Julian I & Helen M, Trustees		8.00	20.00			28.00	1.12		26.88		20.00	20.00
Hathaway Family Qtip Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00
Hathaway Family Survivor's Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00
Huntington Park, City of		3,853.00	-423.92		500.00	3,929.08	3,944.99		-15.91		-15.91	-15.91
Inglewood Park Cemetery		317.00	20.00			337.00	0.00		337.00		63.40	63.40
Jefferson Smurfit Corp (US)		1,058.00	254.57			1,312.57	459.73		852.84	42.97	211.60	254.57
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00
Kal Kan Foods, Inc		140.00	20.00			160.00	0.00		160.00		28.00	28.00
King Kelly Marmalade Co, Inc		22.00	19.62			41.62	11.42		30.20		20.00	20.00
Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00		0.00	0.00
La Habra Heights County Water District		2,498.00	35.03			2,533.03	1,920.67		612.36		499.60	499.60
La Hacienda Water Co		1.00	2.00			3.00	0.00		3.00		3.00	3.00
Lakewood, City of		9,423.00	1,666.38	-750.00		10,339.38	8,834.82		1,504.56	0.59	1,503.97	1,504.56
Lincoln Memorial Park, Inc		34.00	61.39			95.39	28.85		66.54	52.16	14.38	66.54
Little Lake Cemetery District		14.00	17.20			31.20	2.31		28.89		20.00	20.00
Long Beach, City of		32,684.00	6,678.09	285.00		39,647.09	24,728.07	6,000.00	8,919.02	4.29	6,593.80	6,598.09
Los Angeles, City of		15,000.00	3,000.00			18,000.00	14,378.66		3,621.34		3,000.00	3,000.00
Los Angeles County Rancho Los Amigos		490.00	98.00			588.00	423.33		164.67		98.00	98.00
Los Angeles Paper Box and Board Mills		257.00	51.40			308.40	174.87		133.53		51.40	51.40
Lunday-Thagard Oil Co		212.00	20.00			232.00	90.28		141.72		42.40	42.40
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00
Lynwood, City of		5,337.00	745.56			6,082.56	5,545.81		536.75		536.75	536.75
Lynwood Park Mutual Water Co #		222.00	8.33			230.33	247.72		-17.39		-17.39	-17.39
McLaren, Velma and Arline K Nuzum		9.00	0.00	-9.00		0.00	0.00		0.00		0.00	0.00
Martin, Mary		28.00	20.00			48.00	0.00		48.00		20.00	20.00
Maywood Mutual Water Co No 1		741.00	86.57			827.57	744.87		82.70		82.70	82.70

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2005 - June 30, 2006

October 2006

Arnold Schwarzenegger
Governor
State of California

Mike Chrisman
Secretary for Resources
The Resources Agency

Lester A. Snow
Director
Department of Water Resources

STATE OF CALIFORNIA

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2005-2006 (acre-feet)

Party	Sales * 2005-06	Allowed Pumping Allocation 2005-06	Carryover from 2004-05	Leases* With Flex	Leases* Without Flex	Allowable Extraction	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2006-07 Drought	Allowable Carryover into 2006-07 Normal	Allowable Carryover into 2006-07 Total	
Engler Rentals I		8.00	0.00	-8.00		0.00	0.00		0.00		0.00	0.00	
Equilon Enterprises, LLC		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Farmers & Merchants Trust Co of L B		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
Filtrol Corp		456.00	91.20			547.20	0.00		547.20		91.20	91.20	
Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00	
Frampton, William H		25.00	36.42			61.42	0.00		61.42	16.42	20.00	36.42	
G N B, Inc		62.00	20.00	-62.00		20.00	0.00		20.00		20.00	20.00	
Golden State Water Company	16,439.20	16,439.20	3,340.73	1,750.00		21,529.93	18,556.32		2,973.61		2,973.61	2,973.61	e/
Gordon, Robert E		4.00	20.80			24.80	0.68		24.12	0.80	20.00	20.80	
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
Harada Brothers		6.00	18.00			24.00	0.00		24.00		20.00	20.00	
Hathaway, John J		8.00	20.00			28.00	0.00		28.00		20.00	20.00	
Hathaway, Julian I & Helen M, Trustees		8.00	20.00			28.00	1.28		26.72		20.00	20.00	
Hathaway Family Qtip Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00	
Hathaway Family Survivor's Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00	
Huntington Park, City of		3,853.00	-15.91			3,837.09	3,647.59		189.50		189.50	189.50	
Inglewood Park Cemetery		317.00	63.40			380.40	0.00		380.40		63.40	63.40	
Jefferson Smurfit Corp (US)		1,058.00	254.57			1,312.57	459.08		853.49	42.97	211.60	254.57	
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
Kal Kan Foods, Inc		140.00	28.00			168.00	0.00		168.00		28.00	28.00	
King Kelly Marmalade Co, Inc		22.00	20.00	-15.00		27.00	12.73		14.27		14.27	14.27	
Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00		0.00	0.00	
La Habra Heights County Water District		2,498.00	499.60			2,997.60	2,567.04		430.56		430.56	430.56	
La Hacienda Water Co		1.00	3.00			4.00	0.00		4.00		4.00	4.00	
Lakewood, City of		9,423.00	1,470.17	-500.00		10,393.17	9,233.67		1,159.50	0.59	1,158.91	1,159.50	f/
Lincoln Memorial Park, Inc		34.00	66.54			100.54	26.27		74.27	52.16	20.00	72.16	
Little Lake Cemetery District		14.00	20.00			34.00	0.03		33.97		20.00	20.00	
Long Beach, City of		32,684.00	6,598.09	285.00	-900.00	38,667.09	23,352.53	6,000.00	9,314.56	4.29	6,593.80	6,598.09	
Los Angeles, City of		15,000.00	3,000.00			18,000.00	13,289.70		4,710.30		3,000.00	3,000.00	
Los Angeles County Rancho Los Amigos		490.00	98.00			588.00	458.73		129.27		98.00	98.00	
Los Angeles Paper Box and Board Mills	-257.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	g/
Lunday-Thagard Oil Co		212.00	42.40	-140.00		114.40	98.54		15.86		15.86	15.86	
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
Lynwood, City of		5,337.00	536.75			5,873.75	4,656.40		1,217.35		1,067.40	1,067.40	
Lynwood Park Mutual Water Co.		222.00	-17.39			204.61	193.12		11.49		11.49	11.49	
McLaren, Velma and Arline K Nuzum		9.00	0.00	-9.00		0.00	0.00		0.00		0.00	0.00	
Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00		20.00	20.00	
Maywood Mutual Water Co No 1		741.00	82.70			823.70	843.86		-20.16		-20.16	-20.16	

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2006 - June 30, 2007

October 2007

Arnold Schwarzenegger
Governor
State of California

Mike Chrisman
Secretary for Resources
The Resources Agency

Lester A. Snow
Director
Department of Water Resources

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2006-2007 (acre-feet)

Party	Sales * 2006-07	Allowed Pumping Allocation 2006-2007	Carryover from 2005-2006	Leases* With Flex	Leases* Without Flex	Allowable Extraction	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2007-2008 Drought	Allowable Carryover into 2007-2008 Normal	Allowable Carryover into 2007-2008 Total	
Engler Rentals I	-8.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	i
Equilon Enterprises, LLC		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Exide Technologies	62.00	62.00	20.00			82.00	0.00		82.00		20.00	20.00	j
Farmers & Merchants Trust Co of L B		14.00	20.00	-34.00		0.00	0.00		0.00		0.00	0.00	
Filtrol Corp	-456.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	b
Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00	
Frampton, William H		25.00	36.42			61.42	0.00		61.42	16.42	20.00	36.42	
Frances, Carol Jeanne	8.00	8.00	0.00	-8.00		0.00	0.00		0.00		0.00	0.00	i
G N B, Inc	-62.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	j
Golden State Water Company		16,439.20	2,973.61	2,012.00		21,424.81	19,114.74		2,310.07		2,310.07	2,310.07	
Gordon, Robert E		4.00	20.80			24.80	0.17		24.63	0.80	20.00	20.80	
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
Harada Brothers		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Hathaway, John J		8.00	20.00			28.00	0.00		28.00		20.00	20.00	
Hathaway, Julian I & Helen M, Trustees	-8.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	k
Hathaway Family Qtip Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00	
Hathaway Family Survivor's Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00	
Huntington Park, City of		3,853.00	189.50			4,042.50	3,685.44		357.06		357.06	357.06	
Inglewood Park Cemetery		317.00	63.40			380.40	0.00		380.40		63.40	63.40	
Jefferson Smurfit Corp (US)	-1,058.00	0.00	0.00			0.00			0.00		0.00	0.00	l
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
Kal Kan Foods, Inc		140.00	28.00			168.00	0.00		168.00		28.00	28.00	
King Kelly Marmalade Co, Inc		22.00	14.27	-15.00		21.27	7.38		13.89		13.89	13.89	
Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00		0.00	0.00	
La Habra Heights County Water District		2,498.00	430.56			2,928.56	2,924.99		3.57		3.57	3.57	
La Hacienda Water Co	-1.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	m
Lakewood, City of		9,423.00	1,159.50	-300.00	900.00	11,182.50	9,965.16		1,217.34	0.59	1,216.75	1,217.34	
Lincoln Memorial Park, Inc		34.00	72.16			106.16	32.20		73.96	52.16	20.00	72.16	
Little Lake Cemetery District		14.00	20.00			34.00	0.27		33.73		20.00	20.00	
Long Beach, City of		32,684.00	6,598.09	785.00	-900.00	39,167.09	25,487.09	5,778.50	7,901.50	4.29	6,693.80	6,698.09	
Los Angeles, City of		15,000.00	3,000.00			18,000.00	13,358.02		4,641.98		3,000.00	3,000.00	
Los Angeles County Rancho Los Amigos		490.00	98.00			588.00	575.70		12.30		12.30	12.30	
Lunday-Thagard Oil Co		212.00	15.86	-140.00		87.86	86.14		1.72		1.72	1.72	
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
Lynwood, City of		5,337.00	1,067.40			6,404.40	4,711.59		1,692.81		1,067.40	1,067.40	
Lynwood Park Mutual Water Co.		222.00	11.49			233.49	189.18		44.31		44.31	44.31	
McLaren, Velma and Arline K Nuzum		9.00	0.00	-9.00		0.00	0.00		0.00		0.00	0.00	

STATE OF CALIFORNIA
THE RESOURCES AGENCY
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SOUTHERN DISTRICT

WATERMASTER SERVICE
in the
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Los Angeles County

July 1, 2007 - June 30, 2008

October 2008

Arnold Schwarzenegger	**Mike Chrisman**	**Lester A. Snow**
Governor	Secretary for Resources	Director
State of California	The Resources Agency	Department of Water Resources

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2007-2008 (acre-feet)

Party	Sales * 2007-2008	Allowed Pumping Allocation 2007-2008	Carryover from 2006-2007	Leases*		Allowable Extraction	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2008-2009			
				With Flex	Without Flex					Drought	Normal	Total	
Farmers & Merchants Trust Co of L B		14.00	0.00	-34.00		-20.00	0.00		-20.00		-20.00	-20.00	
Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00	
Frampton, William H		25.00	36.42			61.42	14.55		46.87	16.42	20.00	36.42	
Frances, Carol Jeanne		8.00	0.00			8.00	0.00		8.00		8.00	8.00	
Golden State Water Company		16,439.20	2,310.07	6,896.44		25,645.71	21,463.26		4,182.45		4,182.45	4,182.45	
Gordon, Robert E		4.00	20.80			24.80	0.00		24.80	0.80	20.00	20.80	
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
Harada Brothers		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Hathaway, John J	-8.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	b
Hathaway Family Qtip Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00	
Hathaway Family Survivor's Trust		11.11	20.00			31.11	0.00		31.11		20.00	20.00	
Huntington Park, City of		3,853.00	357.06			4,210.06	3,730.91		479.15		479.15	479.15	
Inglewood Park Cemetery		317.00	63.40	-300.00		80.40	0.00		80.40		20.00	20.00	
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
Kal Kan Foods, Inc		140.00	28.00			168.00	0.00		168.00		28.00	28.00	
King Kelly Marmalade Co, Inc		22.00	13.89	-15.00		20.89	2.05		18.84		18.84	18.84	
Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00		0.00	0.00	
La Habra Heights County Water District	8.00	2,506.00	23.57	96.00	551.00	3,176.57	3,154.93		21.64		21.64	21.64	b
Lakewood, City of		9,423.00	1,217.34		-100.00	10,540.34	9,471.96		1,068.38	0.59	1,067.79	1,068.38	
Lincoln Memorial Park, Inc		34.00	72.16			106.16	59.50		46.66	46.66	0.00	46.66	
Little Lake Cemetery District		14.00	20.00			34.00	0.77		33.23		20.00	20.00	
Long Beach, City of		32,684.00	6,698.09	285.00	600.00	40,267.09	35,815.91		4,451.18	4.29	4,446.89	4,451.18	
Los Angeles, City of		15,000.00	3,000.00			18,000.00	12,207.48		5,792.52		3,000.00	3,000.00	
Los Angeles County Rancho Los Amigos		490.00	12.30		200.00	702.30	680.03		22.27		22.27	22.27	
Lunday-Thagard Oil Co		212.00	1.72	-140.00		73.72	94.19		-20.47		-20.47	-20.47	
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
Lynwood, City of		5,337.00	1,067.40			6,404.40	6,306.14		98.26		98.26	98.26	
Lynwood Park Mutual Water Co.		222.00	44.31			266.31	180.41		85.90		44.40	44.40	
McLaren, Velma and Arline K Nuzum		9.00	0.00	-9.00		0.00	0.00		0.00		0.00	0.00	
Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00		20.00	20.00	
Maywood Mutual Water Co No 1		741.00	57.64			798.64	790.57		8.07		8.07	8.07	
Maywood Mutual Water Co No 2		912.00	428.35	189.00		1,529.35	1,255.63		273.72	273.72	0.00	273.72	
Maywood Mutual Water Co No 3		1,407.00	201.69	250.00		1,858.69	1,533.26		325.43		325.43	325.43	
Mellano, G, et al		13.00	13.00			26.00	0.00		26.00		20.00	20.00	
Mitsuuchi, Mary F Trust		11.00	0.00			11.00	0.00		11.00		11.00	11.00	
Montebello, City of		386.50	77.30			463.80	341.15		122.65		77.30	77.30	
Montebello Land and Water Co		1,624.00	607.05	1,920.00	100.00	4,251.05	3,647.82		603.23	23.24	579.99	603.23	
New England Mutual Life Insurance Co		2.00	20.00			22.00	0.00		22.00		20.00	20.00	

STATE OF CALIFORNIA
CALIFORNIA NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN REGION

WATERMASTER SERVICE
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Los Angeles County

July 1, 2008- June 30, 2009

October 2009

Arnold Schwarzenegger
Governor
State of California

Mike Chrisman
Secretary for Natural Resources
California Natural Resources Agency

Lester A. Snow
Director
Department of Water Resources

TABLE 2. ALLOWED PUMPING ALLOCATION ACCOUNTING, 2008-09 (acre-feet)

Party	Sales * 2008-2009	Allowed Pumping Allocation 2008-2009	Carryover from 2007-2008	Leases*		Allowable Extraction	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2009-2010			
				With Flex	Without Flex					Drought	Normal	Total	
Frampton, William H		25.00	36.42			61.42	0.11		61.31	16.42	20.00	36.42	
Frances, Carol Jeanne		8.00	8.00			16.00	0.00		16.00		16.00	16.00	
Golden State Water Company		16,439.20	4,182.45	4,691.00		25,312.65	21,377.44		3,935.21		3,935.21	3,935.21	
Gordon, Robert E		4.00	20.80			24.80	0.00		24.80	0.80	20.00	20.80	
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
Harada Brothers		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Hathaway Family Qtip Trust	-11.11	0.00	0.00			0.00	0.00		0.00		0.00	0.00	e
Hathaway Family Survivor's Trust	-11.11	0.00	0.00			0.00	0.00		0.00		0.00	0.00	f
Hathaway, Jesse R.	4.07	4.07	7.33			11.40	0.00		11.40		11.40	11.40	ef
Hathaway, Merrie F.	1.86	1.86	3.34			5.20	0.00		5.20		5.20	5.20	e
Hathaway, Richard F., Jr.	4.07	4.07	7.33			11.40	0.00		11.40		11.40	11.40	ef
Hathaway, William A.	4.07	4.07	7.33			11.40	0.00		11.40		11.40	11.40	ef
Hathaway, Loline	4.08	4.08	7.33			11.41	0.00		11.41		11.41	11.41	ef
Huntington Park, City of		3,853.00	479.15			4,332.15	3,616.73		715.42		715.42	715.42	
Inglewood Park Cemetery		317.00	20.00	-300.00		37.00	0.00		37.00		20.00	20.00	
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
Kal Kan Foods, Inc	-140.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	g
King Kelly Marmalade Co, Inc	-22.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	h
Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00		0.00	0.00	
La Habra Heights County Water District	90.00	2,596.00	39.64	570.00		3,205.64	2,971.18		234.46		234.46	234.46	g
Lakewood, City of	9.00	9,432.00	1,068.38		165.00	10,665.38	8,678.78		1,986.60	0.59	1,886.40	1,886.99	i
Lincoln Memorial Park, Inc		34.00	46.66			80.66	30.95		49.71	46.66	3.05	49.71	
Little Lake Cemetery District		14.00	20.00			34.00	0.09		33.91		20.00	20.00	
Long Beach, City of		32,684.00	4,411.18	137.00	1,435.00	38,667.18	35,335.25		3,331.93	4.29	3,327.64	3,331.93	#
Los Angeles, City of		15,000.00	3,000.00		-1,000.00	17,000.00	11,937.18		5,062.82		3,000.00	3,000.00	
Los Angeles County Rancho Los Amigos		490.00	22.27		92.00	604.27	586.71		17.56		17.56	17.56	
Lunday-Thagard Oil Co		212.00	-20.47	-100.00		91.53	81.43		10.10		10.10	10.10	
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
Lynwood, City of		5,337.00	98.26			5,435.26	5,365.34		69.92		69.92	69.92	
Lynwood Park Mutual Water Co.		222.00	44.40			266.40	257.94		8.46		8.46	8.46	
McLaren, Velma O. and Arline K. Nuzum	-9.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	i
Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00		20.00	20.00	
Maywood Mutual Water Co No 1		741.00	8.07	150.00		899.07	811.72		87.35		87.35	87.35	
Maywood Mutual Water Co No 2		912.00	273.72	426.00		1,611.72	1,171.09		440.63	273.72	166.91	440.63	
Maywood Mutual Water Co No 3		1,407.00	325.43	50.00		1,782.43	1,541.08		241.35		241.35	241.35	
Mellano, G, et al		13.00	20.00	-26.00		7.00	0.00		7.00		7.00	7.00	
Mitsuuchi, Mary F Trust		11.00	11.00			22.00	0.00		22.00		20.00	20.00	
Montebello, City of		386.50	77.30			463.80	294.03		169.77		77.30	77.30	
Montebello Land and Water Co		1,624.00	603.23	2,230.00	-180.00	4,277.23	3,538.08		739.15	23.24	715.91	739.15	
New England Mutual Life Insurance Co		2.00	20.00			22.00	0.00		22.00		20.00	20.00	
The Newark Group, Inc	-200.00	357.00	111.40			468.40	221.42		246.98		71.40	71.40	a
Northrop Grumman Systems Corporation		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Norwalk, City of	50.00	1,773.00	354.60		-1,000.00	1,127.60	459.70		667.90		354.60	354.60	g
Norwalk-La Mirada Unified School District		378.00	20.00	-378.00		20.00	0.00		20.00		20.00	20.00	
O N K Farms		8.00	20.00			28.00	0.00		28.00		20.00	20.00	

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Arnold Schwarzenegger
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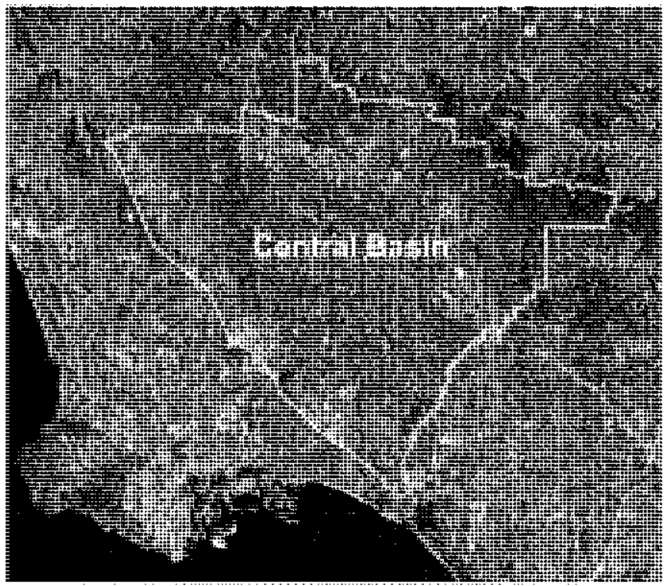
California Natural Resources Agency

Mark W. Cowin
Director
Department of Water Resources

Party	Sales[1] 2009-2010	Allowed Pumping Allocation 2009-2010	Carryover from 2008-2009	Leases[1] With Flex	Leases[1] Without Flex	Allowable Extraction	Amount Pumped	In-Lieu	Balance	Allowable Carryover into 2010-2011 Drought	Normal	Total	
Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00	
Frampton, William H		25.00	36.42			61.42	22.13		39.29	16.42	20.00	36.42	
Francis, Carol Jeanne	-8.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	8
Golden State Water Company		16,439.20	3,935.21	5,200.00		25,574.41	21,765.67		3,808.74		3,808.74	3,808.74	
Gordon, Robert E		4.00	20.80			24.80	0.00		24.80	0.80	20.00	20.80	
Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
Harada Brothers		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
Hathaway, Jesse R.		4.07	11.40			15.47	0.00		15.47		15.47	15.47	
Hathaway, Merrie F.		1.86	5.20			7.06	0.00		7.06		7.06	7.06	
Hathaway, Richard F., Jr.		4.07	11.40			15.47	0.00		15.47		15.47	15.47	
Hathaway, William A.		4.07	11.40			15.47	0.00		15.47		15.47	15.47	
Hathaway, Loline		4.08	11.41			15.49	0.00		15.49		15.49	15.49	
Huntington Park, City of		3,853.00	715.42			4,568.42	3,494.57		1,073.85		770.60	770.60	
Inglewood Park Cemetery		317.00	20.00			337.00	0.00		337.00		63.40	63.40	
Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
Kotake, Masao		27.97	0.00			27.97	0.00		27.97		20.00	20.00	
La Habra Heights County Water District		2,596.00	234.46	340.00		3,170.46	2,700.74		469.72		469.72	469.72	
Lakewood, City of		9,432.00	1,886.99		-375.00	10,943.99	9,107.79		1,836.20	0.59	1,835.61	1,836.20	
Lincoln Memorial Park, Inc		34.00	49.71			83.71	20.22		63.49	46.66	16.83	63.49	
Little Lake Cemetery District		14.00	20.00			34.00	1.67		32.33		20.00	20.00	
Long Beach, City of	8.00	32,692.00	3,347.93	4,000.00	1,115.00	41,154.93	33,818.01		7,336.92	4.29	7,332.63	7,336.92	8
Los Angeles, City of		15,000.00	3,000.00			18,000.00	11,766.29		6,233.71		3,000.00	3,000.00	
Los Angeles County Rancho Los Amigos		490.00	17.56		125.00	632.56	495.24		137.32		98.00	98.00	
Lunday-Thagard Oil Co		212.00	10.10	-100.00		122.10	76.17		45.93		22.40	22.40	
Lussman, Paul H Jr, et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
Lynwood, City of		5,337.00	69.92	1,000.00		6,406.92	5,611.17		795.75		795.75	795.75	
Lynwood Park Mutual Water Co.		222.00	8.46			230.46	199.85		30.61		30.61	30.61	
Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00		20.00	20.00	
Maywood Mutual Water Co No 1		741.00	87.35			828.35	753.19		75.16		75.16	75.16	
Maywood Mutual Water Co No 2		912.00	440.63	13.00		1,365.63	1,137.91		227.72	227.72	0.00	227.72	
Maywood Mutual Water Co No 3		1,407.00	241.35	200.00		1,848.35	1,476.51		371.84		321.40	321.40	
Mellano, G, et al		13.00	7.00	-26.00		-6.00	0.00		-6.00		-6.00	-6.00	
Mitsuuchi, Mary F Trust		11.00	20.00			31.00	0.00		31.00		20.00	20.00	
Montebello, City of		386.50	77.30			463.80	317.28		146.52		77.30	77.30	
Montebello Land and Water Co		1,624.00	739.15	1,696.00	-70.00	3,989.15	3,372.67		616.48	23.24	593.24	616.48	
New England Mutual Life Insurance Co		2.00	20.00			22.00	0.00		22.00		20.00	20.00	
The Newark Group, Inc		357.00	71.40			428.40	225.60		202.80		71.40	71.40	
Northrop Grumman Systems Corporation		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
Norwalk, City of		1,773.00	354.60		-1,200.00	927.60	403.53		524.07		354.60	354.60	
Norwalk-La Mirada Unified School District		378.00	20.00	-378.00		20.00	0.00		20.00		20.00	20.00	
O N K Farms		8.00	20.00			28.00	0.00		28.00		20.00	20.00	
Oltmans Construction Co		3.00	20.00			23.00	0.00		23.00		20.00	20.00	
Orange County Nursery, Inc	-13.00	0.00	0.00			0.00	0.00		0.00		0.00	0.00	5

STATE OF CALIFORNIA
CALIFORNIA NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN REGION



WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2010 - June 30, 2011

October 2011

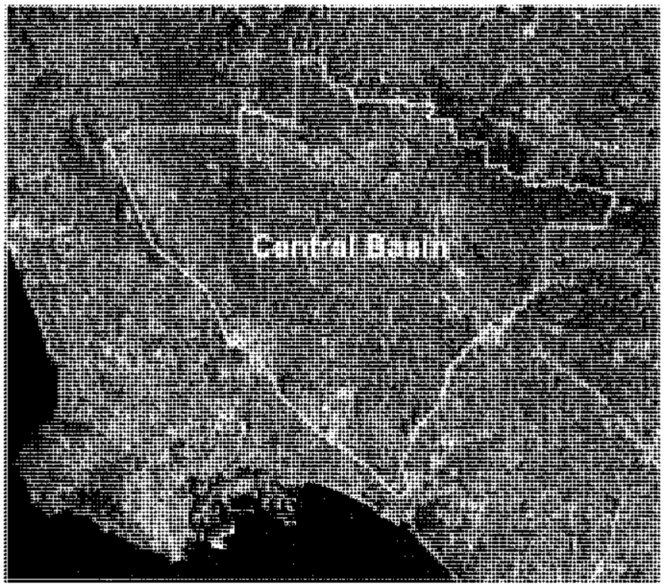
Edmund G. Brown Jr.
Governor
State of California

John Laird
Secretary for Natural Resources
California Natural Resources Agency

Mark W. Cowin
Director
Department of Water Resources

Pumper ID	Party	Sales [1] 2010-2011	Allowed Pumping Allocation 2010-2011	Carryover from 2009-2010	Leases [1] With Flex	Leases [1] Without Flex	Allowable Extraction [2]	Amount Pumped	In Lieu	Balance [3]	Allowable Carryover into 2011-2012 Drought	Normal	Total
1560	Emoto, John H		2.00	20.00			22.00	0.00		22.00		20.00	20.00
1572	Equilon Enterprises, LLC		6.00	20.00			26.00	0.00		26.00		20.00	20.00
1597	Exide Technologies		62.00	20.00			82.00	0.00		82.00		20.00	20.00
1606	Farmers & Merchants Trust Co of Long Beach		14.00	-26.00			-12.00	0.00		-12.00		-12.00	-12.00
1700	Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00
1720	Ford Motor Co		4.50	20.00			24.50	0.00		24.50		20.00	20.00
1726	Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00
1735	Frampton, William H		25.00	36.42			61.42	42.85		18.57	16.42	2.15	18.57
1843	Golden State Water Company		16,439.20	3,808.74	4,794.20		25,042.14	21,232.41		3,809.73		3,809.73	3,809.73
1960	Gordon, Robert E		4.00	20.80			24.80	0.00		24.80	0.80	20.00	20.80
1988	Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00
2155	Harada Brothers		6.00	20.00			26.00	0.00		26.00		20.00	20.00
2209	Hathaway, Jesse R		4.07	15.47	-19.54		0.00	0.00		0.00		0.00	0.00
2211	Hathaway, Merrie F		1.86	7.06			8.92	0.00		8.92		8.92	8.92
2212	Hathaway, Richard F, Jr		4.07	15.47	-19.54		0.00	0.00		0.00		0.00	0.00
2213	Hathaway, William A		4.07	15.47	-19.54		0.00	0.00		0.00		0.00	0.00
2214	Hathaway, Loline		4.08	15.49	-19.57		0.00	0.00		0.00		0.00	0.00
2378	Huntington Park, City of		3,853.00	770.60			4,623.60	3,171.17		1,452.43		770.60	770.60
2440	Inglewood Park Cemetery		317.00	63.40	-317.00		63.40	0.00		63.40		20.00	20.00
2493	Jones Co, The		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00
2710	Kotake, Masao		27.97	20.00	-27.97		20.00	0.00		20.00		20.00	20.00
2749	La Habra Heights County Water District		2,596.00	469.72	70.00		3,135.72	2,627.96		507.76		507.76	507.76
2770	Lakewood, City of		9,432.00	1,836.20		300.00	11,568.20	7,751.83		3,816.37	0.59	1,886.40	1,886.99
2884	Lincoln Memorial Park, Inc		34.00	63.49			97.49	17.25		80.24	46.66	20.00	66.66
2890	Little Lake Cemetery District		14.00	20.00			34.00	0.78		33.22		20.00	20.00
2910	Long Beach, City of		32,692.00	7,336.92		-1,150.00	38,878.92	26,027.00	6,723.60	6,128.32	4.29	6,124.03	6,128.32
2920	Los Angeles, City of		15,000.00	3,000.00			18,000.00	5,099.03		12,900.97		3,000.00	3,000.00
2930	Los Angeles County Rancho Los Amigos		490.00	98.00			588.00	345.64		242.36		98.00	98.00
3010	Lunday-Thagard Oil Co		212.00	22.40			234.40	59.78		174.62		42.40	42.40
3040	Lussman, Paul H, Jr et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00
3060	Lynwood, City of		5,337.00	795.75	700.00		6,832.75	5,593.74		1,239.01		1,207.40	1,207.40
3080	Lynwood Park Mutual Water Co		222.00	30.61			252.61	260.14		-7.53		-7.53	-7.53
3140	Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00		20.00	20.00
3170	Maywood Mutual Water Co No 1		741.00	75.16			816.16	658.30		157.86		148.20	148.20
3180	Maywood Mutual Water Co No 2		912.00	227.72	250.00		1,389.72	1,107.96		281.76	227.72	54.04	281.76
3190	Maywood Mutual Water Co No 3		1,407.00	321.40			1,728.40	1,374.36		354.04		281.40	281.40
3210	Mellano, G, et al		13.00	-6.00			7.00	0.00		7.00		7.00	7.00
3301	Mitsuuchi, Mary F Trust		11.00	20.00	-31.00		0.00	0.00		0.00		0.00	0.00
3351	Montebello, City of		386.50	77.30			463.80	390.04		73.76		73.76	73.76
3360	Montebello Land and Water Co		1,624.00	616.48	2,000.00		4,240.48	3,300.82		939.66	23.24	724.80	748.04
3514	New England Mutual Life Insurance Co		2.00	20.00			22.00	0.00		22.00		20.00	20.00
3517	The Newark Group, Inc		357.00	71.40	-50.00		378.40	235.44		142.96		61.40	61.40
3545	Northrop Grumman Systems Corporation		4.50	20.00			24.50	0.00		24.50		20.00	20.00
3550	Norwalk, City of		1,773.00	354.60		-1,200.00	927.60	411.14		516.46		354.60	354.60
3560	Norwalk-La Mirada Unified School District		378.00	20.00	-100.00		298.00	0.00		298.00		55.60	55.60

STATE OF CALIFORNIA
CALIFORNIA NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN REGION



WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

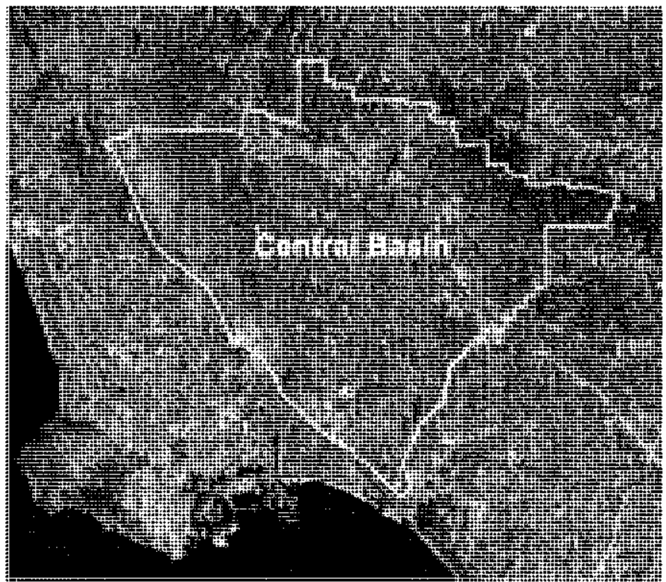
July 1, 2011 - June 30, 2012

October 2012

Edmund G. Brown Jr.	**John Laird**	**Mark W. Cowin**
Governor	Secretary for Natural Resources	Director
State of California	California Natural Resources Agency	Department of Water Resources

Party ID	Party	Sales [1] 2011-2012	Allowed Pumping Allocation 2011-2012	Carryover from 2010-2011	Leases [1] With Flex	Leases [1] Without Flex	Allowable Extraction [2]	Amount Pumped	In-Lieu	Balance [3]	Allowable Carryover into 2012-2013 Drought	Allowable Carryover into 2012-2013 Normal	Allowable Carryover into 2012-2013 Total	
1560	Emoto, John H		2.00	20.00			22.00	0.00		22.00		20.00	20.00	
1572	Equilon Enterprises, LLC		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
1597	Exide Technologies		62.00	20.00			82.00	0.00		82.00		20.00	20.00	
1606	Farmers & Merchants Trust Co of Long Beach		14.00	-12.00			2.00	0.00		2.00		2.00	2.00	
1700	Flesch, Elizabeth, et al		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
1720	Ford Motor Company		4.50	20.00			24.50	0.00		24.50		20.00	20.00	
1726	Frampton, Harvey		10.00	20.00			30.00	0.00		30.00		20.00	20.00	
1735	Frampton, William H		25.00	18.57			43.57	19.62		23.95	16.42	7.53	23.95	
1843	Golden State Water Company		16,439.20	3,809.73	5,110.00		25,358.93	22,161.18		3,197.75		3,197.75	3,197.75	
1960	Gordon, Robert E		4.00	20.80			24.80	0.00		24.80	0.80	20.00	20.80	
1988	Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00		0.00	0.00	
2155	Harada Brothers		6.00	20.00			26.00	0.00		26.00		20.00	20.00	
2209	Hathaway, Jesse R		4.07	0.00			4.07	0.00		4.07		4.07	4.07	
2211	Hathaway, Merrie F		1.86	8.92			10.78	0.00		10.78		10.78	10.78	
2212	Hathaway, Richard F, Jr.		4.07	0.00			4.07	0.00		4.07		4.07	4.07	
2213	Hathaway, William A		4.07	0.00			4.07	0.00		4.07		4.07	4.07	
2214	Hathaway, Loline		4.08	0.00			4.08	0.00		4.08		4.08	4.08	
2378	Huntington Park, City of		3,853.00	770.60	-350.00		4,273.60	3,099.50		1,174.10		700.60	700.60	
2440	Inglewood Park Cemetery		317.00	20.00			337.00	0.00		337.00		63.40	63.40	
2493	The Jones Company		70.00	0.00	-70.00		0.00	0.00		0.00		0.00	0.00	
2710	Kotake, Masao		27.97	20.00	-47.97		0.00	0.00		0.00		0.00	0.00	
2749	La Habra Heights County Water District		2,596.00	507.76	70.00		3,173.76	2,862.69		311.07		311.07	311.07	
2770	Lakewood, City of		9,432.00	1,886.99		-1,400.00	9,918.99	8,060.86		1,858.13	0.59	1,857.54	1,858.13	
2884	Lincoln Memorial Park, Inc		34.00	66.66			100.66	24.32		76.34	46.66	20.00	66.66	
2890	Little Lake Cemetery District		14.00	20.00			34.00	0.00		34.00		20.00	20.00	
2910	Long Beach, City of		32,692.00	6,128.32		900.00	39,720.32	25,377.91	7,815.10	6,527.31	4.29	6,523.02	6,527.31	
2920	Los Angeles, City of		15,000.00	3,000.00			18,000.00	9,486.06		8,513.94		3,000.00	3,000.00	
2930	Los Angeles County Rancho Los Amigos		490.00	98.00			588.00	338.71		249.29		98.00	98.00	
3010	Lunday-Thagard Oil Company		212.00	42.40	-168.00		86.40	67.15		19.25		19.25	19.25	
3040	Lussman, Paul H, Jr., et al		7.00	20.00			27.00	0.24		26.76		20.00	20.00	
3060	Lynwood, City of		5,337.00	1,207.40	700.00		7,244.40	5,778.86		1,465.54		1,207.40	1,207.40	
3080	Lynwood Park Mutual Water Company		222.00	-7.53			214.47	238.13		-23.66		-23.66	-23.66	
3140	Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00		20.00	20.00	
3170	Maywood Mutual Water Company No 1		741.00	148.20			889.20	651.84		237.36		148.20	148.20	
3180	Maywood Mutual Water Company No 2		912.00	281.76	26.00	50.00	1,269.76	1,086.61		183.15	183.15	0.00	183.15	
3190	Maywood Mutual Water Company No 3		1,407.00	281.40			1,688.40	1,338.49		349.91		281.40	281.40	
3210	Mellano, G, et al		13.00	7.00			20.00	0.00		20.00		20.00	20.00	
3301	Mitsuuchi, Mary F Trust		11.00	0.00	-11.00		0.00	0.00		0.00		0.00	0.00	
3351	Montebello, City of		386.50	73.76			460.26	268.75		191.51		77.30	77.30	
3360	Montebello Land and Water Company		1,624.00	748.04	1,568.00		3,940.04	3,370.02		570.02	23.24	546.78	570.02	
3514	New England Mutual Life Insurance Company		2.00	20.00			22.00	0.00		22.00		20.00	20.00	
3517	The Newark Group, Inc	-100.00	257.00	61.40			318.40	207.09		111.31		51.40	51.40	4
3545	Northrop Grumman Systems Corporation		4.50	20.00			24.50	0.00		24.50		20.00	20.00	6
3550	Norwalk, City of		1,773.00	354.60	-1,200.00	0.00	927.60	498.37		429.23		114.60	114.60	
3560	Norwalk-La Mirada Unified School District		378.00	55.60	-378.00		55.60	0.00		55.60		20.00	20.00	

State of California
California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES
SOUTHERN REGION OFFICE



WATERMASTER SERVICE
in the
CENTRAL BASIN
Los Angeles County

July 1, 2012 - June 30, 2013

October 2013

Party ID	Party	Sales[1]	Allowed Pumping Allocation 2012-2013	Carryover from 2011-2012	Leases: With Flex	Leases: Without Flex	Allowable Extraction[2]	Amount Pumped	In-Lieu	Balance[3]	Allowable Carryover into 2013-2014: DCO-77	DCO-91	Normal	Total
1597	Exide Technologies		62.00	55.00			117.00	0.00		117.00		35.00	20.00	55.00
1606	Farmers & Merchants Trust Co of Long Beach		14.00	2.00			16.00	0.00		16.00			16.00	16.00
1700	Flesch, Elizabeth, et al		14.00	34.00			48.00	0.00		48.00		14.00	20.00	34.00
1719	Footbridge 1 Trust	3.75	3.75	3.75			7.50	0.00		7.50			7.50	7.50 [5]
1720	Ford Motor Company		4.50	24.50			29.00	0.00		29.00		4.50	20.00	24.50
1726	Frampton, Harvey		10.00	30.00			40.00	0.00		40.00		10.00	20.00	30.00
1735	Frampton, William H		25.00	23.95			48.95	23.57		25.38	16.42		8.96	25.38
1843	Golden State Water Company		16,439.20	3,197.75	5,760.00		25,396.95	22,925.58		2,471.37			2,471.37	2,471.37
1960	Gordon, Robert E		4.00	24.80			28.80	0.00		28.80	0.80	4.00	20.00	24.80
1988	Graham, Hugh W or Marcia K, Trustees		6.00	0.00	-6.00		0.00	0.00		0.00			0.00	0.00
2155	Harada Brothers		6.00	26.00			32.00	0.00		32.00		6.00	20.00	26.00
2209	Hathaway, Jesse R		4.07	4.07			8.14	0.00		8.14			8.14	8.14
2211	Hathaway, Merrie F		1.86	10.78			12.64	0.00		12.64			12.64	12.64
2212	Hathaway, Richard F, Jr.		4.07	4.07			8.14	0.00		8.14			8.14	8.14
2213	Hathaway, William A		4.07	4.07			8.14	0.00		8.14			8.14	8.14
2214	Hathaway, Loline		4.08	4.08			8.16	0.00		8.16			8.16	8.16
2378	Huntington Park, City of		3,853.00	1,382.43			5,235.43	3,631.16		1,604.27		681.83	770.60	1,452.43
2440	Inglewood Park Cemetery		317.00	98.40			415.40	0.00		415.40		35.00	63.40	98.40
2493	Jones Company, The	-70.0	0.00	0.00			0.00	0.00		0.00			0.00	0.00 [7]
2710	Kotake, Masao		27.97	0.00	-27.97		0.00	0.00		0.00			0.00	0.00
2749	La Habra Heights County Water District		2,596.00	311.07	400.00	365.00	3,672.07	3,141.40		530.67			530.67	530.67
2770	Lakewood, City of		9,432.00	3,787.51	-270.00	550.00	13,499.51	9,825.41		3,674.10	0.59	1,929.38	1,744.13	3,674.10
2884	Lincoln Memorial Park, Inc		34.00	80.24			114.24	23.95		90.29	46.66	13.58	20.00	80.24
2890	Little Lake Cemetery District		14.00	33.22			47.22	0.03		47.19		13.22	20.00	33.22
2910	Long Beach, City of		32,692.00	6,527.31		250.00	39,469.31	30,796.00	2,180.00	6,493.31	4.29		6,489.02	6,493.31 [6]
2920	Los Angeles, City of		15,000.00	8,250.00			23,250.00	6,310.08		16,939.92		5,250.00	3,000.00	8,250.00
2930	Los Angeles County Rancho Los Amigos		490.00	242.36			732.36	324.85		407.51		144.36	98.00	242.36
3010	Lunday-Thagard Oil Company		212.00	93.45	-150.00		155.45	66.19		89.26		74.20	15.06	89.26
3040	Lussman, Paul H, Jr., et al		7.00	26.76			33.76	0.24		33.52		6.76	20.00	26.76
3060	Lynwood, City of		5,337.00	1,239.01	-200.00		6,376.01	5,091.25		1,284.76		31.61	1,027.40	1,059.01
3080	Lynwood Park Mutual Water Company		222.00	-23.66			198.34	153.93		44.41			44.40	44.40
3140	Martin, Mary		28.00	20.00	-28.00		20.00	0.00		20.00			20.00	20.00
3170	Maywood Mutual Water Company No 1		741.00	157.86			898.86	658.33		240.53		9.66	148.20	157.86
3180	Maywood Mutual Water Company No 2		912.00	183.15	200.00		1,295.15	1,059.64		235.51	183.15		52.36	235.51
3190	Maywood Mutual Water Company No 3		1,407.00	354.04			1,761.04	1,278.26		482.78		72.64	281.40	354.04
3210	Mellano, G, et al		13.00	20.00			33.00	0.00		33.00			20.00	20.00
3301	Mitsuuchi, Mary F Trust		11.00	0.00	-11.00		0.00	0.00		0.00			0.00	0.00
3351	Montebello, City of		386.50	77.30			463.80	236.32		227.48			77.30	77.30
3360	Montebello Land and Water Company	70.00	1,694.00	761.64	1,700.00		4,155.64	3,468.42		687.22	23.24	191.62	472.36	687.22 [7]
3501	Nancy Dee Keane Living Trust	4.00	4.00	4.00	-8.00		0.00	0.00		0.00			0.00	0.00 [5]
3514	New England Mutual Life Insurance Company		2.00	22.00			24.00	0.00		24.00		2.00	20.00	22.00

MANHATTAN WELLS IMPROVEMENT (RESTORATION) PROJECT

SCOPE OF WORK DOCUMENT

June 2011

Prepared by:

Los Angeles Department of Water and Power
Water Engineering and Technical Services
Water Master Planning

Rafael Villegas

necessary hydraulic grade. The calculated head loss in the pipe and valves assemblies that convey groundwater to the forebay is 2 ft, with all eight wells operating simultaneously. Total head loss is added to the high water elevation of the forebay, resulting in a hydraulic grade of 143 ft for the individual well pumps.

B. Project Detail

The site for the MHWIP is within the Water System-owned Manhattan Wells Facility. The proposed facility improvements are illustrated on the attached conceptual drawings, Attachments A, B & C.

1. Wells

Four groundwater wells and two monitoring wells are planned for construction.

a) Well Locations

Groundwater Management Group of the WQD will establish the locations of new wells, including the two monitoring wells. The wells are to be spaced far enough apart to minimize effect of pumping drawdown between wells. WQD will also coordinate and manage the work necessary to hire a drilling contractor to construct the required wells at the selected locations.

b) Operating Criteria

The four wells will have an estimated flow rate of 4 cfs per well. The wells will add an additional 16 cfs, increasing the total groundwater production capacity at the facility to 30 cfs. The selection of the number of new wells was based on the estimated production capacity per well, the production capacity of both Central Basin well fields, and the capacity needed to fully utilize annual groundwater entitlements.

c) Well Laterals

The preliminary calculations indicate that a 12-inch diameter pipe is adequate for the lateral connections to the wells. The design parameters are a maximum velocity of 5 ft per second and maximum head loss of 3 ft per 1000 ft. Both the collector line and flush line shall include one lateral connection per well.

d) Well Valves

A dual valve assembly will be required on each new and existing wellhead to divert flow to the storm drain system during flushing operations. Each wellhead should incorporate two 12-inch gate valves. Wellheads should also include a sample tap for water quality testing and a hose connection for Baker Tank usage, when necessary.

e) Corporation Stops

The California Department of Water Resources (DWR) has required that all wells be fitted with equipment to allow for the independent

Miluska Propersi

Subject: FW: GLAC P84, Round 3 - RMC Follow-Up Request for Information

---

From: Repp, Chris [mailto:Chris.Repp@ladwp.com]
Sent: Tuesday, June 10, 2014 4:36 PM
To: Miluska Propersi; Ching, Mark
Cc: Lamacchia, Chad; Brian Dietrick; Romy Sharafi; Reed, Greg; Lacombe, Sarah
Subject: RE: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Miluska/Brian,

I spoke with the individual group within LADWP that provides rough estimates on the breakdown between purchased SWP water vs. CRA water. The average is about 85% (SWP) / 15% (CRA).

Regards, Chris (213)367-4736

From: Ching, Mark [mailto:Mark.Ching@ladwp.com]
Sent: Monday, June 09, 2014 8:25 AM
To: Miluska Propersi
Cc: Repp, Chris; Lamacchia, Chad; Brian Dietrick
Subject: RE: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Hi Miluska,

Regarding the conference call, would you like to combine the call with Romy and the Burbank Interconnect Project? It is also our team that is working on that project and we may benefit from hearing each other's questions and concerns.

We are available this afternoon or tomorrow morning for the call, let us know what works for you. If neither, we can try to arrange for another time later this week. Thank you.

Regards,

Mark Ching
213.367.0794

From: Miluska Propersi [mailto:MPropersi@rmcwater.com]
Sent: Friday, June 06, 2014 1:37 PM
To: Ching, Mark
Cc: Repp, Chris; Lamacchia, Chad; Brian Dietrick
Subject: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Dear Mark,

Thank you for working with our team the past couple of weeks to provide information for the Prop. 84, Round 3 grant application. We understand that it can be overwhelming. Because of your responsiveness, we have made incredible progress; and we anticipate that we will have drafts for you to review by mid-June. Note that this is a little later than originally planned.

The reasons we are delaying have to do with the Final PSP that was released on Monday. First, the application deadline has been moved to July 21st (from July 3rd). And second, the Final PSP indicates a few additional items that we will need to develop the best possible grant application.

To help make your life as easy as possible, **I would like to schedule a conference call at your earliest convenience** to walk through this additional request for information and answer any questions you may have. Please let me know when you are available.

The additional information we will need is summarized below:

1. **Detailed Budget** (template and example attached) – Originally we thought this would not be needed until Conditional Acceptance (expected Fall 2014), but now we are realizing that it would be prudent to confirm and document all cost information now. We only need to provide a budget summary by July 21st yet the summary is highly dependent on the detailed costs and reference documents (all of which need to be consistent).
2. **Reference Documents for Detailed Budget –** needed so that RMC can double-check all Budget information
3. **Drought Impacts information** (template attached) – the Final PSP gives more clarification on what DWR is expecting, so we have developed an approach that we could use your input on
4. **Specific Questions Related to the Manhattan Wells Improvement Project**:
    a. What is the percent blend of imported water for your agency (i.e., % SWP and % CRA)?
    b. Can you provide more detail on the container packaged treatment unit. Is this part of a second phase of the project? We want to clarify what the project is and guarantee that benefits will be provided, especially since we say that part of the reason the GW rights aren't used is because of contamination.
    c. How come WRD is administering the contract if LADWP is implementing the project?
    d. For the annual benefits, you indicated a portion (16.7%) will start in 2017 and full benefits will start in 2018. Since construction ends in October 2016, why don't we have the full benefits starting in 2017?
    e. In the "Watermaster Service in the Central Basin, 2009-2013, Table 1" reference, it is not clearly indicated that LADWP pumped 8,920 afy of groundwater from 2009-2013. Is there another table or reference that shows LADWP's pumping amount from 2009-2013 and the APA of 15,000 AFY?

Thanks again for your patience and cooperation in this very important grant process!

Sincerely,

Miluska
Miluska Propersi, P.E.
Water Resources Engineer

RMC Water and Environment
2400 Broadway, Suite 300
Santa Monica, CA 90404
P: 310.566.6460

mpropersi@rmcwater.com | www.rmcwater.com
RMC water and environment
Complex Challenges | Innovative Solutions

Groundwater Assessment Study

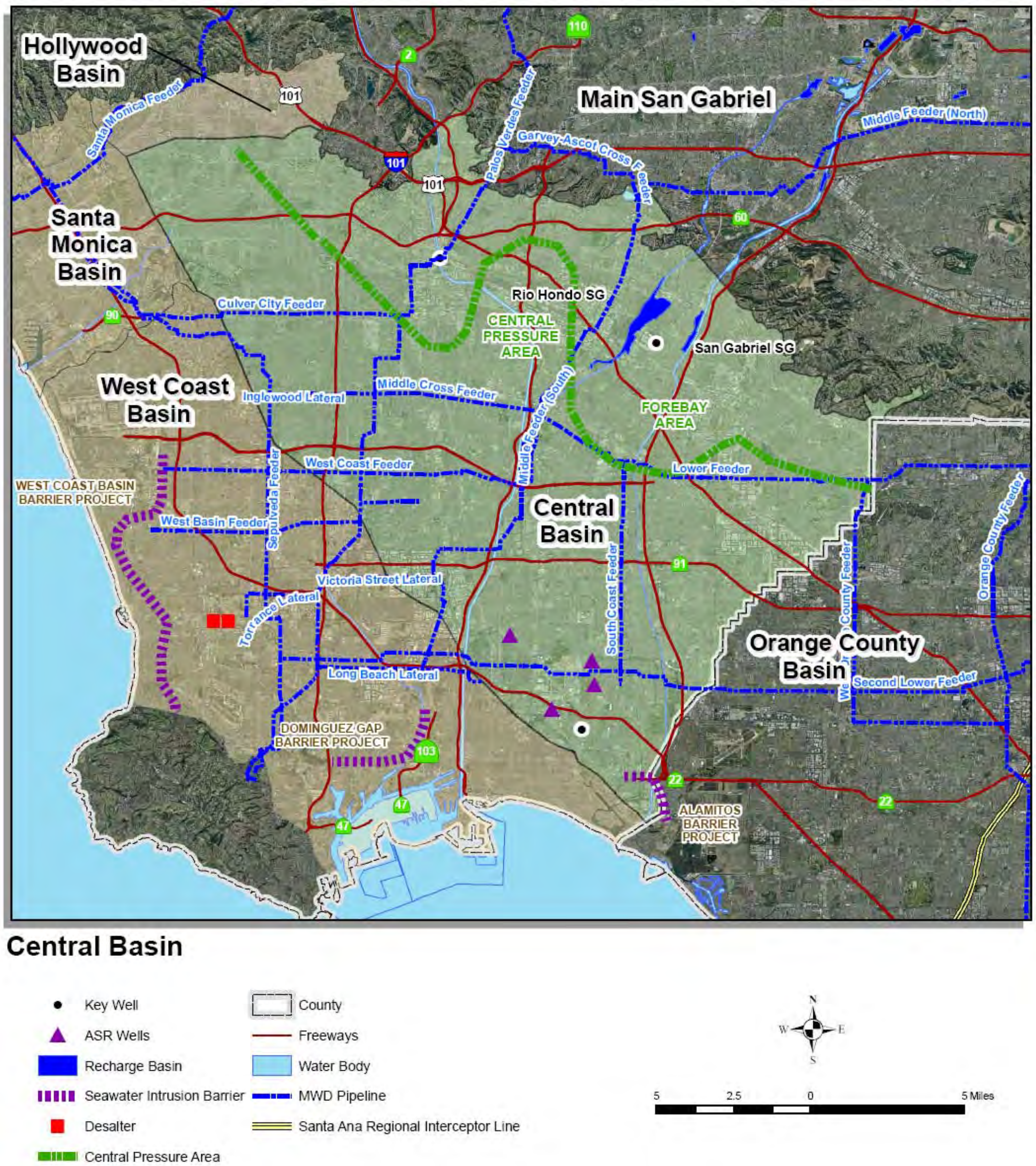
A Status Report on the Use of Groundwater in the Service Area of the Metropolitan Water District of Southern California

Report Number 1308

September 2007

The Central Basin lies within central Los Angeles County, California. It underlies the service areas of Metropolitan member agencies Central Basin Municipal Water District (Central Basin MWD), West Basin Municipal Water District (West Basin MWD), the City of Compton, the City of Los Angeles, and the City of Long Beach. The cities of Artesia, Bellflower, Cerritos, Compton, Downey, Huntington Park, Lakewood, Los Angeles, Long Beach, Montebello, Paramount, Pico Rivera, Norwalk, Santa Fe Springs, Signal Hill, South Gate, Vernon and Whittier overlie the basin. A map of the Central Basin is provided in **Figure 3-1**.

Figure 3-1
Map of Central Basin



BASIN CHARACTERIZATION

The following section provides a physical description of the Central Basin, including its geographic location and hydrogeologic character.

Basin Producing Zones and Storage Capacity

The Central Basin is bounded on the northeast and east by the Elysian, Repetto, Merced and Puente Hills. The southeast boundary of the Central Basin is along Coyote Creek, which is used to separate the Central Basin from the Orange County Basin, although there is no physical barrier between the two basins. The southwest boundary is the Newport, Inglewood fault system. The hydrogeologic parameters of the Central Basin are summarized in **Table 3-1 and Figure 3-2**.

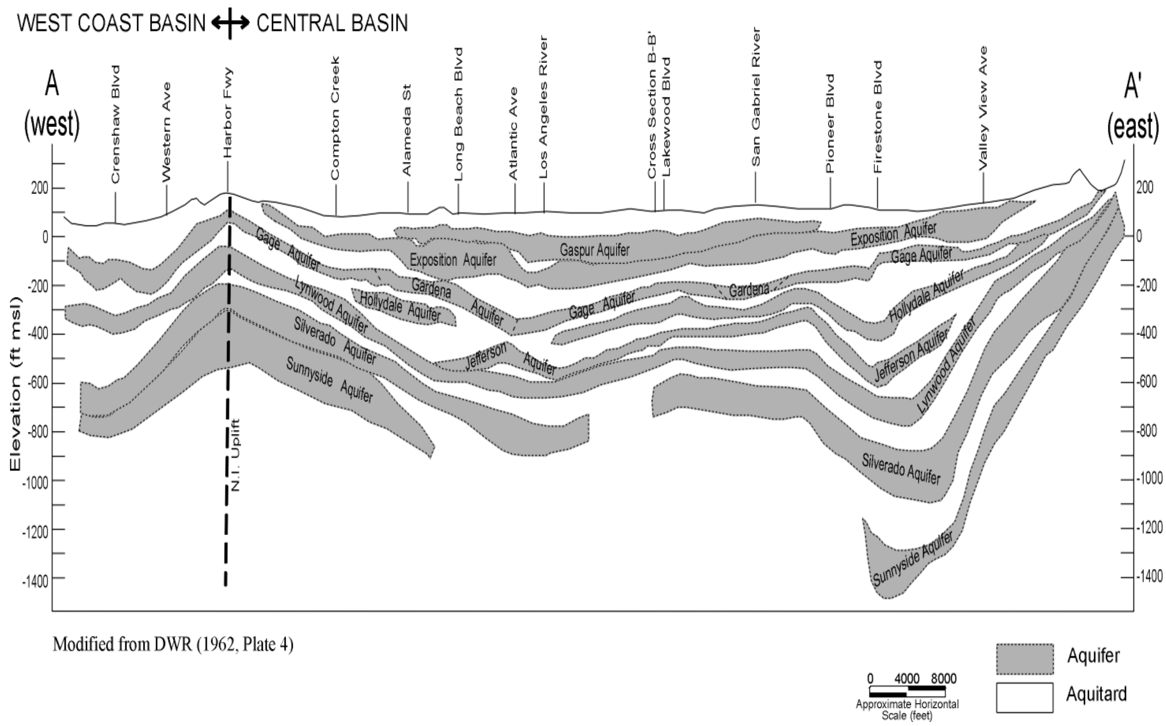
Table 3-1
Summary of Hydrogeologic Parameters of Central Basin

Parameter Structure	Description
Aquifer(s)	Forebay areas (unconfined) Pressure area (confined) • Alluvium (Gaspur and Semi-perched aquifers) • Lakewood Formation (Gardena and Gage aquifers) • San Pedro Formation (Lynwood, Silverado, and Sunnyside aquifers)
Depth of groundwater basin	Forebay areas – up to 1,600 feet Pressure area – up to 2,200 feet
Thickness of water-bearing units	Alluvium (up to 180 feet) Lakewood Formation (up to 280 feet) San Pedro Formation (up to 800 feet)
Yield and storage	
Natural safe yield	125,805 AFY
Allowable Pumping Allocation and Managed Safe Yield	217,367 AFY
Total Storage	13.8 million AF
Unused Storage Space	1.1 million AF
Portion of Unused Storage Available for Storage	330,000 AF

WRD, 2006a and WRD, 2006e

The depth of the Central Basin ranges from 1,600 to more than 2,200 feet. The main source of potable groundwater in the Central Basin is from the deeper aquifers of the San Pedro Formation (including from top to bottom, the Lynwood, Silverado and Sunnyside aquifers), which generally correlate with the Main and Lower San Pedro aquifers of Orange County. The shallower aquifers of the Alluvium and the Lakewood Formation (including the Gaspur, Exposition, Gardena-Gage, Hollydale and Jefferson aquifers) locally produce smaller volumes of potable water. In the northern portions of the Central Basin, referred to as the Forebay Area, many of the aquifers are merged and allow for direct recharge into the deeper aquifers. In the area referred to as the Pressure Area, the aquifers are separated by thick aquitards, which create confined aquifer conditions and protection from surface contamination.

Figure 3-2
Generalized Cross Section of Central Basin



Source: WRD, 2006

Total storage in the Central Basin is estimated to be approximately 13.8 million AF. Unused storage space is estimated to be approximately 1.1 million AF. Of the unused storage space, the amount available is approximately 330,000 AF assuming that up to 75 feet below the ground surface is actually available (WRD, 2006e).

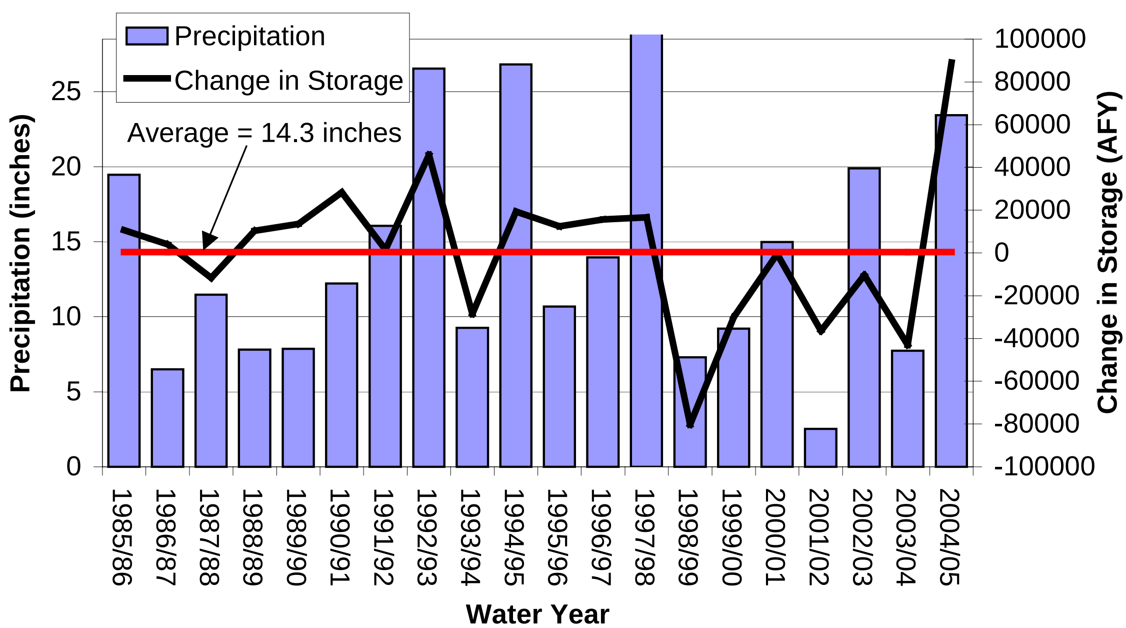
Safe Yield/Long-Term Balance of Recharge and Discharge

According to the California Department of Water Resources (DWR), groundwater enters the Central Basin through surface and subsurface flow and by direct percolation of precipitation, stream flow, and applied water in the forebay areas. Natural replenishment of the groundwater is largely from surface and subsurface inflow through Whittier Narrows. Percolation in the

Los Angeles Forebay from the north is restricted as a result of urbanization at the surface, which prevents downward percolation (DWR, 2004). The natural safe yield of the Central Basin is approximately 125,805 AFY (WRD, 2006e), which represents the amount of water from native waters alone. The managed safe yield of Central Basin is equal to the allowable pumping allocation amount of 217,367 AFY, which is substantially higher than the natural safe yield. This higher yield is possible because of artificial recharge maintained by the Water Replenishment District of Southern California (WRD).

Figure 3-3 shows the historical precipitation as it relates to the change in storage calculated by WRD (2006c). These data show that the average precipitation over the Central Basin is approximately 14.3 inches per year. In general, storage in the Central Basin increases during wet years and decreases during dry years. As discussed below, the amount of recharge in the forebay areas is also a controlling factor in the change in storage that may or may not be related to wet year and dry year cycles. The average change in storage between water year 1985/86 and water year 2004/05 was approximately 1,300 AFY, suggesting that the basin was nearly balanced.

Figure 3-3
Historical Precipitation and Change in Storage for Central Basin



GROUNDWATER MANAGEMENT

The following section describes how the Central Basin is currently managed.

Basin Governance

The Central Basin is an adjudicated basin. It was adjudicated in October 1965 with adjudicated rights set at 267,900 AFY (WRD, 2006f). The amount of the adjudicated water rights that can be pumped each year (Allowable Pumping Allocation, or APA) is limited to approximately 80 percent of the total adjudicated amount (217,367 AFY).

The Judgment allows annual overpumping of 20 percent of the APA as well as carryover of up to 20 percent of the APA. The DWR serves as Watermaster. The Water Replenishment District of Southern California (WRD), established in 1959, has the statutory authority to replenish the groundwater basin and address water quality issues. The Los Angeles County Department of Public Works (LACDPW) owns and operates the Montebello Forebay Spreading Grounds and the portion of the Alamitos Barrier Project located within Los Angeles County; Orange County Water District operates the Orange County section. WRD procures imported and recycled water to be recharged by LACDPW at these facilities. Table 3-2 provides a list of the management agencies in the Central Basin.

As discussed above, the Judgment APA is 217,367 AFY. However, natural recharge does not support this annual amount of pumping, and the APA exceeds the natural safe yield of the basin and is dependent upon artificial recharge of imported and reclaimed water. Each year WRD makes a determination of the amount of supplemental recharge that is needed based on an estimation of the ensuing year's groundwater production and an estimation of the annual change in storage based on groundwater levels collected throughout the basin.

Table 3-2
Summary of Management Agencies for Central Basin

Agency	Role
California Department of Water Resources	Court appointed Watermaster to administer the Judgment
Water Replenishment District of Southern California	Replenish groundwater, address water quality, administer storage in Central and West Coast Basins
Los Angeles County Department of Public Works	Operation of spreading facilities and Alamitos Barrier facilities
Sanitation Districts of Los Angeles County	Producer of recycled water for Montebello Forebay Spreading Grounds
California Regional Water Quality Control Board – Los Angeles Region (Regional Board)	Issuance of permits for spreading of recycled water in Montebello Forebay and injection of recycled water in seawater intrusion barriers

Note: WRD's authority to administer storage is the subject of disagreement among basin parties.

The WRD adopted Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins in May 2005. The rules govern storage in the basins outside and above the adjudicated water rights that would utilize up to 450,000 AF of unused space in the two basins. As of June 2006, the interim rules were the subject of on-going controversy among some groundwater producers in the basins and WRD.

Available storage capacity addressed by WRD Interim Rules is 450,000 AF (330,000 AF in Central Basin and 120,000 AF in West Coast Basin). This estimated capacity is based upon modeling and takes into account requirements that the water level be 75 feet or more below ground surface. However, this analysis did not include potential water quality impacts from contaminated sites in the basin. These could reduce the amount of storage space available if rising water can interact with the contamination. Detailed studies to look at these issues and others are part of the review process prior to approval of a storage project.

Interactions with Adjoining Basins

Central Basin receives subsurface inflow from the San Fernando Basin via downward percolation from the Los Angeles River (Los Angeles Forebay). The Los Angeles Forebay was historically a recharge area from the Los Angeles River. This forebay's recharge capacity has been substantially reduced since the river channel was lined. Recharge is now limited to deep percolation of precipitation, in-lieu when available, and subsurface inflow from the Montebello Forebay to the east, the Hollywood Basin and relatively small amounts from the San Fernando Valley through the Los Angeles Narrows.

The Montebello Forebay, located in the northeastern portion of the Central Basin, connects the Main San Gabriel Basin to the north with the Central Basin via the Whittier Narrows. The Rio Hondo and San Gabriel River spreading grounds in the forebay provide the vast majority of surface recharge to the Central Basin aquifers. Judgment in Case No. 722647 entered in September 1965, provides an adjudication of Upper and Lower Areas on the San Gabriel River. The San Gabriel River Watermaster prepares an annual Watermaster Report providing an accounting of water received, credits, and make-up water.

The Newport Inglewood Uplift separates the Central Basin from the West Coast Basin. Groundwater moves across the uplift, but its movement is slow and restricted because of low permeability sediments and offset of aquifers along the fault.

The boundary with Orange County Basin is not a barrier to flow. Therefore, water can flow between the two basins.

WATER SUPPLY FACILITIES AND OPERATIONS

The following provides a summary of the facilities within the Central Basin. Key storage and extraction facilities include nearly 500 production wells and associated facilities, the Rio Hondo and San Gabriel River spreading grounds and the Alamitos Barrier Project.

Municipal Production Wells

Table 3-3 provides a summary of the production wells in the Central Basin.

There are approximately 497 production wells in the Central Basin (WRD, 2006d). Of the 384 municipal wells identified by WRD (2006d), 367 of these are active and 17 are inactive. Poor water quality is the primary reason for inactive wells. Capacity of wells is not available at this time. WRD estimates that typical groundwater pumping costs for energy are about $65/AF.

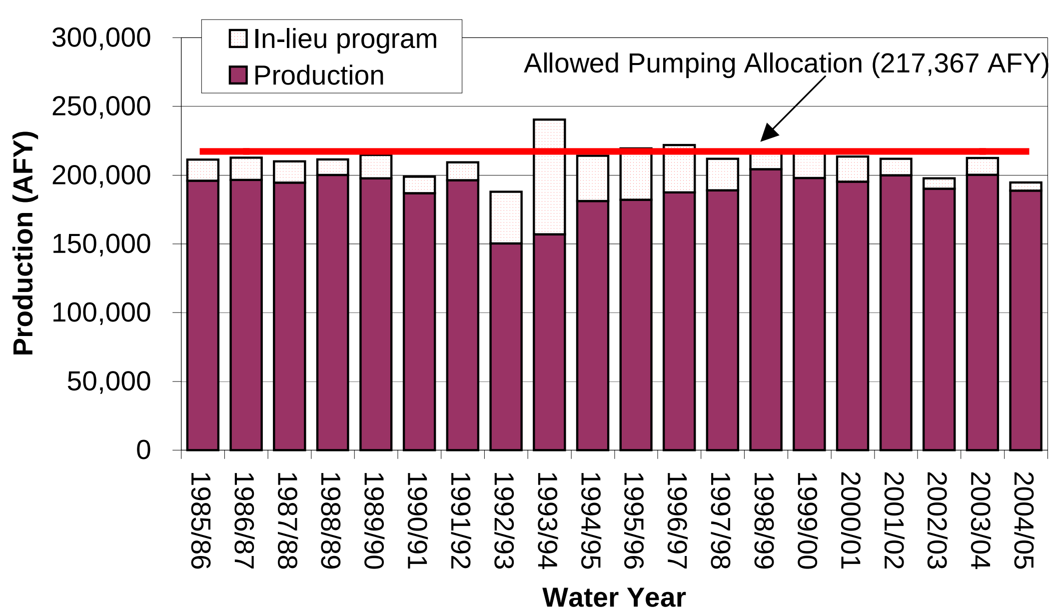
Table 3-3
Summary of Production Wells in the Central Basin

Category	Number of Wells	Estimated Production Capacity (AFY)	Average Production 1985-2004 (AFY)	Well Operation Cost ($/AF)
Municipal	384	Data not available	189,597	$65 Pumping cost
Active	367			
Inactive	17			
Other	113			
Total	**497**			

Source: WRD, 2006d

Production between 1985 and 2004 has ranged from 150,386 AFY to 204,418 AFY with an average of 189,597 AFY. These data are summarized in **Figure 3-4**.

Figure 3-4
Summary of Historical Production in Central Basin



The majority of groundwater production is from the deeper San Pedro Formation including the Lynwood, Silverado, and Sunnyside aquifers (WRD, 2006b). Note that production has been below the APA for the past 20 years.

Central Basin producers participate in an in-lieu groundwater replenishment program whereby they receive imported water purchased from Metropolitan in lieu of pumping groundwater and administered by WRD. In-lieu storage is included in **Figure 3-4**. Between water year 1985/86 and 2004/05, about 22,000 AFY was stored in-lieu. These and other storage programs are discussed in more detail below.

Other Production

According to WRD (2006d), there are approximately 113 other non-municipal wells in the Central Basin. Status information for these wells is not available.

ASR Wells

Two new ASR wells have recently been constructed in the City of Long Beach. In addition, two existing wells have been converted to ASR. The combined extraction capacity of the four wells is estimated to be at least 4,333 AFY. Injection capacity of the ASR wells is estimated to exceed 3,250 AFY.

Spreading Basins

There are currently three primary spreading areas, covering more than 1,000 acres within the Central Basin. The details of these facilities are summarized in **Table 3-4**. The gross capacity of the spreading areas is nearly 398,000 AFY but is limited by mounding and other factors. LACDPW spreads runoff, imported water from Metropolitan and recycled water on behalf of WRD for recharge in the Central Basin.

Total average annual spreading at the Rio Hondo and San Gabriel River Spreading Grounds in the Montebello Forebay for the 20-year period between water years 1985/86 and 2004/05 was approximately 135,000 AFY, with a range of approximately 68,000 AFY to more than 205,000 AFY. Spreading utilizes local runoff, untreated imported water, and recycled water. These data are summarized in **Figure 3-5**.

The Regional Board permit for recharge of recycled water limits recycled water spreading to the lesser of 60,000 AFY or an amount not to exceed 50 percent of the total inflow into the Montebello Forebay for that year. In addition, recycled water shall not exceed 150,000 AF in any three-year period or 35 percent of the total inflow to the forebay.

Seawater Intrusion Barriers

The Alamitos Barrier Project consists of 43 wells with a combined injection capacity of 15 cfs and four extraction wells in the Alamitos Gap in Long Beach (DWR, 2005;WRD, 2006d). The barrier utilizes imported water purchased from the City of Long Beach or recycled water from WRD's Leo J. Vander Lans Advanced Water Treatment Facility that went on-line in 2006.

Figure 3-5
Historical Direct Groundwater Recharge in Central Basin

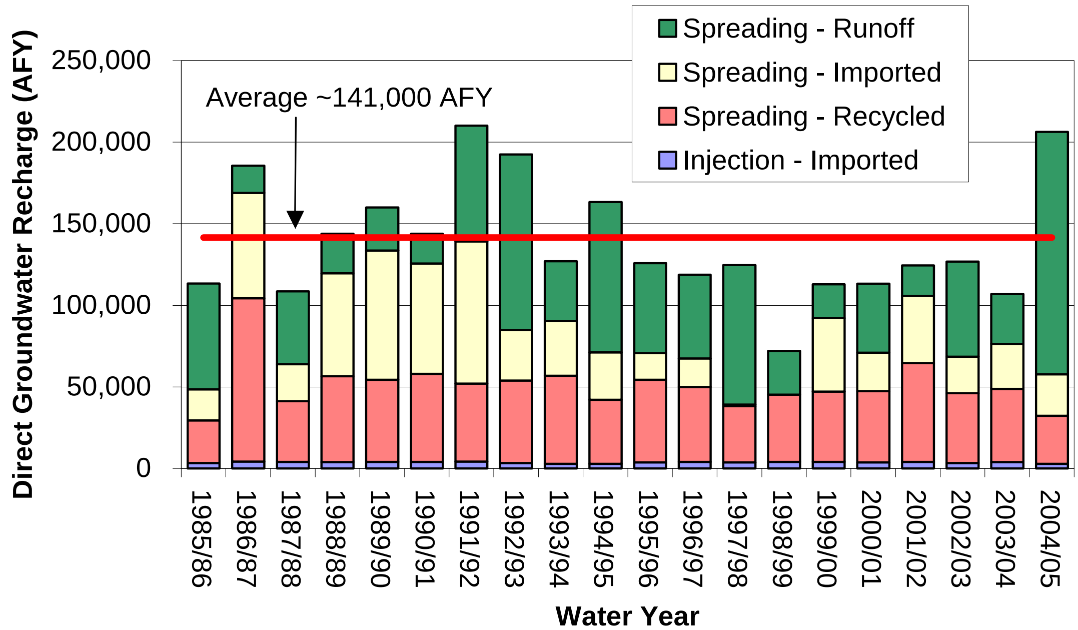


Table 3-4
Summary of Recharge Basins in the Central Basin

Spreading Basin	Area (acres)	Wetted Area (acres)	Recharge Capacity (cfs)	Recharge Capacity (AFY)	Source Water	Owner
Rio Hondo Spreading Grounds	570	430	400	~290,000	Runoff Imported Recycled	LACDPW
San Gabriel River (Basins)	128	96	75	54,000	Runoff Imported Recycled	LACDPW
San Gabriel River (River)	308	308	75	54,000	Runoff Imported Recycled	LACDPW
Total	**1,006**	**834**	**550**	**~398,000**	**--**	**--**

Source: LACDPW, 2006

Injection of imported water at the Alamitos Barrier Project in Central Basin has averaged about 3,711 AFY with a range of 2,800 AFY to 4,200 AFY.

Desalters

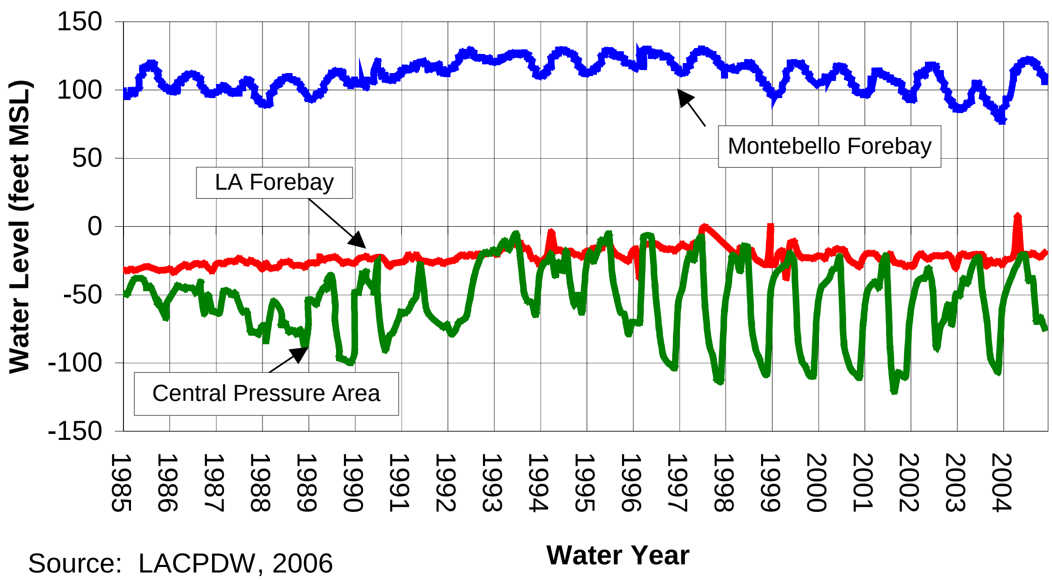
There are no desalters in Central Basin.

GROUNDWATER LEVELS

Historically, groundwater flow in the Central Basin has been from the recharge areas in the northeast toward the Pacific Ocean on the southwest. Pumping patterns have lowered the water level in large portions of the Central Basin. Historical water levels in key wells in various locations in the basin are summarized in **Figure 3-6**. These data, like the precipitation and storage data discussed above, suggest that the water levels have been relatively stable over the past 20 years.

As shown in **Figure 3-7**, in 2005, Central Basin water levels ranged from a high of about 160 feet above mean sea level (MSL) in the northeast portion of the basin upgradient of the spreading grounds to a low of about 90 feet below MSL in the Long Beach area.

Figure 3-6
Historical Water Levels in the Central Basin

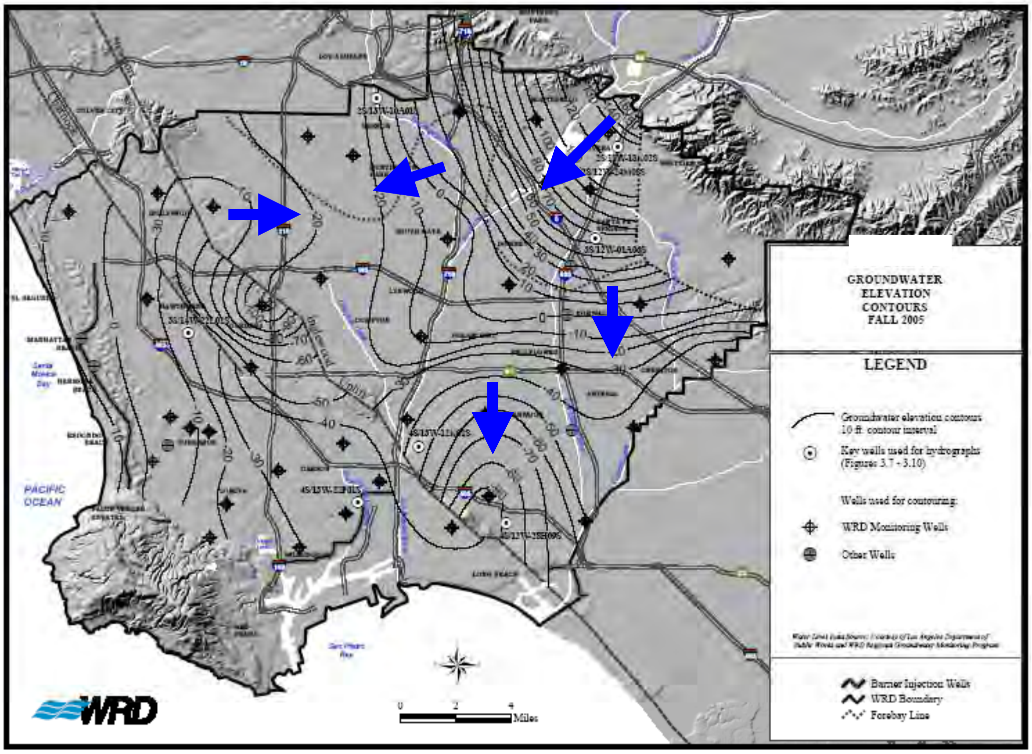


Source: LACPDW, 2006

GROUNDWATER QUALITY

In general, groundwater in the main producing aquifers of the basin is of good quality. Localized areas of marginal to poor water quality exist, primarily on the basin margins and in the shallower and deeper aquifers impacted by seawater intrusion. The following section provides a brief description of the groundwater quality issues in the Central Basin.

Figure 3-7
Groundwater Elevation Contours – Fall 2005



Groundwater Quality Monitoring

In 1995, WRD and the U.S. Geological Survey (USGS) began a cooperative study to improve the understanding of the geohydrology and geochemistry of Central and West Coast Basins. Out of this effort, came WRD's geographic information system (GIS) and the Regional Groundwater Monitoring Program. Twenty-one depth-specific, nested monitoring wells located throughout the basin, allow water quality and groundwater levels to be evaluated on an aquifer-specific basis. Regional Groundwater Monitoring Reports are published by WRD for each water year. Constituents monitored include: TDS, iron, manganese, nitrate, TCE, PCE, arsenic, chromium including hexavalent chromium, MTBE, and perchlorate.

Groundwater Contaminants

As shown in **Table 3-5**, volatile organic compounds (VOCs), primarily tetrachlororoethylene (PCE) and trichloroethylene (TCE), are present in the Central Basin and have impacted many production wells. However, most of the wells that have the VOCs do not exceed drinking water quality standards (WRD, 2006b). Those with higher levels require treatment prior to use as drinking water. Treatment programs in Central Basin are discussed in more detail below.

Table 3-5
Summary of Constituents of Concern in Central Basin

Constituent	Units	Range	Description
TDS Secondary MCL = 500	mg/L	170 to 2,770 Average: 500	WRD is conducting studies to identify potential sources of high TDS, which may be caused by localized seawater intrusion or connate and oil field brines. Range in production wells 250 mg/L to 750 mg/L. Higher TDS concentrations located in northern portion of basin.
VOCs **(TCE and PCE)** TCE MCL = 5 PCE MCL = 5	µg/L	ND to 32 for TCE ND to 8.3 for PCE	Concentrations in 15 wells exceeded MCL for TCE Concentrations in 68 wells exceed MCL for PCE
Perchlorate Notification level =6	µg/L	Less than 6 µg/L	Detected in 5 monitoring wells and three production wells below notification level
Nitrate (as N) MCL = 10	mg/L	ND to 12	Higher concentrations tend to be limited to the uppermost zones and are likely due to localized infiltration and leaching. One production well in the Los Angeles Forebay area has exceed the 10 mg/L MCL. No wells in Silverado aquifer exceeded the 10 mg/L MCL.
Iron and manganese Secondary MCL for iron = 0.3 Secondary MCL manganese = 0.05	mg/L	ND to 8.4 for iron ND to 1.3 for manganese	Some localized wells exceed secondary standard (0.3 mg/L and 0.05, respectively) for iron and manganese.
Chromium MCL = 50	µg/L	Not available	Detected above MCL in one monitoring well and three production wells in the vicinity of the forebay areas

Source: WRD, 2006b

WRD has taken a proactive approach to protecting the basins in the face of emerging water quality issues. Through its monitoring and sampling program and evaluation of current water quality regulations, WRD has determined that the special interest constituents including arsenic, hexavalent chromium, methyl tertiary butyl ether (MTBE), total organic carbon, color and perchlorate do not pose a substantive threat to the basins (WRD, 2006b).

Blending Needs

Data related to blending needs and practices are not available for the Central Basin.

Groundwater Treatment

As discussed above, VOCs including TCE and PCE have been detected and are currently treated in the Central Basin. To mitigate this problem, the WRD established a Safe Drinking Water Program as part of its Clean Water Program in 1991. This program began as a means to provide basin pumpers with wellhead treatment equipment to remove VOCs from the groundwater, allowing affected wells to meet public drinking water standards. The program promotes the cleanup of groundwater resources at specific well locations and is accomplished through partnerships with well owners. The WRD Safe Drinking Water Program also makes local groundwater reserves available that would otherwise be lost to contamination. There are a total of eleven facilities online with several projects in various stages of completion (WRD, 2007).

About 9,200 AF was treated in fiscal year 2004/05 for VOCs, iron and manganese. This represents about five percent of the total water produced in Central Basin during 2004/05. About 330 AF of the water treated in Central Basin in 2004/05 was treated for iron and manganese under Metropolitan's LRP Groundwater Recovery Projects Program (Metropolitan, 2006).

EXISTING STORAGE PROGRAMS

WRD operates an in-lieu replenishment program in the Central Basin. An average of about 21,000 AFY of in-lieu storage was generated through this program between water years 1985/86 and 2004/05. In addition, as discussed below, a few member agencies participate in Metropolitan's conjunctive use storage program. These in-lieu data are summarized in **Figure 3-8**.

Metropolitan has recently implemented three conjunctive programs under the Proposition 13 program in the Central Basin. These include programs in the cities of Long Beach, Lakewood, and Compton. Each of these programs is described in **Table 3-6**. Total storage from these programs is 18,895 AF. About 15,394 AF, or about 80 percent of the programs, is currently in storage under these combined programs.

Figure 3-8
Historical In-lieu Storage for Central Basin

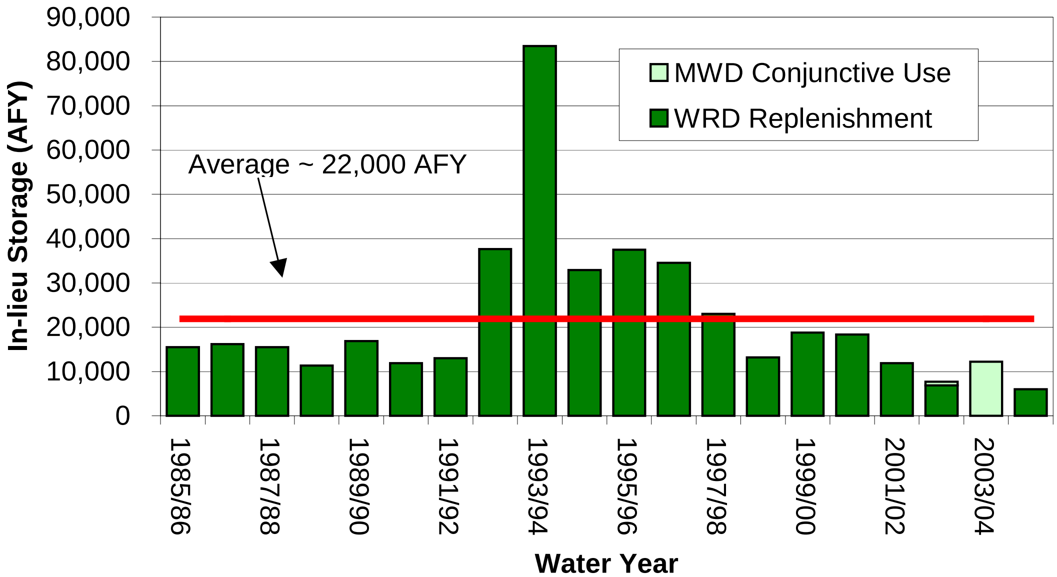


Table 3-6
Conjunctive Use Programs in the Central Basin

Program	Member Agencies	Year Began	Total Storage (AF)	Amount in storage [1] (AF)
Long Beach Conjunctive Use Program (Phase 1)	City of Long Beach	2002	13,000	13,000
Long Beach Conjunctive Use Program (Phase 2)	City of Long Beach	2005	3,600	1,800
Compton Conjunctive Use Program	City of Compton	2005	2,295	1,144
Total	--	--	**18,895**	**15,944**

Notes: 1 Amount in storage at end of fiscal year 2005/06

BASIN MANAGEMENT CONSIDERATIONS

Considerations in the Central Basin include:

- Extraction is limited by the Judgment and the APA. The 20 percent allowed over pumping and carryover is administered by the Watermaster and subject to the provisions of the Central Basin Judgment.
- Disagreements related to the Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins may limit the ability to store and extract water in the Central Basin. At this time, the approval of storage projects is administered by WRD using the framework defined in the Interim Rules for Conjunctive Use Storage and In-Lieu Exchange and Recovery in the Central and West Coast Basins.
- Spreading of recycled water is regulated by the Regional Board and limits the amount of recycled water that can be spread. The Regional Board permit for recharge of recycled water limits recycled water spreading to the lesser of 60,000 AFY or an amount not to exceed 50 percent of the total inflow into the Montebello Forebay for that year. In addition, recycled water shall not exceed 150,000 AF in any three-year period or 35 percent of the total inflow to the forebay.
- Potential for liquefaction and water quality concerns could limit the ability to store water.

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Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

Energy Intensity of Water Supplies for West Basin Municipal Water District

	af/yr	Percentage of Total Source Type	kWh/af Conveyance Pumping	kWh/af MWD Treatment	kWh/af Recycled Treatment	kWh/af Groundwater Pumping	kWh/af Groundwater Treatment	kWh/af Desalination	kWh/af WBMWD Distribution	Total kWh/af	Total kWh/year
Imported Deliveries											
State Water Project (SWP) [1]	57,559	43%	3,000	44	NA	NA	NA	NA	0	3,044	175,209,596
Colorado River Aqueduct (CRA) [1] (other that replenishment water)	76,300	57%	2,000	44	NA	NA	NA	NA	0	2,044	155,957,200
Groundwater[2]											
natural recharge	19,720	40%	NA	NA	NA	350	0	NA	0	350	6,902,030
replenished with (injected) SWP water [1]	9,367	19%	3,000	44	NA	350	0	NA	0	3,394	31,791,598
replenished with (injected) CRA water [1]	11,831	24%	2,000	44	NA	350	0	NA	0	2,394	28,323,432
replenished with (injected) recycled water	8,381	17%	205	0	790	350	0	NA	220	1,565	13,116,278
Recycled Water											
West Basin Treatment, Title 22	21,506	60%	205	NA	0	NA	NA	NA	285	490	10,537,940
West Basin Treatment, RO	14,337	40%	205	NA	790	NA	NA	NA	285	1,280	18,351,360
	35,843										
Ocean Desalination	20,000	100%	200	NA	NA	NA	NA	3,027	460	3,687	82,588,800

Notes:

NA Not applicable

1 Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

2 Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

WEST INFORMATION OFFICE
San Francisco, Calif.

For release Tuesday, May 20, 2014 **14-910-SAN**

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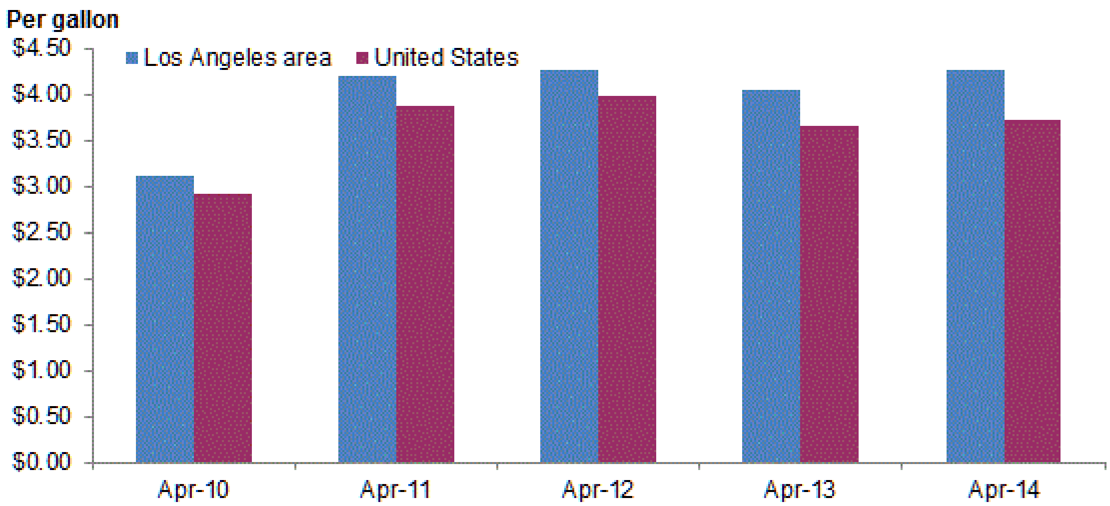
AVERAGE ENERGY PRICES, LOS ANGELES-RIVERSIDE-ORANGE COUNTY APRIL 2014

Gasoline prices averaged $4.263 a gallon in the Los Angeles-Riverside-Orange County area in April 2014, the U.S. Bureau of Labor Statistics reported today. Regional Commissioner Richard J. Holden noted that area gasoline prices were down 22.0 cents compared to last April when they averaged $4.043 per gallon. Los Angeles area households paid an average of 17.8 cents per kilowatt hour (kWh) of electricity in April 2014, down from 21.6 cents per kWh in April 2013. The average cost of utility (piped) gas at $1.211 per therm in April was more than the 1.077 cents per therm spent last year. (Data in this release are not seasonally adjusted; accordingly, over-the-year-analysis is used throughout.)

At $4.263 a gallon, Los Angeles area consumers paid 14.7 percent more than the $3.717 national average in April 2014. A year earlier, consumers in the Los Angeles area paid 10.9 percent more than the national average for a gallon of gasoline. The local price of a gallon of gasoline has exceeded the national average by at least 6 percent in the month of April in each of the past five years.
(See chart 1.)

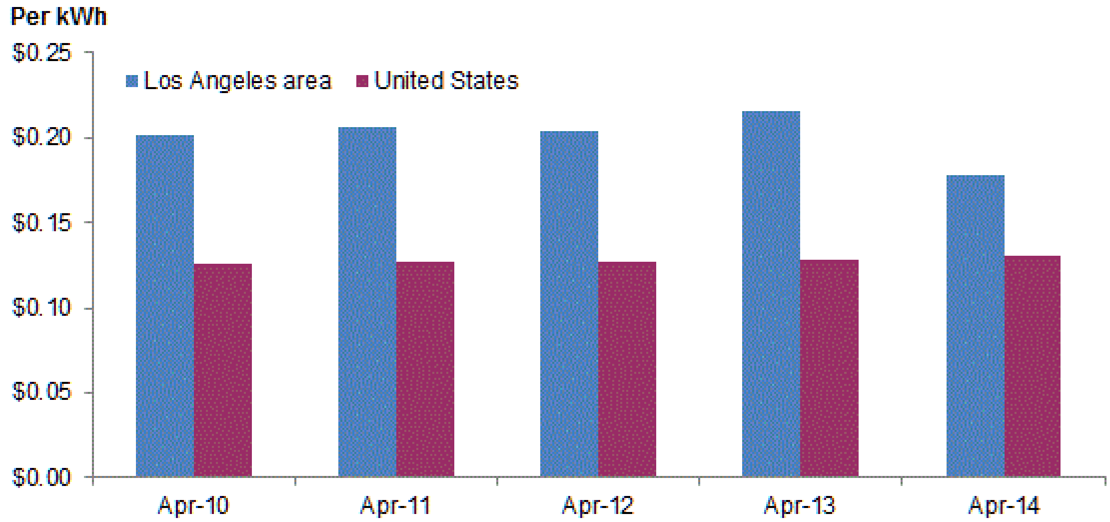
Chart 1. Average prices for gasoline, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)



SOURCE: U.S. Bureau of Labor Statistics.

The 17.8 cents per kWh Los Angeles households paid for electricity in April 2014 was 35.9 percent more than the nationwide average of 13.1 cents per kWh. Last April, electricity costs were 68.8 percent higher in Los Angeles compared to the nation. In the past five years, prices paid by Los Angeles area consumers for electricity exceeded the U.S. average by 35.9 percent or more in the month of April. (See chart 2.)

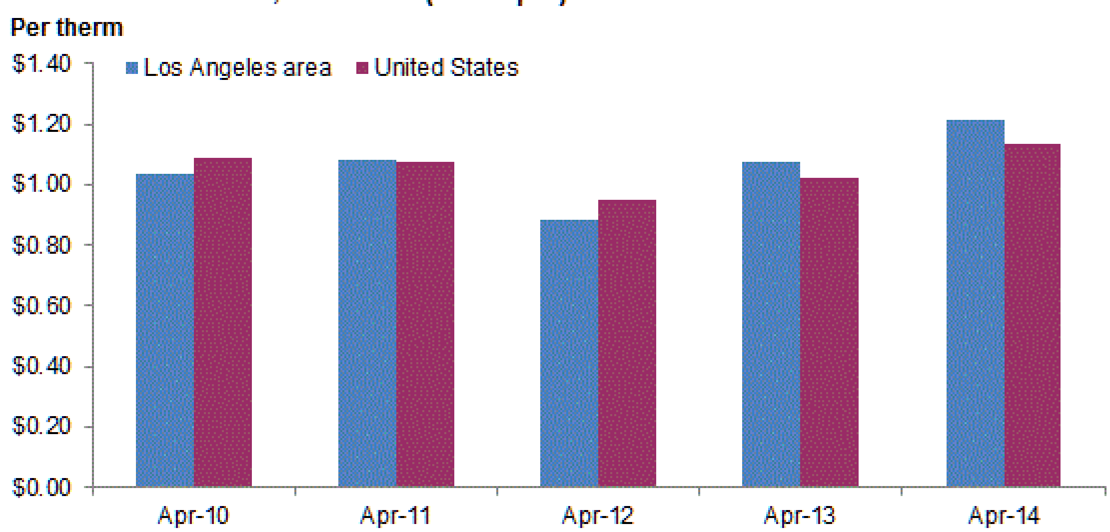
Chart 2. Average prices for electrictity, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)



SOURCE: U.S. Bureau of Labor Statistics.

Prices paid by Los Angeles area consumers for utility (piped) gas, commonly referred to as natural gas, were $1.211 per therm, or 6.5 percent more compared to the national average in April 2014 ($1.137 per therm). A year earlier, area consumers paid 5.6 percent more per therm for natural gas compared to the nation. In the Los Angeles area over the past five years, the per therm cost for natural gas in April has varied between 7.2 percent below and 6.5 percent above the U.S. average.
(See chart 3.)

Chart 3. Average prices for utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, 2010-2014 (as of April)



SOURCE: U.S. Bureau of Labor Statistics.

The Los Angeles-Riverside-Orange County, Calif. metropolitan area consists of Los Angeles, Orange, Riverside, San Bernardino and Ventura Counties in California.

Technical Note

Average prices are estimated from Consumer Price Index (CPI) data for selected commodity series to support the research and analytic needs of CPI data users. Average prices for electricity, utility (piped) gas, and gasoline are published monthly for the U.S. city average, the 4 regions, the 3 population size classes, 10 region/size-class cross-classifications, and the 14 largest local index areas. For electricity, average prices per kilowatt-hour (kWh) and per 500 kWh are published. For utility (piped) gas, average prices per therm, per 40 therms, and per 100 therms are published. For gasoline, the average price per gallon is published. Average prices for commonly available grades of gasoline are published as well as the average price across all grades.

Price quotes for 40 therms and 100 therms of utility (piped) gas and for 500 kWh of electricity are collected in sample outlets for use in the average price programs only. Since they are for specified consumption amounts, they are not used in the CPI. All other price quotes used for average price estimation are regular CPI data.

With the exception of the 40 therms, 100 therms, and 500 kWh price quotes, all eligible prices are converted to a price per normalized quantity. These prices are then used to estimate a price for a defined fixed quantity.

The average price per kilowatt-hour represents the total bill divided by the kilowatt-hour usage. The total bill is the sum of all items applicable to all consumers appearing on an electricity bill including, but not limited to, variable rates per kWh, fixed costs, taxes, surcharges, and credits. This calculation also applies to the average price per therm for utility (piped) gas.

Information from this release will be made available to sensory impaired individuals upon request. Voice phone: 202-691-5200, Federal Relay Service: 800-877-8339.

Table 1. Average prices for gasoline, electricty, and utility (piped) gas, Los Angeles-Riverside-Orange County and the United States, April 2013-April 2014, not seasonally adjusted

	Gasoline per gallon		Electricity per kWh		Utillity (piped) gas per therm	
	Los Angeles area	United States	Los Angeles area	United States	Los Angeles area	United States
2013						
April	$4.043	$3.647	$0.216	$0.128	$1.077	$1.020
May	4.060	3.682	0.216	0.131	1.200	1.036
June	4.073	3.693	0.203	0.137	1.275	1.038
July	4.115	3.687	0.203	0.137	1.239	1.025
August	3.955	3.658	0.203	0.137	1.230	1.003
September	4.008	3.616	0.203	0.137	1.183	1.000
October	3.767	3.434	0.215	0.132	1.175	0.999
November	3.651	3.310	0.215	0.130	1.113	0.999
December	3.661	3.333	0.220	0.131	1.109	0.998
2014						
January	3.665	3.378	0.215	0.134	1.195	1.040
February	3.812	3.422	0.215	0.134	1.236	1.078
March	4.046	3.590	0.215	0.135	1.321	1.154
April	4.263	3.717	0.178	0.131	1.211	1.137

Manhattan Wells Improvement Project - Energy Calculations

Central Basin				Reference/Notes
Information	Groundwater Pumping Cost (2007):	$65.0	per acre-foot	http://www.mwdh2o.com/mwdh2o/pages/yourwater/supply/groundwater/gwas.html
	Groundwater Pumping Cost (2014):	$77.7	per acre-foot	
	Average Annual Imported Water Offset	4,200	AFY	
	Lifespan of Project	50	Years	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	SWP Energy Required for Conveyance and Pumping	3,000	kWh/AF	
	CRA Energy Required for Conveyance and Pumping	2,000	kWh/AF	
	From SWP	85%		Per LADWP Communication
	From CRA	15%		Per LADWP Communication
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
Calculated	Energy Required to Pump GW	436.6	kWh/AF	
	Net Energy Savings	2,413	kWh/AF	
	Energy Conserved with Project Annually	10,136,458	kWh/year	
	Energy Used to Import Water (Without Project)	11,970,000	kWh/year	
	Energy Used to Pump GW (With Project)	1,833,542	kWh/year	
	Energy Conserved over Lifespan	506,822,902	kWh	

Manhattan Wells Improvement Project - GHG Calculations

Central Basin				Reference/Notes
Given Information	Groundwater Pumping Cost:	$65	per acre-foot	http://www.mwdh2o.com/mwdh2o/pages/yourwater/supply/groundwater/gwas.html
	Groundwater Pumping Cost (2014):	$78	per acre-foot	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
	Average Annual Imported Water Offset	4,200	AFY	
	Lifespan of Project	50	Years	
	Energy Required to Pump GW	437	kWh/AF	
	Conversion Factor	0.724	lbs of CO_2/kWh	
	Net Energy Savings	2,413	kWh/AF	
GHG Emissions Avoided	Net Energy Savings x Conversion Factor	1,747	lbs CO_2/AF	
	Net Energy Savings Converted to Metric Tons	0.793	metric tons/AF	
	Avoided Carbon Emissions Annually	3,329	metric tons	
	Avoided Emissions Over Lifespan	166,440	metric tons	
GHG Emissions to Import Water	Energy Required for Importing x Conv. Factor	2,063	lbs CO_2/AF	
	Energy Required for Importing Conv. To Met Tons	0.936	metric tons/AF	
	GHG Emissions to Import Water Annually (Without Project)	3,931	metric tons	
GHG Emissions to Pump GW	Energy Required for GW Pumping x Conv Factor	316	lbs CO_2/AF	
	Energy Required for GW Pumping Conv. to Met Tons	0.143	metric tons/AF	
	GHG Emissions to Pump GW Annually (With Project)	602	metric tons	


California Climate Action Registry General Reporting Protocol

Reporting Entity-Wide Greenhouse Gas Emissions

Version 3.1 | January 2009

Thus, regional/power pool emission factors for electricity consumption can be used to determine emissions based on electricity consumed. If you can obtain verified emission factors specific to the supplier of your electricity, you are encouraged to use those factors in calculating your indirect emissions from electricity generation. If your electricity provider reports an electricity delivery metric under the California Registry's Power/Utility Protocol, you may use this factor to determine your emissions, as it is more accurate than the default regional factor. Utility-specific emission factors are available in the Members-Only section of the California Registry website and through your utility's Power/Utility Protocol report in CARROT.

This Protocol provides power pool-based carbon dioxide, methane, and nitrous oxide emission factors from the U.S. EPA's eGRID database (see Figure III.6.1), which are provided in Appendix C, Table C.2. These are updated in the Protocol and the California Registry's reporting tool, CARROT, as often as they are updated by eGRID.

To look up your eGRID subregion using your zip code, please visit U.S. EPA's "Power Profiler" tool at www.epa.gov/cleanenergy/energy-and-you/how-clean.html.

Fuel used to generate electricity varies from year to year, so emission factors also fluctuate. When possible, you should use emission factors that correspond to the calendar year of data you are reporting. CO_2, CH_4, and N_2O emission factors for historical years are available in Appendix E. If emission factors are not available for the year you are reporting, use the most recently published figures.

U.S. EPA Emissions and Generation Resource Integrated Database (eGRID)

The Emissions & Generation Resource Integrated Database (eGRID) provides information on the air quality attributes of almost all the electric power generated in the United States. eGRID provides search options, including information for individual power plants, generating companies, states, and regions of the power grid. eGRID integrates 24 different federal data sources on power plants and power companies, from three different federal agencies: EPA, the Energy Information Administration (EIA), and the Federal Energy Regulatory Commission (FERC). Emissions data from EPA are combined with generation data from EIA to produce values like pounds per megawatt-hour (lbs/MWh) of emissions, which allows direct comparison of the environmental attributes of electricity generation. eGRID also provides aggregated data to facilitate comparison by company, state or power grid region. eGRID's data encompasses more than 4,700 power plants and nearly 2,000 generating companies. eGRID also documents power flows and industry structural changes.
www.epa.gov/cleanenergy/egrid/index.htm.

Figure III.6.1 eGRID Subregions

Source: eGRID2007 Version 1.1, December 2008 (Year 2005 data).

Project 4

Terminal Island Water Reclamation Plant (TIWRP) Advanced Water Purification Facility and Distribution System Expansion

Supporting Documents

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DATE: May 10, 2013

1.0 Introduction

This Technical Memorandum (TM) presents the results of the hydraulic modeling conducted to evaluate alternative improvement plans for the Harbor Recycled Water System under several operating scenarios. The alternative improvement plans consider various storage and piping options while the operating scenarios represent different combinations of customers taking recycled water from the system. Two groups of analyses were conducted as described below:

- **TIWRP System:** The TIWRP System considers a system with all water provided by the Terminal Island Water Reclamation Plant (TIWRP). Various numbers of customers were considered for the TIWRP System. In all cases, it was assumed that a total of 12 MGD is available and provided to meet maximum day demands (MDD) in the system. When the maximum available supply of 12 MGD is not required by the customers, the remaining available supply is delivered to the Dominguez Gap Seawater Intrusion Barrier injection well system (Dominguez Gap).
- **Combined System:** The combined system considers a system where water is provided by both the TIWRP and the West Basin Municipal Water District (WBMWD). This system considers an increased number of customers. It maintains a maximum available supply of 12 MGD from the TIWRP and adds 18 MGD available from the WBMWD, for a total available supply of 30 MGD. Similar to the TIWRP system, when the maximum available supply of 30 MGD is not required by the customers, the remaining available supply is delivered to Dominguez Gap.

The primary purpose of evaluating the alternatives is to identify storage options for potential future growth scenarios. Based on the results of the analyses, recommendations are provided at the end of this TM. Model results are presented in **Appendix A** to this TM.

Appendix B describes how the model was set-up and provides a reference for future modeling by LADWP staff.

2.0 TIWRP Demand Overview

DWP provided the customer demands that were included in the analyses. These demands are presented in Table 1.

Table 1
Maximum Demands by Customer

Customer	Type	Average Demand (AFY)	Average Demand (MGD)	Maximum Day Peaking Factor	Maximum Day Demand (MGD)	MDD Peaking Pattern
Phillips 66	Industrial	6,500	5.80	1.3	7.54	10 am to 6 pm PF = 1.2 All Other Hours PF = 0.9
Tesoro	Industrial	4,444	3.97	1.3	5.16	10 am to 6 pm PF = 1.5 All Other Hours PF = 0.5
Air Products	Industrial	2,300	2.05	1.3	2.67	Industrial 24-hour
Valero	Industrial	1,200	1.07	1.3	1.39	10 am to 6 pm PF = 1.2 All Other Hours PF = 0.9
Praxair	Industrial	800	0.71	1.3	0.93	Industrial 24-hour
Warren E/P	Industrial	1,000	0.89	1.3	1.16	Industrial 24-hour
Port of LA	Irrigation	400	0.36	3	1.07	Irrigation 10-6
Dominguez Gap	Ground Water Injection	10,400	9.29	1	9.28	Constant
Harbor Generating Station	Industrial	690	0.62	1.4	0.86	Industrial 24-hour
Harbor LLC Generator	Industrial	1,000	0.89	1.3	1.16	Industrial 24-hour
Machado Lake	Lake Make-Up	170	0.15	1.4	0.21	Constant
Harbor Golf Course	Irrigation	120	0.11	3	0.32	Irrigation 10-6
Harbor College	Irrigation	120	0.11	3	0.32	Irrigation 10-6
Harbor Park	Irrigation	60	0.05	3	0.16	Irrigation 10-6

Memorandum

To: *Wing Tam, P.E. Watershed Protection Division, BOS*
Hassan Rad, Regulatory Affairs Division, BOS
Roskanak Aflaki, P.E. Terminal Island Water Reclamation Plant, BOS

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Reviewed By: *Don Schroeder, P.E.; Carla Duncan, P.E.; Heather VanMeter, P.E.;*
Jennifer Thompson, P.E.; Wendy Katagi, CEP

Date: *November 30, 2012*

Subject: *TAF No. 16: TIWRP Recycled Water Opportunity Analysis –*
Machado Lake Analysis REVISED DRAFT Technical Memorandum

The Bureau of Sanitation (BOS) requested CDM Smith and Larry Walker Associates (LWA) evaluate the potential use of purified recycled water from the Terminal Island Water Reclamation Plant (TIWRP) Advanced Water Purification Facility (AWPF) in Machado Lake. CDM Smith and LWA were authorized to complete this work under Task Agreement Form (TAF) No. 16 under LWA's contract with BOS for on-call regulatory support.

1.0 Background

The City of Los Angeles (City) TIWRP AWPF currently has capacity to produce 5 million gallons per day (mgd) of purified recycled water. Some of this water is used at the Dominguez Gap saltwater intrusion barrier and by industrial and irrigation customers in the Harbor area.

To meet TIWRP's National Pollutant Discharge Elimination System (NPDES) permit, BOS needs to identify additional recycled water demands by 2020 and cease discharging to the Harbor. BOS has identified an opportunity to utilize TIWRP purified recycled water to support the rehabilitation and long-term health of Machado Lake. The added water would be used to make up evaporation losses and for lake flushing. There is an improvement project underway at Machado Lake with goals to:

- Meet nutrient and toxics TMDL commitments,
- Improve visual aesthetics and ecosystem wildlife habitat,
- Increase flood control capacity and geomorphic stability, and

- Create additional recreational opportunities.

To meet these goals, the project will include a number of in-lake rehabilitation improvements, riparian habitat enhancements, and stormwater treatment best management practices (BMPs) in three sub-areas: Machado Lake and associated riparian woodland areas; the freshwater marsh; and parkland areas adjacent to Vermont Avenue and Anaheim Street.

The Machado Lake Project already includes future use of 140 acre-feet per year (AFY) of purified recycled water to make up for evaporation losses in the summer months. This memorandum summarizes the evaluation of using additional purified recycled water at Machado Lake, including water quality modeling, permit assessment, construction considerations, cost, and schedule. . Additionally, it presents key findings and recommendations for implementation.

This memorandum is organized into the following sections:

- Section 1 – Background
- Section 2 – Water Quality Monitoring
- Section 3 – Permitting Assessment
- Section 4 – Construction Considerations
- Section 5 – Conclusions and Recommendations
- Attachments

1.1 TIWRP Upgrades

The City is currently upgrading their existing 5-mgd AWPF with new membranes. When the plant is placed back into service in 2013, it will resume serving purified recycled water to the Dominguez Gap Barrier and industrial and irrigation customers. The City is planning to expand the existing AWPF from the current purified water production capacity of 5 mgd to 11.5 mgd, and improve the treatment process by adding a new disinfection and advanced oxidation process that would replace the existing chloramination disinfection process. The City will conduct a pilot study to confirm TIWRP performance following these upgrades. It is assumed in the analyses in this memorandum that the TIWRP will meet TMDL goals.

1.2 Flows Available From AWPF

The potential flows available from the AWPF are summarized in **Table 1-1**. These flows are based on the following assumptions:

- The AWPF will be expanded from the existing production capacity of 5 mgd to a production capacity of 11.5 mgd.
- The purified recycled water flow to the Dominguez Gap Barrier will increase to between 8 to 9 mgd in the future.

- Non-potable reuse demands will range between 500 to 800 acre-feet per year (AFY).
- For this evaluation, it was assumed that the flow to Machado Lake would be constant over a nine-month period (March through November) and that a varying flow would be pumped to the Dominguez Gap Barrier to account for variations in non-potable reuse demands and allow a constant flow to the lake.

As shown in **Table 1-1**, BOS is planning for the upgraded and expanded AWPF to have an online factor of 10 percent, which means that the AWPF could be offline up to 10 percent of the year for maintenance and equipment replacement. In addition, it is assumed that purified recycled water would be added to the lake during non-rainy months, which is a nine-month period from March through November. For the purpose of this evaluation, the range of flow rates assumed for the model were based adding water over a nine-month period, that the plant would be online 100 percent of the time for these nine months, and that non-potable reuse was at the lower end of the range (i.e., 500 AFY). The flows summarized in **Table 1-1** were used to select the maximum purified recycled water flow rates assumed in the model scenarios.

Table 1-1. Purified Recycled Water Flow Summary

Parameter	AWPF Production Capacity = 11.5 mgd (12,900 AFY) 10% online factor				AWPF Production Capacity = 11.5 mgd (12,900 AFY) No online factor			
Dominguez Gap Barrier	8 mgd 8,960 AFY	8 mgd 8,960 AFY	9 mgd 10,080 AFY	9 mgd 10,080 AFY	8 mgd 8,960 AFY	8 mgd 8,960 AFY	9 mgd 10,080 AFY	9 mgd 10,080 AFY
Non-potable Reuse	0.45 mgd 500 AFY	0.71 mgd 800 AFY	0.45 mgd 500 AFY	0.71 mgd 800 AFY	0.45 mgd 500 AFY	0.71 mgd 800 AFY	0.45 mgd 500 AFY	0.71 mgd 800 AFY
Flow Available for Machado Lake								
12 months	1.9 mgd 2,132 AFY	1.6 mgd 1,832 AFY	0.9 mgd 1,012 AFY	0.6 mgd 712 AFY	3.1 mgd 3,420 AFY	2.8 mgd 3,120 AFY	2.1 mgd 2,300 AFY	1.8 mgd 2,000 AFY
9 months[1]	1.9 mgd 1,599 AFY	1.6 mgd 1,374 AFY	0.9 mgd 759 AFY	0.6 mgd 534 AFY	3.1 mgd 2,565[2] AFY	2.8 mgd 2,340 AFY	2.1 mgd 1,725[3] AFY	1.8 mgd 1,500 AFY

Note: 1 mgd = 1,120 AFY
[1]For this evaluation, it is assumed that purified recycled water would be added for a nine month period (March through November).
[2]Basis for Run 6, see Table 2-2.
[3]Basis for Run 2, see Table 2-2.

For the purposes of comparison, the typical flow from a storm event with a 1-year return period is 868 cubic feet per second (cfs)[1]. The flows available for Machado Lake in **Table 1-1** range from 534 AFY to 3,420 AFY, equal to about 0.73 cfs to 4.72 cfs, which is lower than the stormwater flows.

[1] CDM in association with Parsons, 2011. Machado Lake Ecosystem Rehabilitation Project Hydrologic and Hydraulic Report 100% Design Submittal, Prepared for Bureau of Engineering, December.

2.0 Water Quality Modeling

Water quality modeling was completed to determine if the lake will still meet the final waste load allocations (WLAs) of the Nutrients Total Maximum Daily Load (TMDL) through use of purified recycled water at various flow rate. CDM Smith originally developed, parameterized, calibrated and documented the Machado Lake water quality model as part of the Machado Lake Project[2,3]. The model has been applied extensively in the past to evaluate in-lake rehabilitation options.

For this study, the model was used to evaluate the potential changes in concentrations of total phosphorus (TP), total nitrogen (TN), and phytoplankton (as chlorophyll-a [chl-a]) if additional purified recycled water is used in place of the on-site phosphorus removal and oxygenation systems. The model cannot be used to quantitatively predict dissolved oxygen (DO) concentrations. However, model results can be used to infer DO levels through predictions of TP and chl-a concentrations.

2.1 Overview of Lake Water Quality Model

The Lake Water Quality Model is a numerical model that was constructed to evaluate the complex dynamics within the lake, including internal and external loading of nutrients. As such, the model is based on in-lake dynamics, historic pollutant loading, and the nutrient flux study performed for Machado Lake (CDM in association with Parsons, 2009).

The lake water column is simulated as a fully mixed system, also termed a "continuously stirred tank reactor," or CSTR. This approximates lake dynamics for small, shallow lakes, such as Machado Lake, where mixing (e.g., diffusion or wind turbulence) dominate over advection (e.g., transport of pollutants by the motion of flowing water). Lake volumes are assumed steady on a daily basis (outflow = inflow), but can be varied monthly to account for summer losses (e.g., evapotranspiration [ET]). The model targets the key parameters of this eutrophic lake: phytoplankton (indicated by chl-a), TP, and TN. The model was constructed in Microsoft Excel to allow for easy adaptation of code to address various potential rehabilitation options and alternatives.

Additional information on the Lake Water Quality Model is provided in Appendix C of the *Machado Lake Nutrients TMDL Lake Water Quality Management Plan* (CDM in association with Parsons 2010).

2.2 Pump and Treat Modeling

In April 2012, a brief modeling exercise was performed to investigate the use of "pump and treat" to lower lake nutrient concentrations. The concept simulated pumping 1,730 AFY from the lake to TIWRP, treating to specified nutrient concentration (i.e., 0.167 mg/L TP and 2.27 mg/L TN) and then returned to Machado Lake. The model was run with and without the on-site oxygenation and phosphorus removal systems. This effort used a previous version of the lake water quality model

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[2] CDM in association with Parsons. 2009. Final Pre-Design Report. Prepared for Bureau of Engineering. July.
[3] CDM in association with Parsons. 2010. *Machado Lake Nutrients TMDL Lake Water Quality Management Plan*. Prepared for Bureau of Sanitation, Watershed Protection District and Recreation and Parks. July 14.

and did not incorporate more recent monitoring data. While numeric results were presented at that time for multiple scenarios involving various combinations of the above alternatives, the key points from that exercise can be summarized as:

- The model showed little sensitivity to depth within the range simulated, with only small improvements in lake water quality predicted for 8 feet compared to 6 feet depth.
- The model showed sensitivity to assumed oxygenation strategies with significant nutrient reductions predicted from the implementation of oxygenation.
- The model showed benefit from purified recycled water, particularly for TN.

However, the "pump and treat" function in the model requires nutrient concentrations to be reduced through treatment. Concentrations could never be higher in the outflow than the inflow. Therefore, when the prescribed outflow concentration (2.27 mg/L for TN, 0.167 mg/L for TP) exceeded the inflow concentration, the outflow concentration was set equal to inflow concentration. This would only occur in the model scenarios without implementation of watershed BMPs for TP.

It should be noted that the pump and treat system is fundamentally different than the addition of purified recycled water simulated in the current study. Additionally, as noted above, the lake water quality model was used for the pump and treat exercise was based on a different calibration data set. Therefore, direct comparisons of specific model output are not appropriate.

2.3 Monitoring Data

BOS provided data from July 2009 through August 2012 to update the model calibration. This produced a more accurate and defensible model that has been tested over a greater range of conditions and time periods. The complete set of TP, TN, and chl-a data used in the original model calibration and the most recent calibration are summarized in **Table 2-1** and **Figure 2-1**. Data shown are mean lake concentrations averaged across multiple in-lake sampling locations. Phosphorus data indicate a reasonably steady pattern of concentrations, with a consistent seasonal pattern of elevated summer concentrations and lower winter concentrations observed for each year in the record. This pattern is strongly suggestive of a dominance of internal loadings that peak during the summer dry season.

Both the TN and chl-a data show a marked decrease in concentrations starting in 2010. While minimum concentrations for both constituents are similar across the full period of record, peak and median concentrations in 2010 to 2012 are half of what they were in 2006 to 2009. The coupling of the two constituents is sensible given the fact that the lake is nitrogen limited within the range of measured nutrient data. Attempts were made to identify possible explanations for the observed reductions in lake nitrogen levels. Discussions with the City confirmed that there have been no known operational or structural changes to either the lake or watershed that might explain the recent observed patterns. However, since there is no known reason to exclude or discount any of the observed data in subsequent analyses, the full period of record was used in re-calibrating the water quality model.

Table 2-1. Summary of Machado Lake Measured Water Quality Data

Year	N[1]	Avg. TP[2] (mg/L)	Max. TP[2] (mg/L)	Avg. TN[2] (mg/L)	Max. TN[2] (mg/L)	Avg. chl a[3] (µg/L)	Max. chl a[3] (µg/L)
2006	4	0.9	1.0	2.4	3.1	-	-
2007	17	0.9	1.3	2.3	4.2	55	81
2008	60	0.7	1.1	1.7	3.0	70	210
2009	17	0.8	1.7	1.8	4.1	68	180
2010	13	0.9	1.4	1.3	1.9	42	74
2011	22	0.8	1.4	1.2	2.1	34	84
2012[4]	18	0.7	1.3	1.0	2.1	32	62

[1] = Number of data point (sampling dates) used in annual statistics calculations
[2] = Annual average/maximum
[3] = Growing season (April – September) average/maximum
[4] = Data collected through 9/4/12

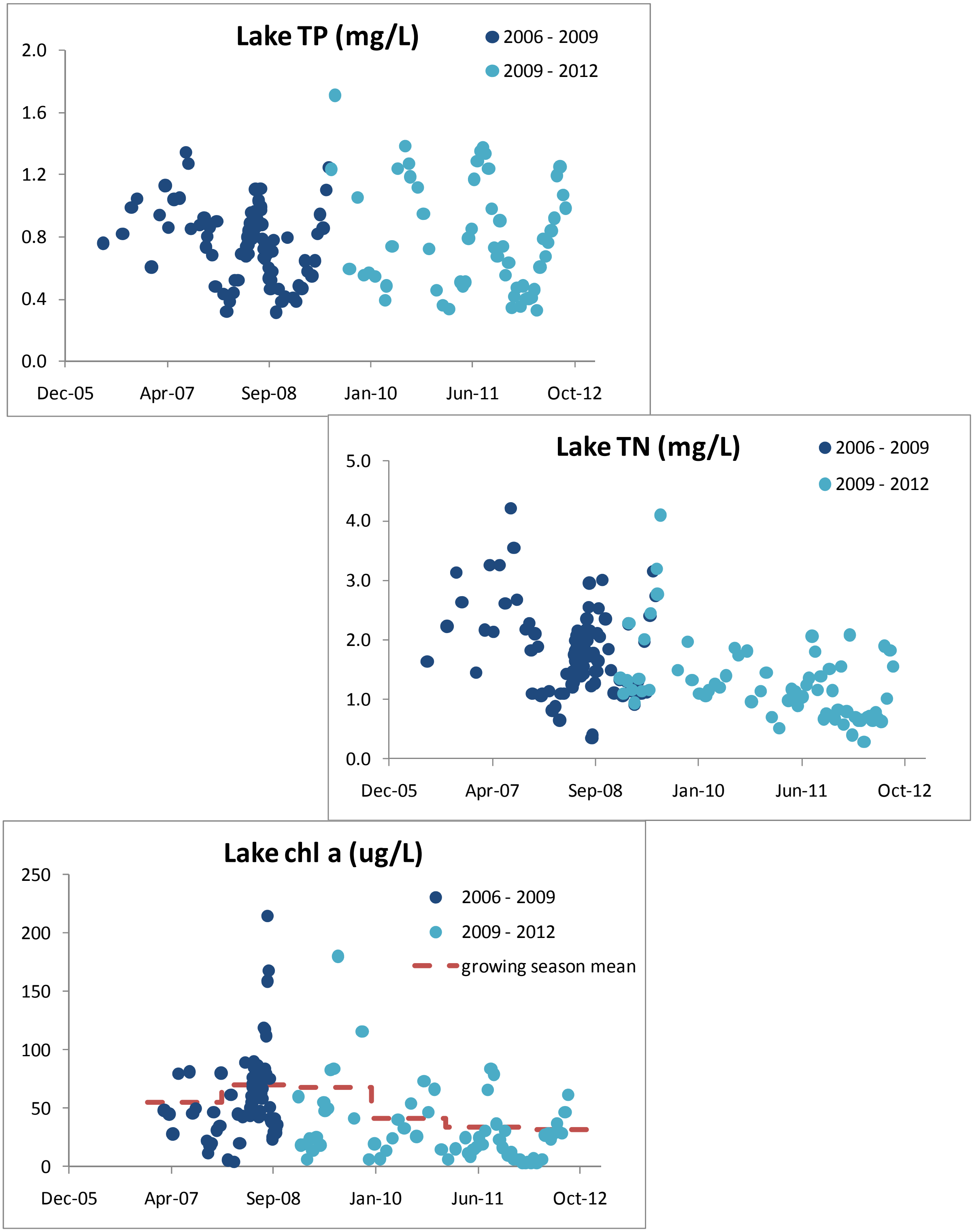


Figure 2-1. Machado Lake Measured Water Quality Data

2.4 Calibration

With any numerical modeling project, it is often beneficial to update the calibration efforts as new information becomes available. This can either serve as a verification of previous calibration parameters or may result in new adjustments. The end result is generally a more accurate and defensible predictive model.

Using the data described above for the period of July 2009 to August 2012, the model calibration was updated. Only very minor changes to model parameters were required to achieve strong agreement between modeled and measured TP values. Similarly, after achieving nutrient calibration, only a minor adjustment of the chl-a calibration factor was required to achieve acceptable agreement between modeled and measured chl-a values. These results serve as verification of the model construction, parameterization, and predictive power with respect to these two constituents.

As discussed in Section 2.3 Water Quality Data , the measured TN and coupled chl-a data reveal a significant improvement in lake water quality over the period of 2010 to 2012 compared to 2006 to 2009. Since the mechanism behind this change has not been determined, we cannot directly incorporate such change in the model. However, in this case, the modeling strongly suggests that the only way such a rapid and major reduction in lake nitrogen concentrations could have occurred is if external loads to the lake were reduced over the same time period. Therefore, as part of this calibration exercise, we have reduced model TN Event Mean Concentrations (EMCs) values by half starting in 2010.

The end result is an excellent agreement between modeled and measured TN concentrations for the full simulation period. Since the modeled changes in EMCs are not supported by observed watershed data, the uncertainty associated with TN predictions (see Section 2.6) is greater than that associated with TP predictions. See **Attachment A** for additional information on the re-calibration of the Lake Water Quality Model.

2.5 Recycled Water Simulations

The model was used to simulate scenarios associated with the addition of purified recycled water to the lake in lieu of the on-site phosphorus removal and oxygenation systems. These scenarios were designed to evaluate the impacts of such a management strategy on lake water quality and, more specifically, investigate the ability of various management alternatives to achieve in-lake TMDL targets. It should be noted that purified recycled water inputs to the lake have the potential to improve water quality in two primary ways:

1. Maintain depth and volume leading to lowered phytoplankton concentrations via light limitation; and,

2. Increased dilution and flushing of lake nutrients with a low nutrient source, particularly during the dry season, leading to lowered lake nutrient concentrations.

The second point above is dependent on purified recycled water nutrient concentrations being lower than the in-lake concentrations. In addition, per the TMDL requirements, any waters being added to Machado Lake need to meet the TMDL requirements.

BOS is planning to upgrade the AWPF to include advanced oxidation process of either ultraviolet light (UV) or ozone (O_3). When combined with hydrogen peroxide, this will provide disinfection and advanced oxidation (AOP) to replace the existing chloramination disinfection process and reduce the TN in the purified recycled water. The AOP does not impact the TP or TN assumptions for the model input. As summarized in **Attachment B**, the expanded and upgraded AWPF is projected to achieve a TN concentration of 1.0 mg/L or lower. Based on data from other AWPFs, the TIWRP AWPF will achieve a TP concentration of 0.1 mg/L or lower (see additional discussion in Section 2.7). Therefore, the purified recycled water nutrient concentrations (TP, TN) were set to 0.1 and 1.0 milligrams per liter (mg/L), respectively, for all scenarios with purified recycled water.

The scenarios capture a range of potential purified recycled water inflow rates with and without other in-lake and watershed treatment alternatives. The model scenarios are summarized in **Table 2-2**.

The model scenarios were:

- Baseline and Model Run Nos. 1a through 1d were included to provide an initial basis for comparison to higher flow rates scenarios. The minimum flow rate is 140 AFY because that is the rate the offsets evaporative losses.
- Model Run Nos. 2 and 6 were selected based on the maximum flows potentially availably from the AWPF (see further discussion below).
- Model Run Nos. 3, 4 and 5 were selected as a range of minimum flows greater than Model Run Nos. 1a through 1d, but less than Model Run No. 2, to identify a minimum flow rate to be provided to Machado Lake.

Table 2-2. Modeled Scenarios

Model Run Number	On-site Phosphorus Removal System (Y or N)	On-site Oxygenation System (Y or N)	Purified Recycled Water Quantity (AFY)[1]	UV/AOP or O3/AOP	Notes
Baseline	Y	Y	0 (140 AFY potable water)	N/A	Current project (update of April 2012 modeling run). Water quantity = ET flows
1a	Y	Y	140	UV/AOP	Current project (update of April 2012 modeling run) with purified recycled water instead of potable water. Water quantity = ET flows
1b	N	Y	140	UV/AOP	Demonstrate impact of no on-site phosphorus removal system but with purified recycled water. Water quantity = ET flows
1c	N	N	140	UV/AOP	Demonstrate impact of no on-site oxygenation or phosphorus removal systems but with purified recycled water. Water quantity = ET flows
1d	N	N	0 (140 AFY potable water)	N/A	Demonstrate impact of no on-site oxygenation or phosphorus removal systems but with potable water. Water quantity = ET flows
2	N	N	420	UV/AOP (a) or O3/AOP (b)	Sensitivity run to identify minimum flow.
3	N	N	840	UV/AOP (a) or O3/AOP (b)	Sensitivity run to identify minimum flow
4	N	N	1,260	UV/AOP (a) or O3/AOP (b)	Sensitivity run to identify minimum flow
5	N	N	1,700	UV/AOP (a) or O3/AOP (b)	Update of Pump and Treat modeling run; sensitivity run to identify maximum flow (maximum flow available to Machado Lake is 1,725 AFY if Dominguez Gap Barrier accepts 9 mgd).
6	N	N	2,570	UV/AOP (a) or O3/AOP (b)	Sensitivity run to identify maximum flow (maximum flow available to Machado Lake if Dominguez Gap Barrier accepts 8 mgd).

ET = evapotranspiration
[1]See notes column for explanation of water quantity flow rate.

2.5.1 Baseline Project Improvements

For all simulations, a set of baseline project improvements were assumed in the model that include:

- Dredging of lake sediments to achieve a mean water depth of six feet. Post-dredging lake depths and volumes were modeled according to final design drawings.
- AquaBlok cap placed over the dredged lake bed and, combined with an assumed one time application of alum, is the basis for assuming a "reset" of sediment nutrient concentrations.
- Re-circulating lake water through the adjacent constructed wetlands at a rate of 1 cfs during the period March through November, with nutrient uptake kinetics parameterized as previously documented.

2.5.2 Supplemental Water Inflows

Supplemental water inflows, either purified recycled or potable, are assumed to be distributed evenly (at a steady flow rate) across the non-rainy months of March through November in the model. It is assumed for all of the inflow rates simulated here that the supplemental water will maintain the lake at full volume throughout the year. Consequently, the dredged mean depth of six feet, and the associated full lake volume and surface area of 224 acre-feet (AF) and 32 acres, respectively, were held steady in the model for the duration of the simulation period for all scenarios. Additionally, for all simulations, modeled watershed daily precipitation rates were set equal to those measured in 2007 at the Long Beach meteorological station. This pattern of daily rainfall was repeated for each year in the 10-year simulation period. As previously documented, user-defined rainfall rates, in combination with nutrient EMCs, are used in the model to simulate runoff flows and nutrient loads to the lake as part of a daily timestep continuous simulation.

2.5.3 In-Lake Treatment

For three of the scenarios (Baseline, 1a, and 1b) hypolimnion oxygenation was assumed, while two of the scenarios (Baseline and 1a) include on-site phosphorus removal. The scenarios with oxygenation were modeled by setting sediment anoxia fractions to zero for the full simulation period. As described in previous documentation, prescribed sediment anoxic fractions are used to calculate effective sediment nutrient mineralization rates. Lower anoxic fractions result in lower mineralization rates and ultimately lower sediment nutrient fluxes.

For the two modeled scenarios with on-site phosphorus removal, a steady TP concentration of 0.1 mg/L is assigned to the outflow from the constructed wetlands based on anticipated treatment levels.

2.5.4 Baseline Scenario

Potable water, rather than purified recycled water, inputs to the lake are assumed, which represents the Machado Lake Project as currently designed. Potable water will be used for makeup water in the early years of the project before the purified recycled water pipeline is extended west on West Anaheim Street. For this simulation, inflow TP and TN concentrations for potable water are set at 0.05 and 0.55 mg/L, respectively, based water quality data previously provided by the City.

2.5.5 No Action

For this simulation, model inputs were maintained at current calibration values with no in-lake or watershed management projects. The same ten year repeating sequence of precipitation data, used in the other simulations, was used for the "no action" simulation.

2.5.6 Watershed BMPs

The scenarios described above were repeated with an assumption of the future implementation of full watershed BMPs to reduce nutrient levels from upstream stormwater. This practice follows a similar process included as part of the Lake Water Quality Management Plan (CDM in association with Parsons, 2010) since the City of Los Angeles' upstream portion of the watershed is only 13 percent of the total watershed. Therefore, 87 percent of the watershed is not within the City of Los Angeles' jurisdiction. For this set of scenarios, both dry and wet weather EMCs are lowered to the TMDL targets of 0.1 and 1.0 mg/L for the two constituents, respectively For comparison, the wet weather EMCs without watershed BMPs are 0.86 mg/L for TP and 1.7 mg/L for TN. The two sets of model runs were performed to reflect the uncertainty associated with future watershed activities, including those outside of the jurisdiction of the City of Los Angeles.

2.6 Results

Modeling results for each scenario are presented in **Table 2-3** and **Table 2-4**, both without and with assumed watershed BMPs, respectively. The results for TP, TN, and chl-a are also graphically shown in **Figure 2-2** for the without watershed-wide BMPs scenarios.

Results are tabulated based on an average of modeled concentrations over the six month summer growing season, April through September. The summer growing season was targeted since this is the critical time period for phytoplankton nuisance blooms (measured as chl-a), as triggered by elevated nutrient concentrations, sunlight, and water temperature in combination with lower flushing rates. Results corresponding to both the first year of the proposed project activities (Year 1) and the tenth year (Year 10) are presented. The Year 1 results should be interpreted as near-term results reflecting immediate impacts of dredging, wetlands construction, and the initiation of new supplemental flow regimes. Some of these impacts are temporary, such as the assumed elimination of sediment nutrient fluxes immediately following dredging, capping, and alum application. Therefore, Year 10 results are presented to reflect projected longer term sustainable water quality conditions.

2.6.1 No Action

Results for the "no action" scenario demonstrate that, without any remedial efforts, TMDL targets for nutrients and chl-a will be exceeded in both near- and long-terms. Even with large scale reductions in watershed runoff concentrations (**Table 2-4**), TP exceedances are projected through Year 10. It should be noted that results of this particular simulation show gradually decreasing TP concentrations throughout the simulation period, as the sediment nutrient mass is flushed out of the lake and the system moves toward a new equilibrium condition. These results imply that eventually, beyond Year 10, the TP target will be achieved under this scenario.

A similar dynamic occurs in the TN simulations. For both with and without watershed BMPs, projected Year 10 TN values are lower than Year 1 values. This is because of the abrupt reductions in simulated external TN loads for both models. This change in external load causes a disruption to the equilibrium between the sediment TN and water column TN. Without watershed BMPs, the disruption due to the reduction in watershed EMCs described in Section 2.4 Calibration. In these simulations, the model gradually moves toward a new equilibrium over the 10-year period. This is why we see a small reduction in water column TN over the 10 year simulation period.

2.6.2 Adding Recycled Water

Water quality is predicted to improve with increased recycled water inflow rates up to approximately 840 AFY. However, gains level off above this level, with minimal projected improvement between the flow rate scenarios. While the higher flow rates provide enhanced flushing and high volume turnover during the summer, they do not directly mitigate lake internal nutrient loads. These nutrients are replenished by winter runoff, which continue to persist even with high purified recycled water inputs.

2.6.3 Baseline

At the simulated flow rate of 140 AFY, the model predicts little difference between the use of purified recycled water versus potable water to maintain summer lake volumes (Baseline vs. 1a), which is in line with the pump and treat modeling results.

2.6.4 Phosphorus Treatment

Model results also indicate limited benefit from the proposed additional phosphorus treatment in re-circulating wetlands. Essentially, the wetland kinetic uptake, as modeled, achieves the same level of phosphorus reduction assumed for the treatment simulation. However, as discussed in previous documentation, large uncertainties exist in the modeling of the re-circulating wetlands system. These uncertainties are primarily associated with the magnitude and timing of assumed wetland nutrient removal kinetics. Enhanced TP treatment using chemical additions could therefore be viewed as one method for reducing the uncertainty associated with immediate and long term wetland performance and consequently an important redundancy in the system to help achieve long term phosphorus goals.

2.6.5 Summary

Modeling results highlight the need for watershed scale management of pollutant loadings in order to achieve in-lake TMDL targets. While nitrogen and chl-a targets are achieved on a mean summer basis for the majority of the scenarios without watershed BMPs (**Table 2-3**), none of these scenarios project mean phosphorus levels at or below the TMDL target. Conversely, TMDL targets for the three constituents are projected to be achieved on a mean summer basis for all scenarios that include watershed BMPs.

Table 2-3. Modeling Results Without Watershed-Wide BMPs

Scenario	Purified Recycled Water Quantity (AFY)[4]	On-site Phosphorus Removal System (Y or N)	On-Site Oxygenation System (Y or N)	Constituent [Limit]	Without BMPs Within Watershed: Year 1 Summer Average	Without BMPs Within Watershed: Year 10 Summer Average
No Action	0 (100 AFY potable water)	N	N	TP (mg/L) [0.10]	1.0	1.0
				TN (mg/L) [1.0]	1.8	1.6
				chl a (µg/L) [20]	46	41
Baseline	0 (140 AFY potable water)	Y	Y	TP (mg/L) [0.10]	0.3	0.4
				TN (mg/L) [1.0]	0.5	0.8
				chl a (µg/L) [20]	6	13
1a	140	Y	Y	TP (mg/L) [0.10]	0.3	0.4
				TN (mg/L) [1.0]	0.5	0.9
				chl a (µg/L) [20]	7	14
1b	140	N	Y	TP (mg/L) [0.10]	0.3	0.4
				TN (mg/L) [1.0]	0.5	0.9
				chl a (µg/L) [20]	7	14
1c	140	N	N	TP (mg/L) [0.10]	0.3	0.7
				TN (mg/L) [1.0]	0.6	1.1
				chl a (µg/L) [20]	8	18
1d	0 (140 AFY potable water)	N	N	TP (mg/L) [0.10]	0.3	0.7
				TN (mg/L) [1.0]	0.7	1.0
				chl a (µg/L) [20]	7	17
2	420	N	N	TP (mg/L) [0.10]	0.3	0.6
				TN (mg/L) [1.0]	0.6	1.1
				chl a (µg/L) [20]	9	17
3	840	N	N	TP (mg/L) [0.10]	0.2	0.4
				TN (mg/L) [1.0]	0.7	1.0
				chl a (µg/L) [20]	10	16
4	1,260	N	N	TP (mg/L) [0.10]	0.2	0.4
				TN (mg/L) [1.0]	0.7	1.0
				chl a (µg/L) [20]	10	15
5	1,700	N	N	TP (mg/L) [0.10]	0.2	0.3
				TN (mg/L) [1.0]	0.8	1.0
				chl a (µg/L) [20]	11	15
6	2,570	N	N	TP (mg/L) [0.10]	0.1	0.3
				TN (mg/L) [1.0]	0.8	1.0
				chl a (µg/L) [20]	10	13

Notes:

1. Baseline indicates the as designed project; Run 1a is the same as baseline but RO water instead of potable; Run 1b is Run 1a without the on-site phosphorus removal system; Run 1c is without the on-site phosphorus removal system and on-site oxygenation.
2. Red indicates result greater than TMDL target level
3. All Alternatives include a lake bottom cap, 6-ft water depth, and re-circulating constructed wetland
4. Water (potable or purified recycled) is added to the lake from March through November (9 months).

Table 2-4. Modeling Results With Watershed-Wide BMPs

Scenario	Purified Recycled Water Quantity (AFY)	On-site Phosphorus Removal System (Y or N)	On-Site Oxygenation System (Y or N)	Constituent [Limit]	With Watershed-Wide BMPs* Year 1 Summer Average	With Watershed-Wide BMPs* Year 10 Summer Average
No Action	0 (100 AFY potable water)	N	N	TP (mg/L) [0.10]	0.6	0.2
				TN (mg/L) [1.0]	0.7	0.5
				chl a (µg/L) [20]	16	10
Baseline	0 (140 AFY potable water)	Y	Y	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.4	0.5
				chl a (µg/L) [20]	3	6
1a	140	N	Y	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.4	0.6
				chl a (µg/L) [20]	4	7
1b	140	N	Y	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.4	0.6
				chl a (µg/L) [20]	4	7
1c	140	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.5	0.7
				chl a (µg/L) [20]	5	9
1d	0 (140 AFY potable water)	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.3	0.34
				chl a (µg/L) [20]	2	3
2	420	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.5	0.7
				chl a (µg/L) [20]	7	10
3	840	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.6	0.8
				chl a (µg/L) [20]	8	11
4	1,260	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.7	0.8
				chl a (µg/L) [20]	9	11
5	1,700	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.7	0.9
				chl a (µg/L) [20]	9	11
6	2,570	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.8	0.9
				chl a (µg/L) [20]	9	10

Notes:
*Assume all runoff/baseflow entering the lake meet TMDL target levels
1. Baseline indicates the as designed project; Run 1a is the same as baseline but RO water instead of potable; Run 1b is Run 1a without the on-site phosphorus removal system; Run 1c is without the on-site phosphorus removal system and on-site oxygenation.
2. Red indicates result greater than TMDL target level
3. All Alternatives include a lake bottom cap, 6-ft water depth, and re-circulating constructed wetland
4. Water (potable or purified recycled) is added to the lake from March through November (9 months).

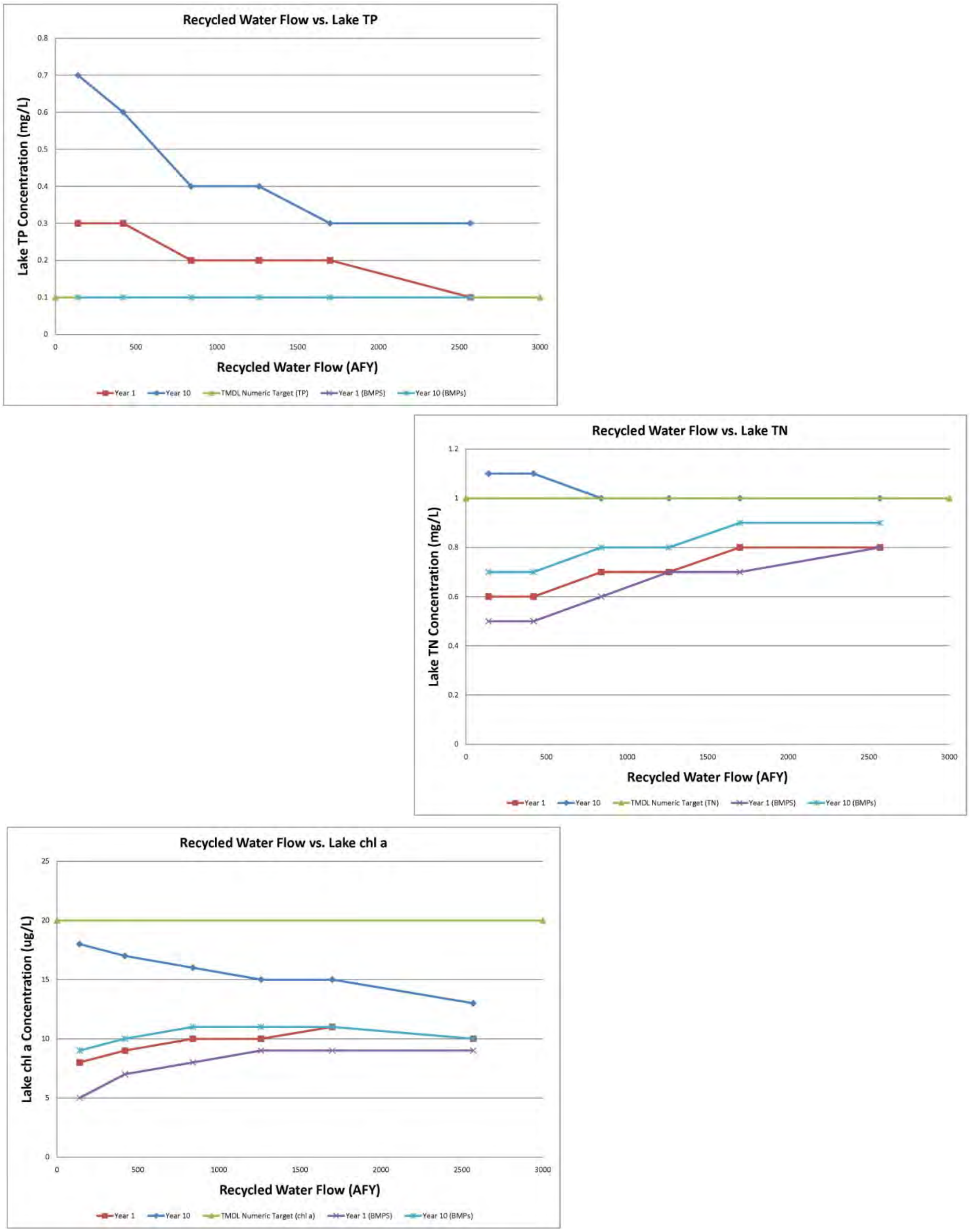


Figure 2-2: Modeling Results for TP, TN, and chl-a (Without Watershed-wide BMPs)

2.7 Sensitivity Analysis

Sensitivity analyses were performed to investigate areas of uncertainty in the model predictions. Four additional scenarios were simulated representing perturbations of Scenario 2.

- Scenario 2-1 addressed operational concerns associated with the purified recycled water system, specifically the impacts of the system going offline for short periods during the summer season. To simulate this scenario, purified recycled water inflows were set to zero for the month of June (a critical month of high nutrient concentration).

- Scenario 2-2 and 2-3 simulated the impacts of varying nutrient concentrations in the purified recycled water inflow, recognizing the uncertainty associated with the projected levels of treatment. Scenario 2-2 assumes a lower TP concentration (0.03 rather than 0.1 mg/L), while Scenario 2-3 assumes a higher TN concentration (1.6 rather than 1.0 mg/L).

  A TP of 0.1 mg/L is most likely a maximum value for the lake. TN to TP ratios are rarely less than 10 in conventional wastewater effluent. Based on data from other operating AWPFs, the ratio ranges from 10:1 to 48:1. For scenario 2-2, a 10:1 ratio was assumed, which results in a TP concentration of 1.4 mg/L in the tertiary effluent (the maximum TN concentration in tertiary effluent was 13.5 mg/L during 2011). Assuming 98 percent rejection through the reverse osmosis membranes (based on manufacturer's projections), the TP in the purified recycled water would be 0.03 mg/L. Based on data from the Orange County Water District's Groundwater Replenishment System (GWRS), this is a conservative assumption. For GWRS, the secondary effluent/membrane filtration influent TP concentration is 1.6 mg/L and the purified recycled water concentration is <0.01 mg/L, demonstrating that TP removal through reverse osmosis can be higher than 98 percent.

  The TN value for the purified recycled water is estimated to be approximately 1.0 mg/L (see **Attachment B**). The concentrations of nitrogen species in the tertiary effluent will depend on the amount of ammonia that is added upstream (in the form of chloramines) to prevent biofouling on the membrane filtration and reverse osmosis membranes, and the removal rates of each nitrogen species through RO. To evaluate whether the TN values will remain below the TMDL numeric targets even if the TN in the purified recycled water is higher than 1 mg/L, a value of 1.6 mg/L was used in Scenario 2-3.

- Scenario 2-4 investigates the impacts of distributing the purified recycled water inflow over the full year, rather than concentrated within the March through November period. This scenario represents an alternative lake operational strategy that could be easily implemented if shown to be beneficial.

- To evaluate whether the TN values with a lower TN concentration of 1 mg/L in the purified recycled water, a value of 0.6 mg/L was used in Scenario 2-5.

Results of the sensitivity analyses are presented in **Tables 2-5 and 2-6**, with and without BMPs, respectively.

For Scenario 2-1, the results demonstrate minor sensitivities to a 1-month disruption to the purified recycled water treatment system with very small increases in nutrient and chl-a summer mean, well within the range of modeling uncertainty. These results would infer that if purified recycled water was not added during summer months, and only added during wet weather the purified recycled water would be less effective at improving lake water quality. The summer months are when the water is needed in the lake to maintain lake levels and provide dilution of nutrient concentrations. During the wet weather months, the purified recycled water is not critical since it will get flushed through and provide minimal benefit.

Table 2-5. Sensitivity Analysis Modeling Results Without Watershed-Wide BMPs

Model Run Number	Purified Recycled Water Quantity (AFY)	On-site Phosphorus Removal System (Y or N)	On-Site Oxygenation System (Y or N)	Constituent [Limit]	Without Watershed-Wide BMPs*	
					Year 1 Summer Average	Year 10 Summer Average
Baseline	0 (140 AFY potable water)	Y	Y	TP (mg/L) [0.10]	0.3	0.4
				TN (mg/L) [1.0]	0.5	0.8
				chl a (µg/L) [20]	6	13
2	1,700	N	N	TP (mg/L) [0.10]	0.2	0.3
				TN (mg/L) [1.0]	0.8	1.0
				chl a (µg/L) [20]	11	15
2-1	1,700 minus June flow	N	N	TP (mg/L) [0.10]	0.2	0.4
				TN (mg/L) [1.0]	0.8	1.1
				chl a (µg/L) [20]	11	16
2-2	1,700, TP=0.03 mg/L TN=1.0mg/L	N	N	TP (mg/L) [0.10]	0.1	0.3
				TN (mg/L) [1.0]	0.8	1.0
				chl a (µg/L) [20]	10	14
2-3	1,700, TP=0.1 mg/L TN=1.6 mg/L	N	N	TP (mg/L) [0.10]	0.2	0.3
				TN (mg/L) [1.0]	1.1	1.4
				chl a (µg/L) [20]	15	19
2-4	2,267 over full year	N	N	TP (mg/L) [0.10]	0.2	0.3
				TN (mg/L) [1.0]	0.8	1.0
				chl a (µg/L) [20]	11	14
2-5	1,700, TP=0.1 mg/L TN=0.6 mg/L	N	N	TP (mg/L) [0.10]	0.2	0.3
				TN (mg/L) [1.0]	0.5	0.8
				chl a (µg/L) [20]	7	11

Notes:
1. Red indicates result greater than TMDL target level
2. All Alternatives include a lake bottom cap, 6-ft water depth, and re-circulating constructed wetland
3. Water (potable or purified recycled) is added to the lake from March through November (9 months) except where noted

Table 2-6. Sensitivity Analysis Modeling Results With Watershed-Wide BMPs

Model Run Number	Purified Recycled Water Quantity (AFY)	On-site Phosphorus Removal System (Y or N)	On-Site Oxygenation System (Y or N)	Constituent [Limit]	With Watershed-Wide BMPs*	
					Year 1 Summer Average	Year 10 Summer Average
Baseline	0 (140 AFY potable water)	Y	Y	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.4	0.5
				chl a (µg/L) [20]	3	6
2	1,700	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.7	0.9
				chl a (µg/L) [20]	9	11
2-1	1,700 minus June flow	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.7	0.9
				chl a (µg/L) [20]	9	11
2-2	1,700, TP=0.03 mg/L TN=1.0 mg/L	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.7	0.9
				chl a (µg/L) [20]	7	8
2-3	1,700, TP=0.1 mg/L TN=1.6 mg/L	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	1.1	1.2
				chl a (µg/L) [20]	12	14
2-4	2,267 over full year	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.7	0.9
				chl a (µg/L) [20]	9	11
2-5	1,700, TP=0.1 mg/L TN=0.6 mg/L	N	N	TP (mg/L) [0.10]	0.1	0.1
				TN (mg/L) [1.0]	0.5	0.6
				chl a (µg/L) [20]	6	8

Notes:
*Assume all runoff/baseflow entering the lake meet TMDL target levels
1. Red indicates result greater than TMDL target level
2. All Alternatives include a lake bottom cap, 6-ft water depth, and re-circulating constructed wetland
3. Water (potable or purified recycled) is added to the lake from March through November (9 months) except where noted

Reducing inflow TP concentrations below 0.1 mg/L (Scenario 2-2) are projected to result in minor improvement in lake water quality. While short-term gains are predicted by reaching the in-lake TMDL target in Year 1, long-term gains are insignificant.

Model sensitivities to an increased TN concentration (Scenario 2-3) are greater than those quantified for the TP reduction. In this scenario, without watershed BMPs, lake TN concentrations are not predicted to reach the TMDL target in the short-term. This is different from the projections associated with Scenario 2.

Lastly, Scenario 2-4 indicates that distributing the purified recycled water inflow volume across the entire calendar year, rather than a nine-month period, is slightly less effective at reducing nutrient and chl-a concentrations in the lake compared to baseline.

Figure 2-3 shows the relationship between recycled water influent TN concentration and the lake water TN concentration at a flow rate of 1,700 AFY.

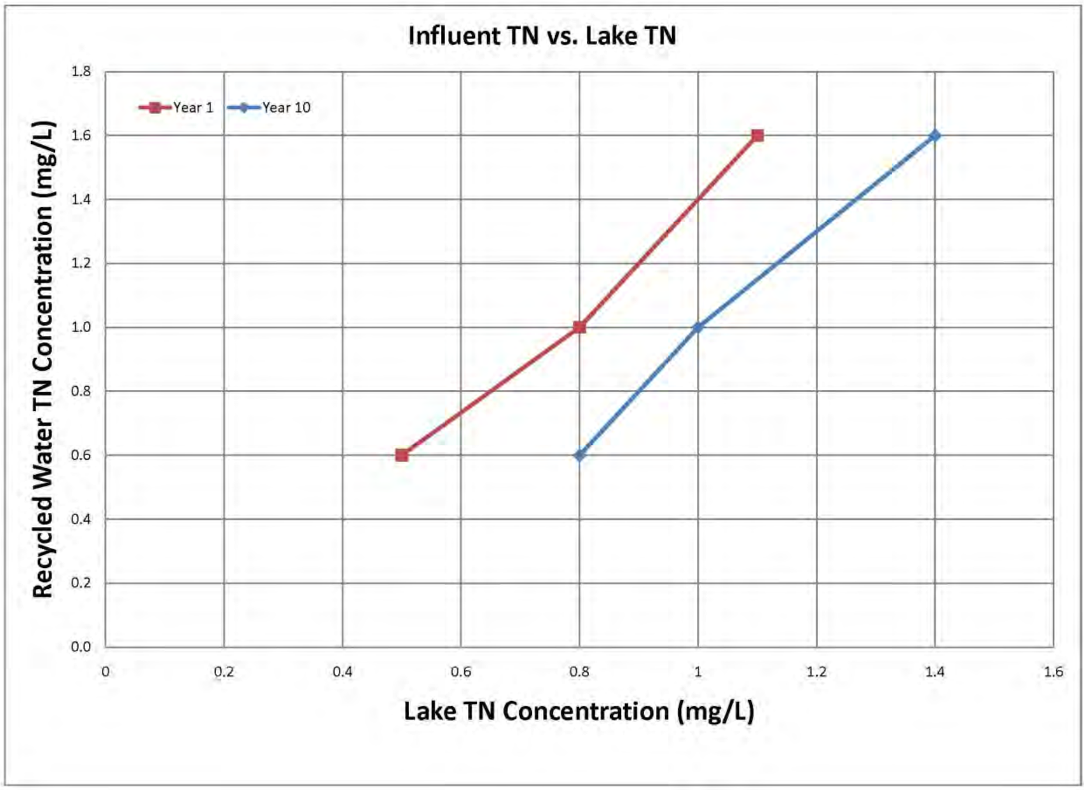


Figure 2-3: Recycled Water TN Concentration Versus Lake Water TN Concentration

2.8 Dissolved Oxygen

The Nutrients TMDL also sets a minimum concentration of DO in the lake at 5 mg/L. While Lake Water Quality model does not predict the concentration of DO in the lake, the model indicates that significant water quality improvements can be achieved through the addition of oxygen, particularly during the hot, dry months from May through October, when DO in the water column is most critical. This is because maintaining DO creates aerobic conditions at the sediment-water interface which mitigates nutrient releases from sediment. Oxygenation is represented by the implementation of watershed-wide BMPs. When those BMPs are simulated, model results for Year 10 indicate reductions in TP and TN concentrations on the order of 50% and 20%, respectively (see Baseline vs. Run 1c scenario with and without watershed BMPs). Oxygenated conditions beneficially convert ammonia to nitrate, enhancing habitat and food supply for fish species. The fish would in turn control phytoplankton blooms (a symptom of eutrophication). Oxygenation will also reduce odor problems created by production of hydrogen sulfide in anoxic conditions.

Purified recycled water has a DO concentration of 7 mg/l or more. Once that water enters the lake, the internal lake dynamics – phytoplankton and macrophyte photosynthesis and respiration, nitrification, and sediment oxygen demand – control the DO concentration. For this reason, the oxygenation system is designed to inject hypo-oxygenated water (DO>30 mg/l) into the hypolimnion, the dense, bottom layer of water, where anoxic conditions are most likely to occur.

The oxygenation system will provide more consistent and reliable DO concentrations in the lake at all levels of the water column than purified recycled water alone. It adds oxygen directly to the lake, dampening sediment nutrient fluxes (which are linked to plant respiration rates), and will decrease sediment oxygen demand. The purified recycled water, in combination with the on-site oxygenation system, will give the City the best opportunity to meet the Nutrient TMDL numeric targets in the event that watershed-wide BMPs are not implemented.

Note that CDM Smith and Parsons evaluated numerous options (e.g., diffusers, aerators, speece cone) to meet the oxygen demand in Machado Lake early in the final design phase. The recommendation from that evaluation was to include a speece cone, which is referred to as an oxygenation system in this memorandum. See the *Oxygenation of Machado Lake* memorandum (CDM in association with Parsons March 30, 2010) for further information on the evaluation of oxygenation options.

2.9 Conclusions from the Recycled Water Simulations

Based on the modeling results and sensitivity analyses presented above, the following conclusions can be drawn with regard to replacing the on-site oxygenation and phosphorus removal systems with a supply of purified recycled water.

1. The purified recycled water improves the water quality above the no action water quality levels for all scenarios. For the scenarios without watershed BMPs, the addition of purified recycled water decreases the TN and chl-a concentrations and benefits the lake's overall health. Also, as the quantity of purified recycled water increases, the water quality generally improves.
2. With flows greater than 140 AFY of purified recycled water, in combination with the other in-lake BMPs (e.g., dredging and constructed wetland) the City would, on average, achieve TMDL compliance for TN and chl-a, but not TP. The only flow rate that allows the City to meet all Nutrients TMDL targets without watershed BMPs is 2,570 AFY, and that is only in the short term. As discussed in 2.2 Pump and Treat Modeling and the Lake Water Quality Management Plan, the only way to achieve full TMDL compliance for all targeted constituents, particularly for TP, is to reduce nutrient loads from the watershed.
3. If the on-site oxygenation and phosphorus removal systems are replaced with purified recycled water, a minimum flow rate of 840 AFY is required to achieve similar water quality as the Baseline Scenario.
4. If watershed BMPs are implemented and the lake nutrient concentrations fall below that of the purified recycled water, then the addition of purified recycled water may no longer be necessary to meet the Nutrients TMDL targets. The phosphorus treatment system may also not be needed.

5. The oxygenation system would introduce a hyperoxygenated water source (>30 mg/L) into the lake hypolimnion . The purified recycled water would have a lower DO concentration (approximately 7.0 mg/L) and will be added at or near the water surface. The oxygenation system would provide added security to maintaining the lake's DO levels above the Nutrients TMDLs target throughout the water column, even with watershed BMPs.

6. With the addition of 840 AFY of purified recycled water, the interim Nutrients TMDL compliance targets (TP 1.25 mg/L, TN 2.45 mg/L) can be achieved.

7. The purified recycled water would have minimal, if any, impacts on the lake biota as long as it is stabilized with minerals required for living biota. In addition, stormwater flows would introduce organic and inorganic substances, and vegetation around the lake would produce detritus (non-living organic matter) necessary for the lake ecosystem to function properly.

2.10 Recommendations

Based on the modeling results presented, a minimum flow of 840 AFY of purified recycled water is recommended for nine months of the year if it is to replace the on-site phosphorus removal. This flow rate would allow the City to meet the Nutrients TMDL, assuming the future implementation of full watershed BMPs to reduce nutrient loads from upstream stormwater. Providing additional purified recycled water above this minimum value will further improve the water quality; therefore, a maximum flow rate is controlled more by available purified recycled water than by the potential water quality benefits.

3.0 Permitting Assessment

The City of Los Angeles Department of Public Works (LADPW) owns and, through BOS, operates the TIWRP. The discharge from the TIWRP is currently regulated under Order No. R4-2010-0071[4] (NPDES Permit No. CA0053856, or NPDES Permit). Most of the treated effluent is currently discharged to the Los Angeles Outer Harbor (Harbor) through Outfall 001 according to provisions specified in the NPDES Permit. The TIWRP NPDES Permit prohibits the discharge of treated municipal wastewater (except brine waste) to the Harbor after 2020 or by the earliest practicable date.[5] Tertiary effluent from the TIWRP undergoes additional treatment at the AWPF[6] to produce purified recycled water. In addition to the current uses[7], purified recycled water is allowed for non-potable irrigation, industrial, and recreational uses under the Master Reclamation Permit for the

[4] Adopted by the Los Angeles Regional Water Quality Control Board on May 6, 2010 and became effective on June 25, 2010.
[5] The City has petitioned this provision in the Permit to the SWRCB and the Petition is currently being held in Abeyance (SWRCB/OCC File A-2101).
[6] Note that the facility has historically been called an advanced water treatment plant (AWTF). Since the AWTF is permitted through the Harbor Water Recycling Project, Attachment C uses the term Harbor AWTF. Since the City is transitioning to the name advanced water purification facility (AWPF), this term is used throughout this memorandum.
[7] The biggest current use of the purified recycled water is for the Barrier Project protecting the West Coast Groundwater Basin from saltwater intrusion (Regulated under Order No. R4-2011-0034).

Harbor Water Recycling Project[8] (Nonpotable Reuse Project) Regional Water Board Order No. R4-2011-0033 (WRRs).

The potential regulatory requirements related to the wastewater and purified recycled water permitting assessment includes:

- Determining whether the existing TIWRP NPDES permit and AWPF Water Recycling Requirements (WRRs) can be modified to allow a discharge of purified recycled water to Machado Lake or if new or revised permits are needed;
- Assessing whether an approval of a change in use of wastewater or point of discharge pursuant of California Water Code §12111 by the State Water Resources Control Board (SWRCB) is required and, if so, the process for attaining said approval;
- Evaluating whether a new permitted source can be discharged into an impaired water, including the potential implications of relevant TMDLs; and,
- Evaluating whether expected effluent concentrations for the purified recycled water would affect the ability to discharge to Machado Lake or require additional treatment beyond what is currently provided by the AWPF.

The Regulatory Analysis is detailed in **Attachment C** and is summarized as follows:

- The existing TIWRP NPDES permit would need to be amended to specify an outfall into Machado Lake, expand the description of the TIWRP to include the facilities of the AWPF, and include additional requirements consistent with an inland surface water discharge.
- While a CWC §1211 Petition may not be required for the change in discharge and use by TIWRP to the Harbor, the City should conduct a further legal evaluation.
- The Pinto Creek decision does not necessarily preclude the discharge of purified recycled water to Machado Lake. However, as reasonable potential exists for all TMDL constituents, the TMDLs must explicitly account for the purified recycled water discharges within the WLAs.

In assessing the potential regulatory issues associated with discharging purified recycled water from the TIWRP to Machado Lake, there are two issues, both related to TMDLs, that need resolution:

1. Machado Lake overflows are not considered in the allocations in the Harbors Toxics TMDL. Thus, WLAs are not currently assigned to NPDES permittees (MS4 or non-MS4 such as TIWRP) in the Machado Lake watershed.
2. The Machado Lake Nutrients TMDL does not assign WLAs to non-MS4 NPDES permittees.

[8] The City of Los Angeles Department of Water and Power is the primary water rights holder of all recycled water produced by the Harbor AWTF pursuant to Section 677 of the City Charter.

These issues may be resolved through discussions with the Regional Water Quality Control Board regarding whether discharges from TIWRP could be considered addressable similar to the other non-MS4 point sources explicitly identified in the TMDL, as in the case of the Harbors Toxics TMDL, or through reopening and adding non-MS4 NPDES WLAs set equal to the concentration-based WLAs in the Machado Lake Nutrients TMDL and the Harbors Toxics TMDL. While reopening the TMDLs will likely require more study, the proposed discharge of purified recycled water, as stated previously, meets multiple objectives not only in Machado Lake, but also the Dominguez Gap Barrier and Harbor.

Additional permits for the Machado Lake Project are not expected to be required since the project results in deletion of treatment systems, the addition of a pipeline segment at the D24010 Storm Drain, and the increase in flow to the freshwater marsh area. However, CDM Smith advises the City to consult with resource agencies to confirm that no additional permits are necessary.

4.0 Construction, Cost, and Schedule Considerations

Design has been completed for the currently defined Machado Lake Project, construction and resource agency permits are currently in progress, and the Bureau of Engineering (BOE) is working with the Bureau of Contract Administration to advertise the project to potential bidders. Revising the project description to increase the amount of purified recycled water added to Machado Lake and to remove project elements (phosphorus removal system and oxygenation system) could affect the cost and construction schedule of the currently defined Machado Lake Project. Therefore, this section presents the construction considerations as well as order-of-magnitude cost and schedule impacts of implementing recommended changes. Note that the information contained in this section assumes that the addition of purified recycled water from the AWPF will result in TMDL compliance.

4.1 Construction Considerations

Supplying purified recycled water to Machado Lake will require several additions or modifications to the Machado Lake Project as currently designed. The following set of construction requirements and options should be addressed in order to supply purified recycled water to the lake:

- **Purified Recycled Water Pipeline.** This element addresses how purified recycled water will be conveyed from an existing point of supply into the lake, and includes construction of a purified recycled water pipeline to an identified discharge location and associated piping tie-ins.
- **Modifications to the Machado Lake Project.** This element includes additions, deletions or changes to the completed Machado Lake Project design, and includes:
    - Eliminating the phosphorus removal system, oxygenation system, and associated intake and discharge piping.
    - Modification of grading in place of phosphorus removal system.
    - Downsizing of inlet piping to recirculation wetlands.

- **Freshwater Marsh Improvements.** This element addresses changes to the freshwater marsh area to account for continuous flow.

While the removal of the oxygenation system is not currently recommended, a discussion is provided in this section regarding how the oxygenation system could be removed from the Machado Lake Project should the City elect to remove the oxygenation system.

One other Machado Lake project element that was evaluated and determined to not require modification is the dam outfall structure. In the current design, of the twelve new one-foot tall slide gate outfalls, only one of them would need to be open approximately three inches in order to accommodate the highest flow considered in this study.

4.1.1 Purified Recycled Water Pipeline

The Machado Lake Project as currently designed includes the existing potable water connection for lake make-up water as well as a 6-inch purified recycled water pipeline that runs north-south in the park area west of the lake. The purified recycled water pipeline is planned to be connected to the future pipeline in West Anaheim Street that would convey purified recycled water from the AWPF. The assumed flow for make-up water included in the Machado Lake Project as currently designed is 140 AFY using either source.

LADWP is currently implementing a recycled water distribution system in the Harbor area (in the vicinity of Machado Lake) to supply Title 22 recycled water to irrigation and industrial users. A 24-inch Title 22 recycled water pipeline has been installed along Figueroa Place and along Anaheim Street, with possible plans to extend supplies to the Harbor Golf Course (see Figure 4-1, Existing and Planned Recycled Water System, Harbor Service Area[9]). While this supply could be implemented in place of potable water currently used for irrigation at Ken Malloy Harbor Regional Park, it would not be suitable for use in the lake due to elevated nutrient levels in the water. Therefore, to implement the recommendations in this memorandum, a separate pipeline would be needed to provide purified recycled water to Machado Lake. As discussed in Section 2, the water quality modeling shows that the potential flow of purified recycled water to Machado Lake could be in the range of 140 to 2,570 AFY. Since the purified recycled water distribution system from the AWPF has not yet been extended near Machado Lake, a new pipeline will be needed to extend the Harbor recycled water distribution system to the lake. The tie-in point for the existing Harbor recycled water distribution system has been identified as the 24-inch pipeline at the intersection of Henry Bridges Boulevard and Figueroa Street. This 24-inch line was constructed in 2011 as part of the Port of Los Angeles Harry Bridges Development Water Recycling Project.

For this analysis, two options were considered to extended the purified water pipeline to Machado Lake and add purified recycled water to the lake. Both options are shown in Figure 4-2 and described below:

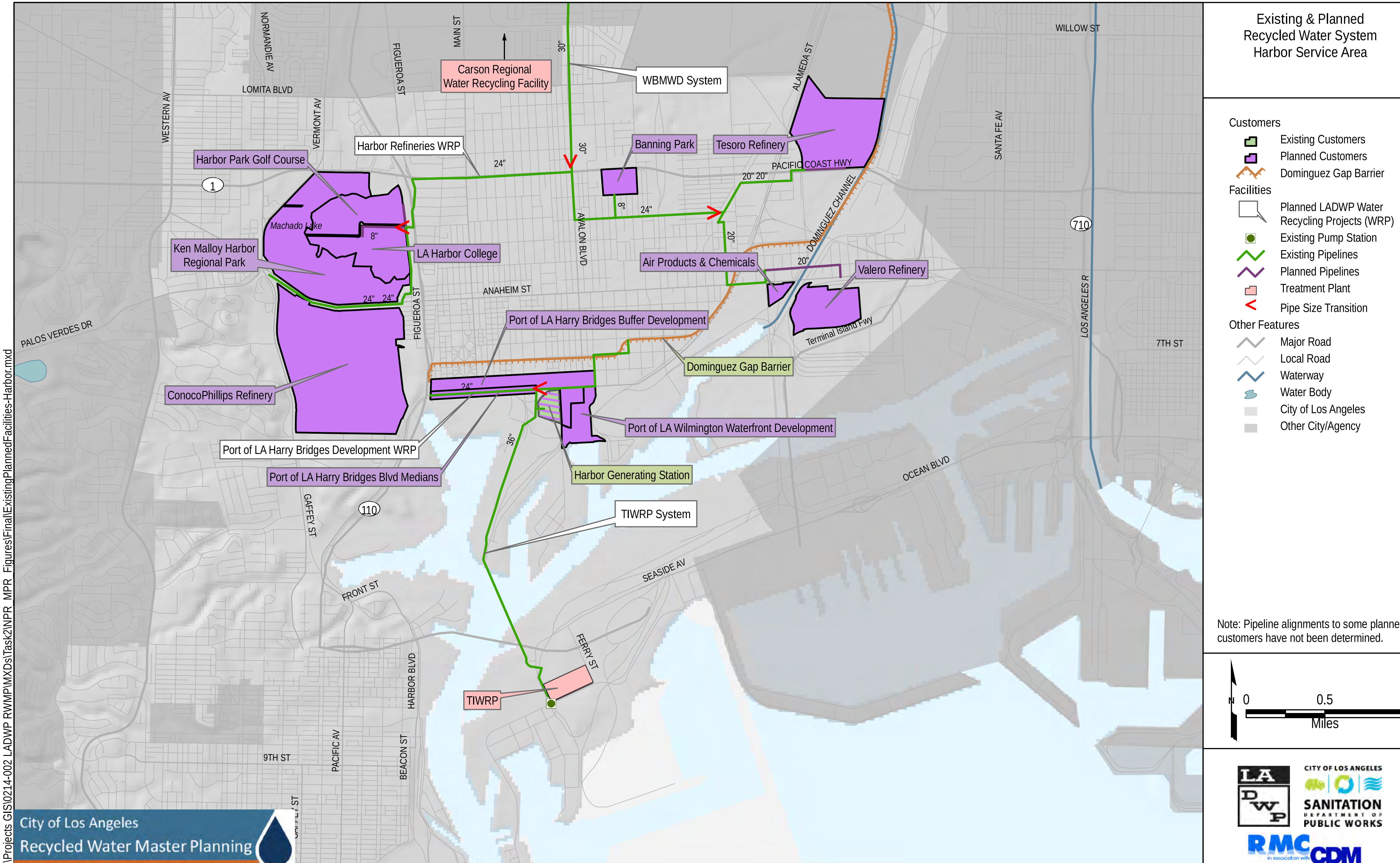
- **Alignment No. 1:** Assumes that a 12-inch purified recycled water pipeline is extended north along Figueroa Street, west along West Anaheim Street under Interstate 110, and north along

[9] Source: Figure 2-2, City of Los Angeles Non-Potable Reuse Master Plan, March 2012, RMC/CDM Smith.

Figueroa Place to the north boundary of the Harbor Park Golf Course. At that point, the pipeline would be routed northeast into the Machado Lake Project boundary and tie-in to the City's existing 78-inch storm drain at Project D24010. The pipe is sized based upon RWMP recommendations for maintaining pipe velocity below a maximum of 8 feet per second. At 12-inches, velocity is approximately 6 feet per second at the maximum flow condition of 2,570 AFY. The proposed discharge point would be located be downstream of the Continuous Deflection Separation (CDS) unit at D24010, which is being installed as a part of the Machado Lake Project. This location would allow construction of the tie-in point during the Machado Lake Project and situate the connection such that flow would not need to pass through the CDS system. From this connection, purified recycled water would be conveyed via the storm drain outfall into the Riparian Woodlands channel, a feature that is being rehabilitated as part of the Machado Lake Project. This channel has more than sufficient capacity to convey the purified recycled water flow (3.55 cfs maximum) as it was designed to transport significantly higher stormwater flows (20 cfs design flow[10]). This channel will convey the water to the sedimentation basin located at the north end of the lake. No additional distribution or mixing piping would be implemented to disperse water in the lake as the sedimentation basin will assist the distribution the water into the lake. No additional agency permits will be required for the tie-in at the storm drain downstream of D24010. The total length of Alignment No. 1 is approximately 7,000 linear feet (LF).

- **Alignment No. 2:** Assumes that the purified recycled water pipeline is extended north along Figueroa Street and then west along West Anaheim Street under Interstate 110 to the southwest corner of Machado Lake. The purified recycled water would be conveyed north through the park along the same alignment as the 6-inch purified recycled water pipeline currently in the design, but would be routed further north to allow the purified recycled water to be added to the sedimentation basin. In addition, the entire length of pipe would need to be sized up to 12-inches to accommodate the maximum flow condition of 2,570 AFY. By adding the water at the sedimentation basin, additional distribution piping within the lake would not be required. The total length of Alignment No. 2 is approximately 11,400 LF. The main basis for the consideration of this alignment is its inclusion in the Environmental Impact Report (EIR) for the Machado Lake Project.

[10] Pg. 5-64, Machado Lake Rehabilitation Project and Machado Drain Multi-Use Project Final Pre-Design Report – July 2009.



Data Sources: USGS, LADWP

Figure 4-1

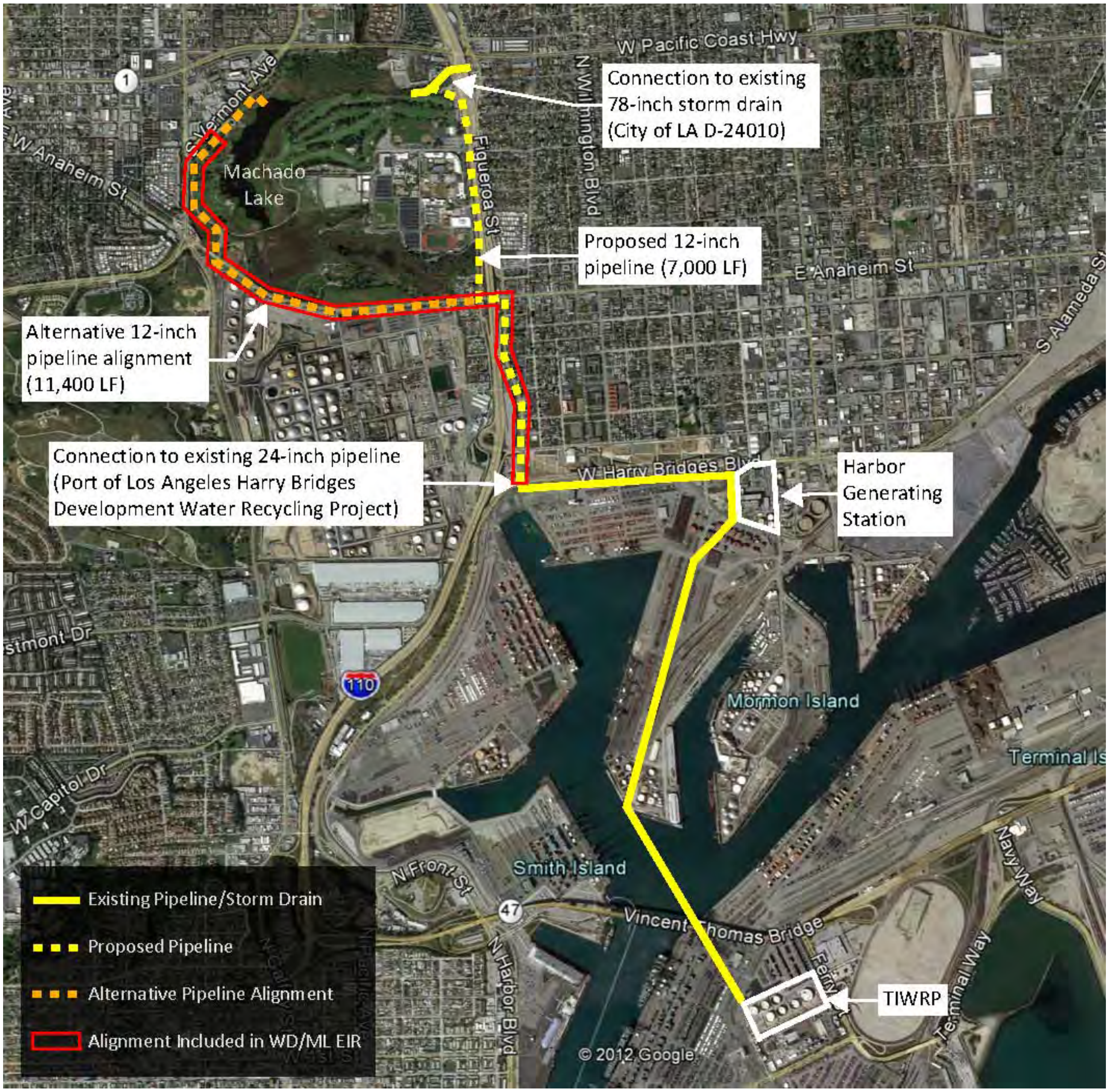


Figure 4-2. Purified Water Alignment from TIWRP to Machado Lake

Table 4-1 provides a brief comparison between these two alignments. Alignment No. 1 is approximately 4,400 LF shorter than the alternative alignment; hence, it is a more cost-effective option. Therefore, Alignment No. 1 is recommended to convey purified recycled water to Machado Lake. Two drawbacks of Alignment No. 1 are that (1) it was not included in the EIR for the Machado Lake Project and would require environmental documentation and (2) it would not allow LADWP to serve potential customers in the area of West Anaheim Street and South Vermont Avenue. It should be noted, however, that while Alignment No. 1 was not included in the EIR for Machado Lake, the additional EIR requirement is limited to filing a categorical exclusion based upon existing recycled water pipeline EIRs for the area. The process involves a 30-day public review period once filed with the City and county agencies prior to final approval.

Table 4-1: Purified Water Pipeline Alignments Comparison

Criteria	Proposed Alignment	Alternative Alignment
Pipe size	12-in	12-in
Length	7,000 LF	11,500 LF
Construction cost[1]	$2.95M	$4.85M[2]
Discharge location	Downstream of CDS at D-24010 storm drain outfall	North Sedimentation Basin
Mixing/distribution piping	None	Possible
Environmental Documentation	Categorical Exclusion needs to be filed for alignment along Figueroa Place north of West Anaheim Street	EIR has been completed along West Anaheim Street as part of the Machado Lake Project EIR documentation.
Other considerations	Possible 'conditioning' and aeration of purified water within the Riparian Woodlands prior to Machado Lake.	No conditioning or aeration of purified water prior to Machado Lake.

Notes:

1. Assumed unit cost of $20/in/LF from Section 3.3.3 of Non-Potable Reuse Master Planning Report, City of Los Angeles Recycled Water Master Planning, March 2012 (RMC/CDM Smith). This includes cost for the materials, equipment, labor, and services necessary to build the potential project. As noted in the reference document, unit costs given represent the cost of installation by LADWP or BOS crews. Cost also includes 30% contingency and 30% implementation costs. Cost has been adjusted to 2012 costs.
2. The cost of $4.85M for the Alternative Alignment replaces the 6-inch MF/RO pipe included in the Machado Lake Design, estimated to have a construction cost of $0.25M.

4.1.2 Modifications to the Machado Lake Project

The current Machado Lake Project design incorporates three major lake water treatment systems which are intended to assist in attaining goals for Machado Lake Nutrient TMDLs: recirculation wetlands, an oxygenation system, and a phosphorus removal system. In all cases, a common intake at the south end of the lake conveys water to the treatment systems which discharges at the north end of the lake.

If the City decides to use purified recycled water at Machado Lake in lieu of the on-site oxygenation system and/or phosphorus removal system, then the following modifications would need to be made to the Machado Lake Project:

- Remove the phosphorus removal system
- Remove the oxygenation system and associated discharge piping
- Revise the intake system for the treatment wetlands and the oxygenation system to supply water to the wetlands system. The flow would be reduced from 5.45 cfs to 1 cfs and, therefore, the intake piping would decrease from 24-inch to 12-inch diameter, based upon maintaining a water velocity of approximately 1.5 feet/second. Additionally, the two oxygenation system feed pumps for the intake water could be eliminated from the pump station leaving only the smaller recirculation wetlands pumps.

In eliminating the phosphorus removal system, the common sheet pile wall shared with the end of the recirculation wetlands would be modified to a simple straight wall,rather than including the concrete intake structure for the phosphorus removal system. Grading would not be required for the phosphorus removal system, only for the sheet pile wall. As the sheet pile wall design is documented in detail sheets, design sheet modifications would be limited to the grading and sheet wall plan.

Depending on the selection of Alignment No. 1 or Alignment No. 2 , the following changes would need to be made to the Machado Lake Project:

- **Alignment No. 1:** Remove the 1,700 LF of 6-inch purified recycled water piping running south to north at the west side of the lake from the Machado Lake Project. Add the purified recycled water tie-in to the D24010 storm drain pipe and install the length of 12-inch conveyance piping from the tie-in to Figueroa Place, where the new supply pipe alignment would be located.
- **Alignment No. 2:** Increase the pipe size of the purified recycled water pipeline from 6-inches to 12-inches (sized for maximum study flow of 2,570 AFY), extend this pipeline to the north side of the lake to discharge into the sedimentation basin, and design the pipe discharge into the lake.

If Alignment No. 1 is selected for the purified recycled water, the following changes would be required to the Machado Lake Project bid documents:

<u>Deletions</u>

- Design Drawings:
  - Volume 1 – Sheets C-021, C-022, C-023
  - Volume 5- Sheets M-003, M-005, M-006, M-011, M-012, M-013, M-014, I-003, I-004, I-005, I-006, I-007, I-008, I-009,
  - Volume 6 – Sheets S-022, S-023, S-024, S-025, S-026
- Specifications:
  - 11213 – Horizontal Centrifugal Pumps
  - 11342 – Cross-Linked Polyethylene Tanks
  - 11490 – Sump Pump
  - 11945 – Super-Oxygenation System
  - 11950 – Oxygen Generator Equipment
  - 13722 – Phosphorus Removal Filter System
  - 15855 – Air Handling and Moving Equipment

<u>Modifications</u>

- Design Drawings:
  - All Volumes- sheet indexes R-002 and R-003, Project Site Plan R-005,
  - Volume 2 – Sheets C-030
  - Volume 4 – Sheets C-113, C-115, C-116, C-117, C-120, C-122, C-123, C-124, C-132, C-133, C-136, C-138, C-139, C-140, C-143, C-144, C-149, C-150, C-155, C-156
  - Volume 5 – Sheets M-001, M-002, M-004, M-008, M-010, E-005, E-006, E-007, E-008, E-009, E-011, E-012, E-013, E-014, I-002, I-010, I-011, I-012,
  - Volume 6 – Sheet S-018

- Specifications:
  - 11300 – Pumps General
  - 11510 – Submersible Non-Clog Pumps

4.1.3 Freshwater Marsh

The current Machado Lake Project design incorporates grading in the Freshwater Marsh to create additional wetland environment (Wetlands #3, 4 ,5, and 6), to improve flow dispersion from the dam, to improve the Figueroa Drain runoff alignment to the Harbor Outlet, and to create a boardwalk into the wetlands for pedestrian use. Grading will include the removal of some non-native plant and tree species and foster development of natural wetlands.

In the freshwater marsh, located downstream of Machado Lake, it is assumed that flow greater than that needed to account for evapotranspiration losses will result in continuous flow through the area to the Harbor Outlet. Further, upon examination of existing elevation contours and Machado Lake Project grading plans for the area, the amount of ponding created to affect additional evapotranspiration losses are insignificant compared to the flows necessary to feed to the lake to make the use of purified recycled water worthwhile. Therefore, the implication of water continuously flowing through the Freshwater Marsh down to the Harbor Outfall is evaluated, considering the following existing factors:

- Presence of sensitive/endangered species (Tarplant),
- Presence of jurisdictional wetlands, and
- Presence of contaminated soils.

Machado Lake water would continuously overflow the dam and would follow natural grading and the flowpath established in the Machado Lake Project (see Figure 4-3 Freshwater Marsh Contours and Estimated Flow Path). No additional construction would be required. This option avoids Tarplant populations (see Figure 4-4 Focused Plant Survey Results, Machado Lake for boundaries) as they are located in drier, higher-elevation areas. It also avoids disturbance of Jurisdictional wetlands (See Figure 4-5 Jurisdictional Delineation, Machado Lake South) since no new construction would occur in the area. Continuous flow through the Freshwater Marsh is considered to be a benefit and the water will promote plant growth and enlarge wetland habitat, favoring development of wetland species. Also, ponding created by the construction of check dams along the flowpath would create habitat for aquatic species, both animal and plant. If the City decides to move forward with this alternative, then the City may want to consider a small-scale biological study to determine how continuous flow will affect flora and fauna in the area.

One potential issue with water continuously flowing through the Freshwater Marsh is the potential for mobilization of contaminated soil sediments and transport to the Harbor outfall. A review of the grading and expected flow path indicate that water will spread over large areas through the Freshwater Marsh, which will decrease water velocity and, in turn, reduce the potential to mobilize soils by scouring. Also, as the area is highly vegetated, scouring potential is further minimized due to soil stabilization by plant root structure and flow obstruction by plant structure. It is expected that continuous flow through the Freshwater Marsh and additional residence time established by the Machado Lake Project Freshwater Marsh improvements will improve water quality and not degrade it.

While a storm water quality study and memorandum[11] were produced to analyze if Freshwater Marsh improvements during the Machado Lake Project could benefit water quality, available water quality data do not support a complete determination of whether contaminant transport from the Freshwater Marsh would occur during continuous flow. No data exist for continuous flow through the area to the Harbor Outlet because water only flows through the Freshwater Marsh during storm events. As discussed in Section 1.2 Flows Available from AWPF, the typical flow from a storm event with a 1-year return period is 868 cubic feet per second (cfs). The recommended minimum flow of purified recycled water of 840 AFY is equal to about 1.2 cfs, much smaller than the stormwater flows.

Once continuous flow is established, the City should establish a sampling and analysis plan to verify that Freshwater Marsh improvements are enhancing contaminant removal. This could also indicate if additional improvements could be made to the Freshwater Marsh to enable additional contaminant removal.

Additional factors considered for this alternative were potential impacts to the Harbor Outlet and other drains that feed the Freshwater Marsh, and the potential for flooding. A study of the existing and planned grading contours of the Machado Lake Project indicate no flooding in areas of possible concern, including the Boy Scout Camp area, the abandoned landfill area, or the Harbor Outfall structure itself. In the first two cases, both are situated at higher elevation than water could reach during maximum water flow. In the case of the Harbor outfall, the 24-inch lower outlet is more than sufficient to pass the 2,570 AFY at maximum flow.

The City could also consider creating a channel through the Freshwater Marsh to route the flow from the dam to the Harbor Outlet, Construction would be difficult with the need to avoid Tarplant, Jurisdictional Wetlands (or compensating for their disturbance at a ratio of 10 to 1 newly constructed unit areas for each existing unit area disturbed), and areas with high levels of soil contamination. These factors make the construction of a channel difficult.

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[11] California Coastal Conservancy Grant – No. 04-04, Wet Weather Water Quality Monitoring – Task 6 (CDM, April 2010)

4.1.4 Other Improvements Considered

The other Machado Lake Project element that was evaluated for potential modifications was the addition or alteration of the lake water control systems at the dam. The Machado Lake Project as currently designed includes 12 dam outlet gates contained within two structures. Each outlet is 9-feet wide by 1-foot tall. Assuming a normal lake water elevation of 10 feet MSL, it was determined that only one outlet would need to be opened approximately one quarter of its full amount to allow water through at the maximum flow condition modeled in this study (2,570 AFY). The dam walkway would not be impacted as it is situated above the dam outlets. As a result, no additional modifications would be required in the Freshwater Marsh to implement continuous flow through the lake.

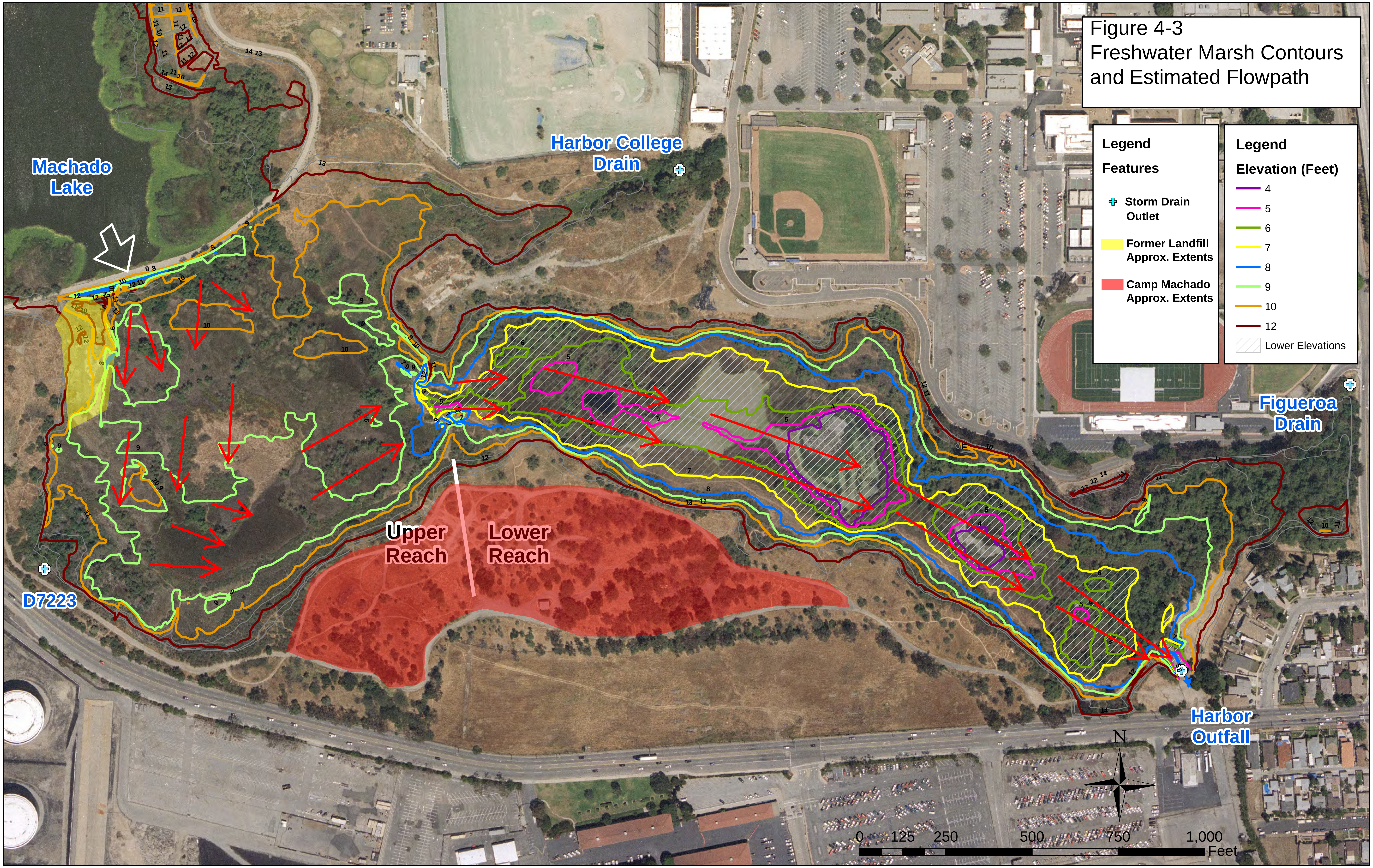

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Figure 4-4
Focused Plant Survey Results
Machado Lake

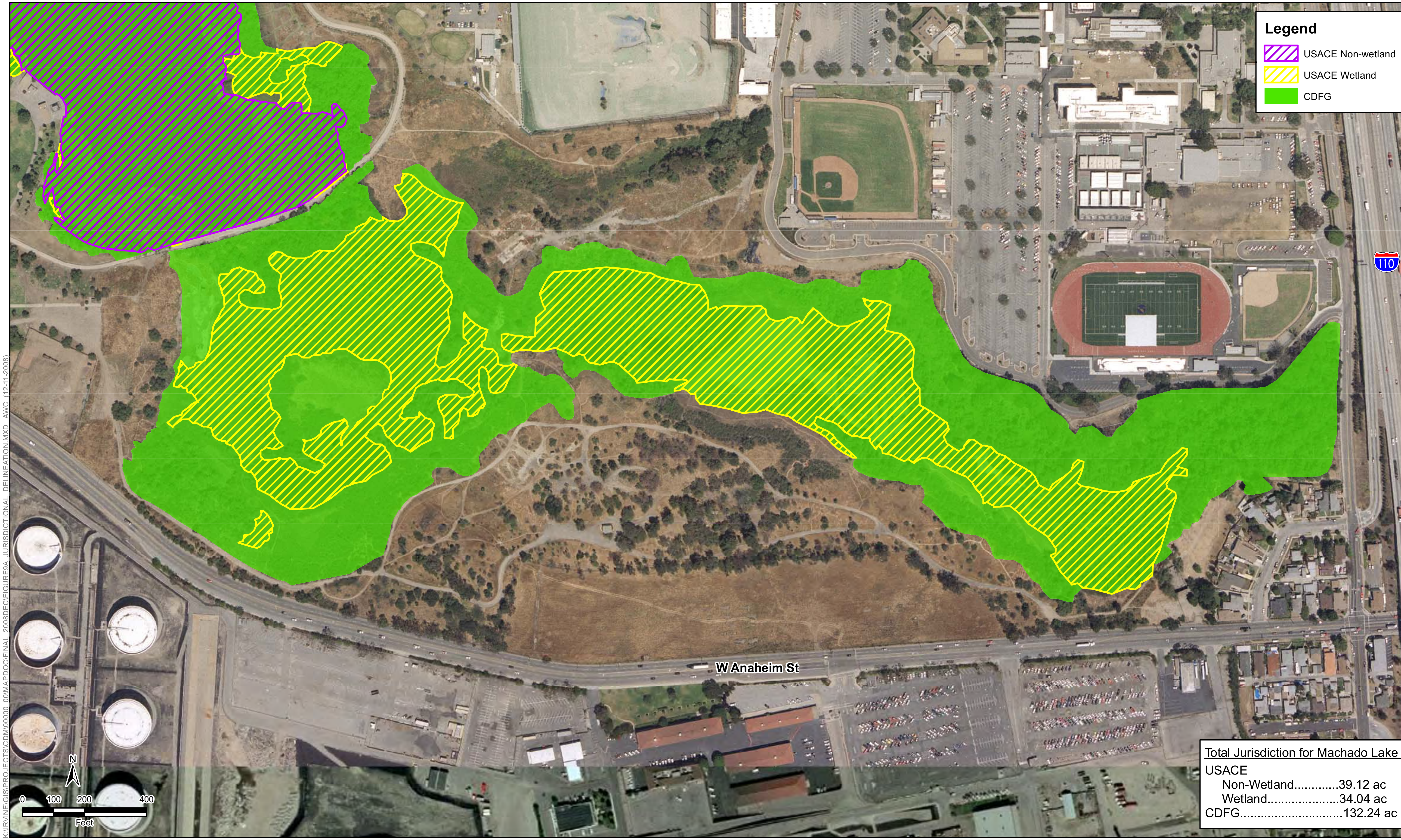

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Figure 4-5
Jurisdictional Delineation
Machado Lake South

4.2 Cost Considerations

As discussed in Section 4.1, the main requirement to convey a higher flow of purified recycled water to Machado Lake is the construction of a purified recycled water pipeline from the 24-inch pipeline at the intersection of Henry Bridges Boulevard and Figueroa Street to Machado Lake.

If the City decided to use purified recycled water in lieu of the on-site phosphorus system and/or oxygenation system, then the following elements of the Machado Lake Project as currently designed could be removed:

- Phosphorus removal system,
- Oxygenation system and associated piping, and
- Six-inch recycled water pipeline that runs north-south on the west side of the lake.

As a result, cost savings for the Machado Lake Project could be realized. However, these cost reductions would only be realized if these items are: (1) identified as separate bid items in the Machado Lake Project or (2) eliminated from the Machado Lake Project prior to bidding. Note that while the removal of the oxygenation system is not recommended as a result of the water quality modeling in Section 2, the costs and savings associated with removing it are included for reference.

Cost additions for the construction of the purified recycled water pipeline and cost reductions for the Machado Lake Project are summarized in **Table 4-2**.

Table 4-2. TIWRP Purified Water Supply Cost Implications[1]

Element	Opinion of Probable Cost (Millions)				Annual O&M Cost	Notes
	Total[2]	Construction	Soft[3]	Design[4]	(Millions/year)	
Cost Additions						
Purified Water Pipeline	$2.95	$2.1	$0.65	$0.2	—[5]	Alignment No. 1 (7,000 LF), see Section 4.1.1. Includes connection at storm drain.
Cost Reductions						
Phosphorus Removal System	—	$2.0	—	—	$0.19	$160,000/yr to $210,000/yr for 9 months (March through November)
Oxygenation System	—	$2.1[6]	—	—	$0.07	$5-7k/mo for 12 months, annual cost based on average of $6k/mo
6-inch RW Pipeline	—	$0.25	—	—	—	

Notes:
[1] = See Table 4-1 for basis of pipeline construction cost. Cost reductions are derived from Machado Lake – 100% Opinion of Probable Cost of Construction, Feb. 21, 2012 (CDM Smith), which includes 10% contingency.
[2] = Total = construction cost + soft cost. Cost accuracy range is -30% to +50%.
[3] = 30% of construction cost.
[4] = 33% of soft cost.
[5] = The purified water is assumed to be free.
[6] = For reference only. Removal of the oxygenation system is not recommended (see Section 5.2).

Total net construction cost for the use of purified recycled water is a reduction of $1.4 million capital cost and $0.26 million per year in operation and maintenance (O&M) costs (if oxygenation system removal is included). Note that the cost to upgrade and expand the AWPF is not included in this cost evaluation. The City is planning for these costs as part of a separate project. Additionally, the costs for increasing nitrogen removal at TIWRP or the AWPF are not included.

4.3 Schedule Considerations

This section discusses the schedules for the Machado Lake TMDL requirements, the Machado Lake Project as currently designed, the City's schedule for the AWPF expansion and improvements, and the implications of modifying the current project to convey purified recycled water to the lake in lieu of on-site treatment systems. Refer to Figure 4-6 for a comparison of schedule timelines.

4.3.1 Deadlines for the Machado Lake TMDL Requirements

The Machado Lake Interim and Final Waste Load Allocation Compliance dates are March 11, 2014 and September 1, 2018, respectively. While this current study examines whether modifications to the Machado Lake Project design could meet compliance requirements through the use of purified recycled water and eliminating the phosphorus removal and oxygenation systems from the project scope, the schedule for construction of the Machado Lake Project (as described in more detail below) has a currently projected completion date of early 2016, about two years after the Interim compliance date.

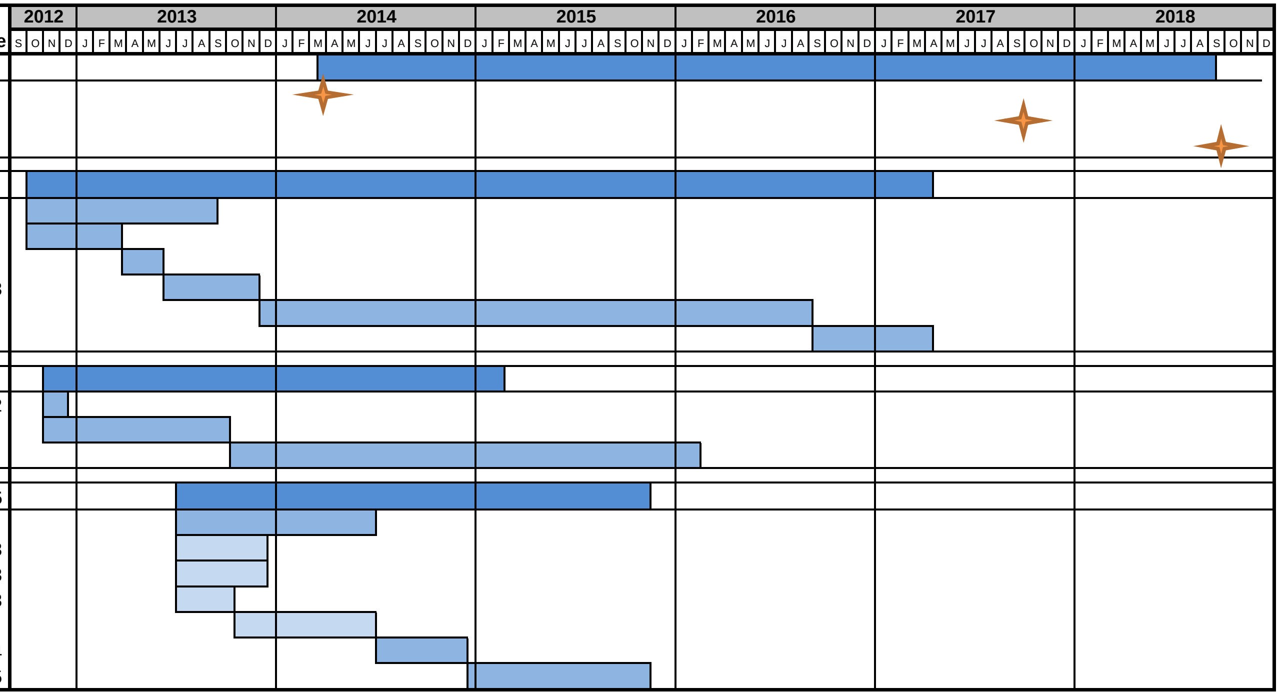
4.3.2 Machado Lake Project Schedule

The Machado Lake Project as currently designed is anticipated to go out for bidding in December 2012 and be awarded to a contractor in April/May 2013. At this time, the project is anticipated to have a 2.75-year construction duration, which translates to a completion date in the first quarter of 2016. (Note that the Machado Lake construction schedule will be updated as part of the bidding process to take into account the final conditions of the environmental permits, which may extend the currently estimated construction duration of 2.75 years.) If the City decides to delete the on-site treatment systems part of the current Machado Lake Project design, then these elements could be deleted during the bidding phase or after contract award.

At this time, BOE is planning to bid and award the project with the on-site treatment systems and 6-inch purified recycled water pipeline included as separate bid items, facilitating their removal from the construction contract if desired by the City. However, until a purified recycled water source is available, make-up water for the lake will need to be supplied by the existing potable water source as designed in the current project.

Figure 4-6
Terminal Island Recycled Water Analysis
Project Implementation Schedule

Task Name	No. of Months	Start Date	End Date
Machado Lake Nutrients TMDL Compliance	**54**	**3/11/14**	**9/1/18**
Interim Compliance Deadline	N/A	3/11/14	3/11/14
Target Compliance Deadline	N/A	9/1/17	9/1/17
Final Compliance Deadline	N/A	9/1/18	9/1/18
Terminal Island AWPF Expansion	**55**	**10/1/12**	**4/14/17**
EIR	12	10/1/12	9/5/13
Preliminary Design/ Bridging Docs	6	10/1/12	3/21/13
D/B Prequalification	3	3/25/13	6/14/13
D/B Bid/ Award	6	6/17/13	11/29/13
Design and Construction	34	12/2/13	9/2/16
Post-Construction	8	9/5/16	4/14/17
Machado Lake Construction	**28**	**11/1/12**	**2/23/15**
Design Addenda	2	11/1/12	12/17/12
Bid/ Award	6	11/1/12	4/23/13
Construction	23	4/23/13	2/23/15
TIWRP Recycled Water Connection	**29**	**7/1/13**	**11/13/15**
RW Pipeline Design (within street R/W)	12	7/1/13	6/27/14
Environmental Documents (CEQA)	6	7/1/13	12/13/13
Permitting	6	7/1/13	12/13/13
Preliminary Design	4	7/1/13	10/18/13
Design	9	10/21/13	6/27/14
Bid/ Award	6	6/30/14	12/12/14
Construction	11	12/15/14	11/13/15



4.3.3 Schedule Requirements for Recycled Water Pipeline Construction

The major element for using purified recycled water in lieu of the on-site treatment systems is the design, construction, and permitting of approximately 7,000 LF of purified recycled water pipeline. It is recommended that this be bid and built as a separate project to obtain competitive pricing from contractors and because the work is outside of the existing boundary for the Machado Lake Project. However, the City could consider adding pipeline construction elements during the Machado Lake Project that are contained within the project boundaries, such as the connection to the City's storm drain downstream of Project D24010 and the installation of a segment of the purified recycled water pipeline from the project boundary to the storm drain connection. These could be issued either through an addendum during the bidding phase or through a change order during the construction phase (depending on if and/or when the decision is made to use purified water in lieu of the on-site treatment systems).

As shown, from the time the City decides to move forward with using purified recycled water, it would take approximately two and a half years to complete environmental documentation, design, bidding, and construction of the pipeline. Assuming that the City decides to start work on this element in mid-2013 to allow for initial planning and budgeting, the pipeline would be in place and operable by the end of 2015. Once installed, purified recycled water could be conveyed to the site once the AWPF improvements are completed (see Section 4.3.4).

4.3.4 AWPF Expansion and Improvements Schedule

The City is currently upgrading their existing 5-mgd AWPF with new membranes. When the plant is placed back into service in 2013, it will resume serving purified recycled water to the Dominguez Gap Barrier, and to industrial and irrigation customers in the Harbor area. The City is planning to expand the existing AWPF from the current capacity of 5 mgd to 11.5 mgd, and improve the treatment process by adding a new disinfection and advanced oxidation process that would replace the existing chloramination disinfection process. Assuming a Design/Build model, the proposed schedule for the expansion is as follows:

- Preliminary Design to begin Fourth quarter of 2012 (six month duration)
- Design / Build Prequalification (three month duration)
- Project Bidding and Awarding (six month duration)
- Design and Construction Phase (thirty-four month duration)
- Post Construction (eight month duration)

Total project duration is approximately 4.5 years with an anticipated end date in the first half of 2017. The AWPF expansion and improvements project and improved nitrogen removal both need to be constructed before purified recycled water can be added to Machado Lake. If the project begins this month (October 2012) as indicated in the schedule, purified recycled water would be available to Machado Lake almost a year and a half before the Final Waste Load Allocation Compliance date of September 1, 2018, which should allow the lake enough time to achieve the Year 1 water quality modeling results (Section 2) before the compliance date.

5.0 Conclusions and Recommendations

5.1 Conclusions

The addition of purified recycled water to Machado Lake from the TIWRP provides the following integrated benefits for stormwater, wastewater, and recycled water:

1. Decreases discharges from TIWRP to the harbor to meet permit requirements,
2. Improves lake water quality to meet TMDL requirements, and
3. Effectively utilizes a local, reliable supply of recycled water.

Results from the water quality model indicate improved water quality without implementing watershed BMPs. Gains appear to level off above a flow rate of 840 AFY. A flow rate of 2,570 AFY will bring the City closest to compliance without watershed-wide BMPs. The same benefits were not demonstrated with solely implementing watershed BMPs, in which case lake nutrient concentrations could increase during the summer. If the watershed runoff concentrations are reduced, then there is no water quality benefit (in fact, there is a small detriment) from adding purified recycled water. When and if watershed BMPs are implemented and the lake nutrient concentrations fall below that of the recycled water facility, then purified recycled water is no longer necessary.

As noted in the Machado Lake Nutrients TMDL Lake Water Quality Management Plan (CDM in association with Parsons, 2010), modeling results highlight the need for watershed-scale management of pollutant loadings in order to achieve in-lake TMDL targets. While nitrogen and chl-a targets are achieved on a mean summer basis for the majority of the scenarios without watershed BMPs, none of these scenarios project mean phosphorus levels at or below the TMDL target. Conversely, TMDL targets for these three constituents are projected to be achieved on a mean summer basis for all scenarios that include watershed BMPs. If lower TP concentrations (i.e., 0.03 mg/L) are possible in the purified recycled water, the TP levels would not dramatically improve because of the buildup of in-lake TP concentrations contributed from the watershed.

The oxygenation system included in the original Machado Lake Rehabilitation Project would increase DO levels in the lake. The removal of the oxygenation system could cause the lake's DO levels not to meet the Nutrients TMDL for DO. The DO in the purified recycled water is anticipated to have a value of approximately 7.0 mg/L. If sufficient flushing flow of purified recycled water is discharged into the lake, the DO would largely be controlled by the purified recycled water and thus the DO levels would most likely be above the Nutrients TMDL minimum DO concentration of 5 mg/L. The oxygenation system would introduce a higher DO water source into the lake at the sediment/water interface, while the recycled water would have a lower DO concentration and will be added at or near the water surface.

While the use of purified recycled water as described in this memorandum should not affect the Machado Lake Project permitting, TIWRP permitting must be considered. Discharging purified recycled water from the TIWRP to Machado Lake requires consideration and resolution of the interpretation of potential lake overflows in relation to the Harbors Toxics TMDL and lack of WLAs assigned to NPDES permittees in the Machado Lake watershed and non-MS4 NPDES permittees such as the TIWRP. Furthermore, the Machado Lake Nutrients TMDL does not assign WLAs to non-MS4 NPDES permittees. Thus, it may preclude the discharge of purified recycled water.

With respect to construction considerations, implementing flow of purified recycled water may result in a net decrease to Machado Lake Project costs, both in terms of capital expenditures and ongoing O&M expenses. If the oxygenation system, phosphorus removal system, and 6-inch purified recycled water piping can be removed from the Machado Lake Project scope, an immediate $4.35 million reduction in capital costs could be achieved with an ongoing savings of $0.25 per year in O&M costs. The construction of a 12-inch purified supply pipe, at an estimated capital cost of $2.95 million, would realize a net savings to the City of $1.4 million in capital costs. Design documents would need modification to reflect system deletions which could be issued as design addenda or a construction change order.

The construction schedule for the Machado Lake Project indicates that the project will be under construction when the Interim Compliance date is reached (March 11, 2014), so the project improvements will not yet be in place. As indicated in Figure 4-6, the new purified recycled water pipeline and the improvements to the AWPF could be completed about a year and a half before the Final TMDL Compliance date of September 1, 2018. Until the purified recycled water is available to be added to the lake, potable water will need to be used for lake make-up water, which is included in the project design.

5.2 Recommendations and Next Steps

Providing purified recycled water to Machado Lake could allow the City to meet the Nutrients TMDL assuming the water quality of the purified recycled water has low concentrations of nutrients. However, it is important to recognize that until watershed-wide BMPs are implemented, the lake will continue to have total phosphorus levels above the Nutrients TMDL target. In addition, there will be regulatory, permitting, and construction challenges associated with implementing the purified recycled water concept.

The following are considerations for next steps for pursuing the addition of purified recycled water from the TIWRP AWPF to Machado Lake:

- Install purified recycled water line sized for a minimum discharge of 840 AFY and maximum discharge of 2,570 AFY.
- Confirm the discharge location for the purified recycled water, which is assumed to tie-in to the D24010 storm drain pipe.
- Eliminate the on-site phosphorus removal system.
- Determine if the City will either keep or eliminate the on-site oxygenation system. CDM Smith recommends that the City consider installing the oxygenation system because will maintain DO levels in the lake more consistently and reliably than purified recycled water. The

recycled water in combination with the on-site oxygenation system will give the City the best opportunity to meet the lake TMDLs in the event that watershed-wide BMPs are not implemented.

- Complete the advanced oxidation pilot testing at the TIWRP AWPF. Conduct additional phosphorus sampling at TIWRP to refine the TP concentration in purified recycled water
- Further evaluation of the need for a supplemental nitrogen removal process to be implemented at TIWRP or the AWPF to provide additional reduction of the TN concentration of the purified recycled water (see **Attachment B**).
- Potentially conduct additional water quality sampling at the discharge of the Freshwater Marsh through the Harbor outfall and a study of the impacts of additional water to the Freshwater Marsh.
- Further evaluation of the potential for soils and potential contamination to be mobilized by water flowing through the Freshwater Marsh and identify impacts, if any, on the Harbor.
- Conduct additional legal evaluation of the necessity of filing a CWC §1211 Petition
- Meet with Regional Water Quality Control Board management and permitting and TMDL staff to discuss the following:
    - Approach to amending the TIWRP NPDES permit.
    - Interpretation of the implications of the Machado Lake Nutrient and Toxics TMDLs and the Harbors Toxics TMDL and, if necessary, identification of potential approaches to modifying the TMDLs.
- Consult with resource agencies to confirm that no additional environmental permits are necessary.
- Track the implementation schedules of the two projects that will to produce and deliver the purified recycled water to Machado Lake: the TIWRP AWPF expansion and upgrade project and the project to install the purified recycled water pipeline. If the projects are delayed for any reason, initiate a back-up plan to meet the 2018 TMDL compliance target.

Attachments

Attachment A: Lake Water Quality Model Recalibration Documentation
Attachment B: Estimated Average Total Nitrogen Concentration of Purified Recycled Water with Ultraviolet Light Disinfection and Advanced Oxidation (UV/AOP)
Attachment C: Regulatory Assessment of TIWRP Recycled Water Opportunity for Machado Lake (revised draft memorandum)

ATTACHMENT A

Lake Water Quality Model Recalibration Documentation

Attachment A

Lake Water Quality Model Recalibration Documentation

Lake Water Quality Model Recalibration

With any numerical modeling project, it is often beneficial to re-examine calibration efforts as new information becomes available. This can either serve as a "verification" of previous calibration parameters or may result in adjustments to previous parameter estimates as part of a "re-calibration" exercise. The end result of such an exercise is generally a more accurate and defensible predictive model.

The Machado Lake water quality model was rigorously calibrated in 2010 using measured lake and watershed data from the monitoring period June 2006 – June 2009 and an independent sediment nutrient flux incubation study. Since that time, the City has collected over 3 years of new in-lake monitoring data as described above. A reassessment of the model calibration, in light of this new data, is therefore appropriate.

As in 2010, visual assessments of modeled vs. measured water column concentration data were the primary guide for the calibration/verification process. Additionally, the following model output parameters were taken into consideration as part of the process:

- Water column nutrient particulate fractions (compared to measured data)
- Sediment nutrient concentrations (compared to measured data and assumed equilibrium conditions)
- Sediment nutrient flux values (compared to the range of measurements from 2009 Alex Horne incubation studies)

Any adjustments to model parameters were made in accordance with recommended ranges found in scientific literature.

Table 1 summarizes the changes in model parameters that were implemented as part of this task. **Table 2**, **Table 3**, and **Figure 1** summarize the new calibration results.

Only very minor changes to model parameters (Table 1) were required to achieve strong agreement between modeled and measured TP values. Similarly, after achieving nutrient calibration, only a minor adjustment of the phytoplankton calibration factor was required to achieve acceptable agreement between modeled and measured chlorophyll-a values. These results serve as verification of the model construction, parameterization, and predictive power with respect to these two constituents.

As discussed above, the measured nitrogen, and coupled chlorophyll-a data, reveal a significant improvement in lake water quality over the past 3 years compared to the previous 3 years. Specifically, total nitrogen concentrations are lower resulting in lower phytoplankton levels in this nitrogen-limited lake. While this appears to be good news for the City, it presents a modeling challenge. Since the mechanism behind this change has not been determined, we cannot directly incorporate such change in the model. Rather, we can only indirectly arrive at hypotheses explaining the observed dynamic. In this case, the modeling strongly suggests that the only way such a rapid and major reduction in lake N concentrations could have occurred, is if external loads to the lake were reduced over the same time period. More specifically, since the model directly incorporates rainfall and runoff hydrologic variability, the model points to reductions in both wet and dry weather TN inflow concentrations (Event Mean Concentrations [EMCs]). Therefore, as part of this calibration exercise, we have reduced model TN EMC values by a factor of two starting in 2010. The nitrogen burial fraction and particulate phase settling rates have also been reduced as part of this exercise. The end result is an excellent agreement between modeled and measured TN concentrations for the full simulation period (Figure 1). However, it is important to realize that, since the modeled changes in EMCs are not supported by observed watershed data, the uncertainty associated with TN predictions is greater than that associated with TP predictions.

Table 1. Model Re-calibration Parameters (old value, new value)

TP	burial fraction (0.7, 0.6); k_{dsed}[1] (0.008, 0.01 d^{-1})
TN	burial fraction (0.8, 0.7); v_s [2] (6.6, 1 ft d^{-1}); EMC_{wet}[3] (3.5, 1.7); EMC_{dry}[4] (2.3, 1.2)
Chl a	K[5] (0.65, 0.55)

[1] = sediment P mineralization rate
[2] = particulate nitrogen settling rate
[3] = nitrogen event mean concentration during wet weather events, only changed for period 2010 - 2012
[4] = nitrogen event mean concentration associated with dry weather baseflow, only changed for period 2010 – 2012
[5] = phytoplankton empirical model calibration coefficient

Table 2: Model Re-calibration Results: Measured vs. Modeled Water Column Concentrations

Year	Avg. TP (mg/L)	Max. TP (mg/L)	Avg. TN (mg/L)	Max. TN (mg/L)	Avg. chl a (µg/L)	Max. chl a (µg/L)
2006	0.9, 0.8	1.0, 1.3	2.4, 2.4	3.1, 4.1	-	-
2007	0.9, 0.8	1.3, 1.3	2.3, 2.1	4.2, 4.6	55, 60	81, 130
2008	0.7, 0.8	1.1, 1.3	1.7, 2.4	3.0, 4.7	70, 71	210, 160
2009	0.8, 0.8	1.7, 1.3	1.8, 2.2	4.1, 5.0	68, 72	180, 160
2010	0.9, 0.8	1.4, 1.4	1.3, 1.6	1.9, 2.5	42, 48	74, 110
2011	0.8, 0.8	1.4, 1.5	1.2, 1.4	2.1, 2.1	34, 43	84, 100
2012	0.7, 0.9	1.3, 1.4	1.0, 1.6	2.1, 2.4	32, 42	62, 90

Table 3: Model Re-calibration Results: Secondary Targets

	TP FP	TN FP	Growing Season (Apr – Sep) Sediment P flux (mg m^{-2} d^{-1})	Growing Season (Apr – Sep) Sediment N flux (mg m^{-2} d^{-1})
Modeled	0.2	0.6	12 - 24	5 – 140
Measured	0.2	0.9	5 - 20[1]	47 - 87[1]

[1] = Horne 2009 incubation studies

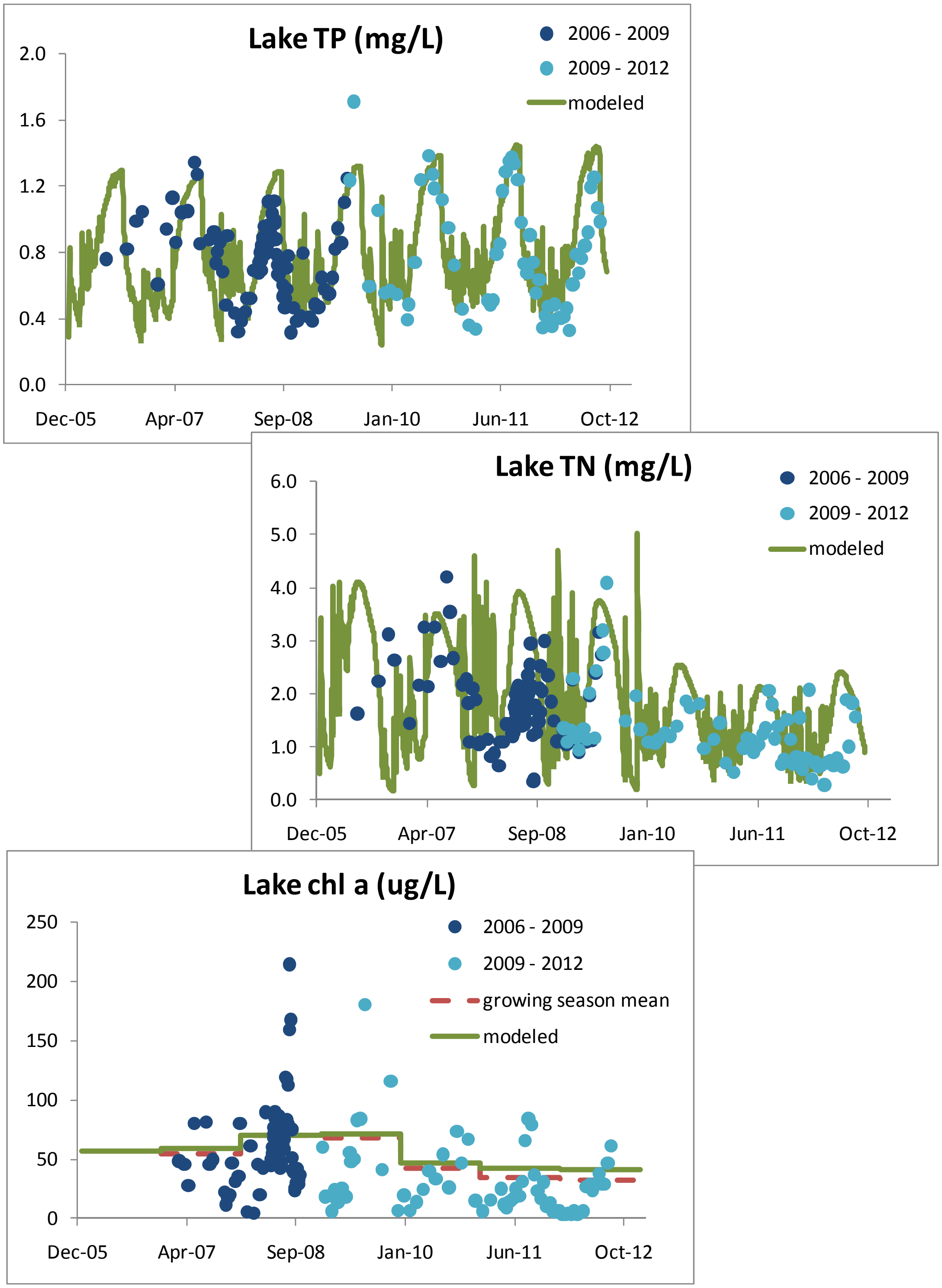


Figure 1. Model Re-calibration Results

ATTACHMENT B

Estimated Total Nitrogen Concentration of Purified Recycled Water with Ultraviolet Light Disinfection and Advanced Oxidation (UV/AOP)

Attachment B

Estimated Average Total Nitrogen Concentration of Purified Recycled Water with Ultraviolet Light Disinfection and Advanced Oxidation (UV/AOP)

This attachment summarizes the estimated total nitrogen (TN) concentration of the future purified recycled water once the existing TIWRP chloramine disinfection process is replaced with ultraviolet (UV) light disinfection and advanced oxidation (UV/AOP). The estimate is based on the following assumptions and data:

- Estimate is based on average TIWRP tertiary effluent data for nitrogen compounds for 2006 through 2011.
- Removal rates are assumed for new reverse osmosis membranes and are based on data from comparable advanced water purification facilities (AWPFs).
- Assumed all of the ammonia in the MF filtrate is in the form of chloramines.

The estimated TN concentration in the purified recycled water with UV/AOP is summarized in Table B-1. The TN concentration in the tertiary effluent averaged 11.2 mg/L from 2006 through 2011. After treatment through reverse osmosis, the TN concentration in the purified recycled water is estimated to be 1.0 mg/L assuming new RO membranes. As the membranes age, the TN concentration may increase. An additional process to remove nitrogen compounds may need to be considered. Examples include breakpoint chlorination (after RO and before UV/AOP), denitirifcation in the secondary system or the tertiary filters, ion exchange (after UV/AOP), or replacing the RO membranes on a more frequent basis. Table B-1 shows an example of how the TN concentration would be further reduced with breakpoint chlorination (after RO and before UV/AOP) to further reduce the ammonia concentration. The need for an additional process to remove nitrogen compounds and process selection needs to be addressed as part of a separate project.

Table B-1 Estimated Average TN Concentration in Purified Recycled Water with UV/AOP[1]

Nitrogen Compounds	Tertiary Effluent/AWPF Influent (Average Concentration 2006-2011) (mg/L)	Removal through RO	Ammonia Removal through Breakpoint Chlorination	Estimated TN Concentration in Purified Recycled Water (mg/L)	
				Without Breakpoint Chlorination	With Breakpoint Chlorination
Ammonia-N	0.6	25%	70%	0.5	0.1
Nitrate-N	8.4	94%	-	0.5	0.5
Nitrite-N	0.0	94%	-	0.0	0.0
Organic-N	2.1	99%	-	0.0	0.0
Total Nitrogen as N	**11.1**			**1.0**	**0.6**

[1]Note that UV/AOP will convert ammonia to nitrate, but the resulting TN concentration will be the same.

ATTACHMENT C

Regulatory Assessment of TIWRP Recycled Water Opportunity for Machado Lake

REVISED DRAFT Memorandum

DATE: November 28, 2012

TO: Jennifer Thompson, CDM Smith

FROM: Larry Walker Associates
Somach Simmons and Dunn
Nellor Environmental Associates

SUBJECT: DRAFT – Regulatory Assessment of TIWRP Recycled Water Opportunity for Machado Lake

1 Assessment Overview

The City of Los Angeles (City) Harbor Water Recycling Project Advanced Wastewater Treatment Facility (Harbor AWTF) currently has the capacity to produce 5.0 million gallons per day (mgd) of highly-treated recycled water, some of which is used for the Dominguez Gap Barrier Project to prevent saltwater intrusion into the West Coast Groundwater Basin. The source water for the Harbor AWTF is tertiary effluent from the City's Bureau of Sanitation (Bureau) Terminal Island Water Reclamation Plant (TIWRP). To meet TIWRP's 2010 National Pollutant Discharge Elimination System (NPDES) permit provision to cease discharge to the Los Angeles Harbor by 2020 (with the exception of brine), the Bureau is assessing various options, including additional recycled water opportunities. The Bureau identified a potential opportunity to utilize recycled water to support the rehabilitation and long-term health of Machado Lake. This Memorandum provides an assessment of potential regulatory requirements related to wastewater and recycled water permitting to allow for the discharge of purified recycled water to Machado Lake. The assessment includes the following:

- Determining whether the existing TIWRP NPDES Permit and Harbor AWTF Water Recycling Requirements (WRRs) can be modified to allow a discharge of purified recycled water to Machado Lake or if new permits are needed.
- Assessing whether an approval of a change in use of wastewater or point of discharge pursuant of California Water Code §12111 by the State Water Resources Control Board (SWRCB) is required and, if so, the process for obtaining said approval.
- Evaluating whether a new permitted source can be discharged into an impaired water, including the potential implications of relevant Total Maximum Daily Loads (TMDLs).
- Evaluating whether expected effluent concentrations for the purified recycled water would affect the ability to discharge to Machado Lake or require additional treatment beyond what is currently provided by the Harbor AWTF.

2 Introduction

The City of Los Angeles Department of Public Works (LADPW) owns and, through the Bureau, operates the TIWRP. Discharge from the TIWRP is currently regulated under Order No. R4-2010-0071 (NPDES Permit No. CA0053856, or NPDES Permit), which was adopted by the Los Angeles Regional Water Quality Control Board (Regional Water Board) on May 6, 2010 and became effective on June 25, 2010. TIWRP has a design capacity of 30 mgd and currently provides tertiary treatment for approximately 15 mgd of wastewater. Most of the treated effluent is currently discharged to the Los Angeles Outer Harbor (Harbor) through Outfall 001 according to provisions specified in the TIWRP NPDES Permit. The Harbor is defined as an enclosed bay and thus is subject to the *Enclosed Bays and Estuaries Policy*, established by the SWRCB in 1974, which requires cessation of discharges from Publicly Owned Treatment Works (POTWs) to enclosed bays at the earliest practicable date. The TIWRP NPDES Permit prohibits the discharge of treated municipal wastewater (except brine waste) to the Harbor by 2020 and shall be eliminated at the earliest practicable date. The City has petitioned this provision in the TIWRP NPDES Permit to the SWRCB, and the Petition is currently being held in abeyance (SWRCB/OCC File A-2101).

Tertiary effluent from TIWRP is the source water for the Harbor AWTF, which provides additional treatment including microfiltration, reverse osmosis, and chlorination for up to 5,600 acre-feet per year (AFY) (5 mgd). Reverse osmosis brine produced at the Harbor AWTF is combined with TIWRP tertiary effluent and discharged at Outfall 001 in accordance with TIWRP NDPES Permit requirements.

During water year 2010/11, approximately 2,400 AFY (2 mgd) of purified recycled water from the Harbor AWTF was supplied to the Dominguez Gap Barrier Project. The barrier project operates under Regional Water Board Water Recycling Requirements (WRR) Order No. R4-2003-0134 to protect groundwater from saltwater intrusion in the West Coast Groundwater Basin. The WRR was amended in 2010 (Order No. R4-2010-0183) and in 2011 (Order No. R4-2011-0034). The WRR and its amendments were issued to LADPW, LADWP, Los Angeles County Department of Public Works (LACDPW), and Water Replenishment District of Southern California (WRD).

Purified recycled water from the Harbor AWTF is also allowed for non-potable irrigation, industrial, and recreational uses under Regional Water Board WRR Order No. R4-2003-0025, which is a Master Reclamation Permit pursuant to California Water Code §13523.1. In 2011, the Regional Water Board issued Order No. R4-2011-0033, which amended Order No. R4-2003-0025. The original WRR and its amendment were issued to LADWP and the Bureau.

The LADWP also owns and, through the Bureau, operates the Harbor AWTF. However, pursuant to Section 677 of the City Charter, the City of Los Angeles Department of Water and Power (LADWP) Board of Water and Power Commissioners has the authority to supply and distribute surplus water, to enter into contracts for water exchanges, and to supply and distribute recycled water. Thus, LADWP is the primary water rights holder of all recycled water produced by the Harbor AWTF.

The City is interested in cultivating Machado Lake as a customer for purified recycled water produced at the Harbor AWTF to support the need to optimize water recycling using TIWRP effluent and eliminate (to the extent practicable) discharges to the Harbor. Purified recycled water would be utilized to support the rehabilitation and long-term health of Machado Lake and increasing the water supply available for the Dominguez Gap Barrier

3 Machado Lake Background

Machado Lake is located within the Ken Malloy Harbor Regional Park (KMHRP), and is impounded by a dam created in 1971. Approximately 88% of the inflow to Machado Lake is through the Wilmington Drain. The Los Angeles County Sanitation Districts (LACSD) operates the Bixby Marshland, which is a remnant of a formerly extensive, natural-freshwater wetland known as Bixby Slough. Over the years, most of Bixby Slough was destroyed due to development. To restore the Bixby Marshland, the site was vegetated with a large number of native plants and re-graded to improve the flow of water. A pump was installed to lift storm water and urban runoff from Wilmington Drain into the marshland. After going through the marshland, water exits back into Wilmington Drain. Through this restoration effort, the site has been rejuvenated, renewing the health of the marshland and increasing its value to wildlife. Water from Wilmington Drain flows through wetlands into Machado Lake. Lake water that flows over the dam and dam seepage flow through additional wetlands before entering storm drains for conveyance to the Los Angeles Harbor (Inner Harbor). A flow schematic of the system is presented in Figure 1.

The State's current Clean Water Act (CWA) section 303(d) list identifies Machado Lake as impaired for the following pollutants: algae, ammonia, ChemA (tissue), chlordane (tissue), DDT (tissue), dieldrin (tissue), eutrophic (nutrients), odor, polychlorinated biphenyls or "PCBs" (tissue), and trash. (2010 California 303(d) List of Water Quality Limited Segments.[1]) TMDLs have been or will be developed, adopted, and/or are being implemented for all of these listings.

The City is currently undertaking the Machado Lake Ecosystem Rehabilitation Project (Project), funded through the City's Proposition O Program. As described on the City's website[2], the goals of the Project are to: implement actions to meet nutrient TMDL commitments, improve visual aesthetics and ecosystem wildlife habitat, increase flood control capacity and geomorphic stability, and create additional recreational opportunities. To meet these goals, the Project will include a number of in-Lake rehabilitation improvements, riparian habitat enhancements, and stormwater treatment best management practices (BMPs) in three sub-areas: Machado Lake and associated riparian woodland areas; the freshwater marsh; and parkland areas adjacent to Vermont Avenue and Anaheim Street.

[1] Available at: http://www.swrcb.ca.gov/water_issues/programs/tmdl/integrated2010.shtml (last visited August 27, 2012).
[2] http://www.lapropo.org/sitefiles/Machado/machadointro.htm#

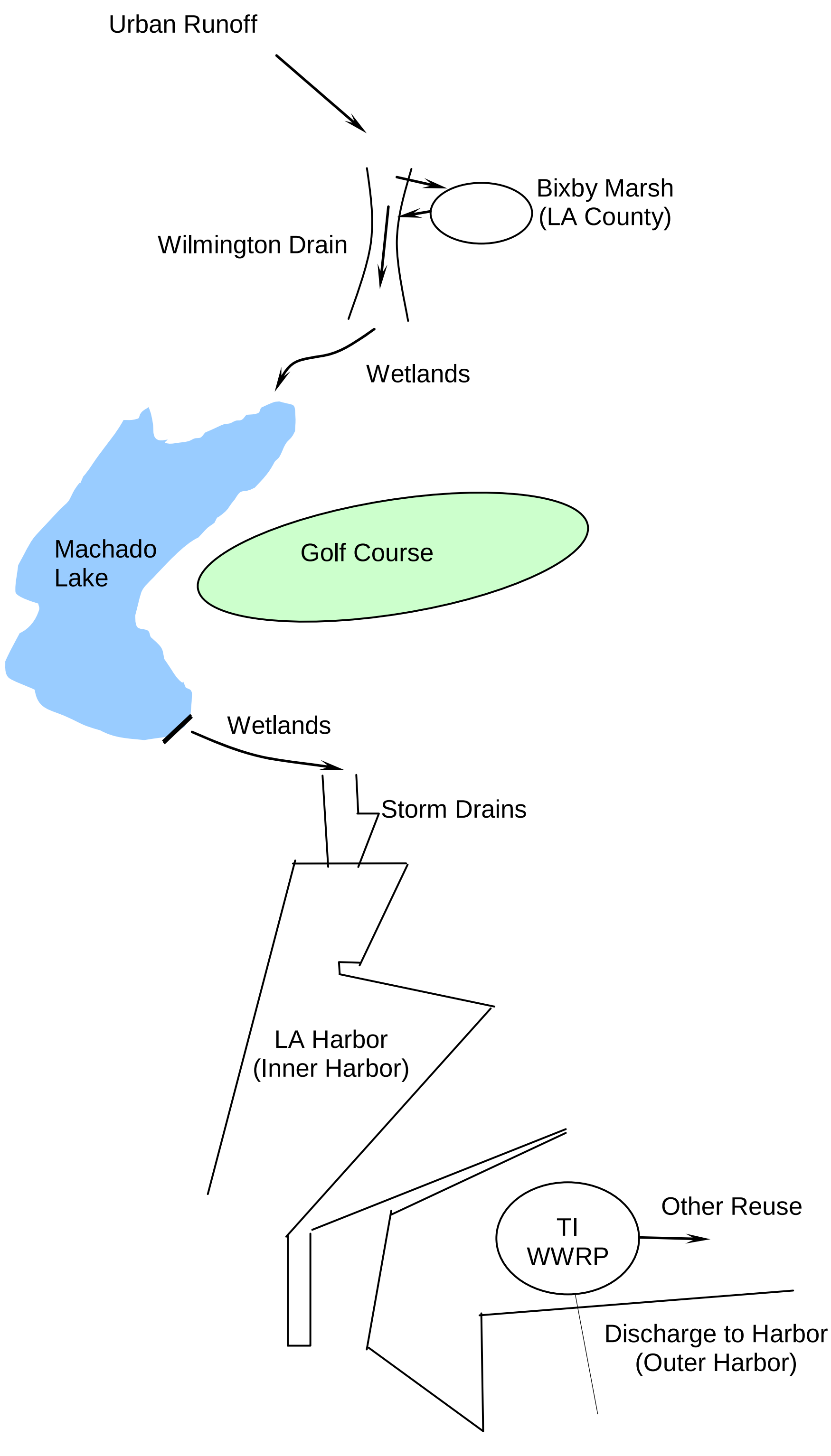


Figure 1. Flow Schematic for Machado Lake and Terminal Island Water Reclamation Plant.

4 Assessment of the Permitting Approach to Use Recycled Water for Machado Lake

Many NPDES Permits have been adopted in California for discharge of tertiary effluent/recycled water for environmental enhancement purposes.[3] Rather than adoption of a separate NPDES Permit to regulate discharges of purified recycled water to Machado Lake, the existing TIWRP NPDES Permit can be modified to include an additional outfall, an expanded description of the TIWRP to include the facilities of the Harbor AWTF, effluent limitations, and receiving water limitations to allow for discharge purified recycled water from the Harbor AWTF to Machado Lake. For clarification purposes, while water treated through the Harbor AWTF would be the ultimate source of purified recycled water to Machado Lake, the water would be considered a discharge from the TIWRP.

The California Code of Regulations Title 22 (Title 22) §60305 includes requirements for use of recycled water for non-restricted recreational impoundments (e.g., an impoundment where no limitations are imposed on body-contact water recreational activities). The quality of recycled water must be at least disinfected tertiary water. Recycled water produced by the Harbor AWTF exceeds this level of treatment. The Master Reclamation Permit for the Harbor Water Recycling Project (Nonpotable Reuse Project) (issued in 2003, amended in 2011) includes the use of recycled water for recreational impoundments as an authorized use of recycled water (see Order No. R4-2011-0033, III.1.F, pg. 9). Thus, the TIWRP effluent meets recycled water quality requirements and may be discharged to Machado Lake. To avoid conflicting and duplicative permit requirements, only one permit should be used to regulate discharges to Machado Lake. As Machado Lake is considered a Waters of the United States, the TIWRP NPDES Permit will be the overriding regulatory mechanism.

The following subsection outlines an approach that will modify conditions of the existing TIWRP NPDES Permit in order to receive regulatory approval of the proposed discharge of purified recycled water to Machado Lake. Additional analyses to further evaluate the specific regulatory challenges associated with permitting discharges to Machado Lake given existing regulations in the form of TMDLs and requirements based on the expected effluent quality are presented in Section 6.

4.1 General NPDES Permit Considerations

The existing TIWRP NPDES Permit may be amended to address discharge of purified recycled water to Machado Lake by adding an additional outfall (e.g., Outfall 002); expanding the description of the TIWRP to include the facilities of the Harbor AWTF required for a discharge to Machado Lake; and adding the associated regulatory requirements for the outfall to meet water quality standards for Machado Lake, including applicable conditions from TMDLs. The following activities and permit modifications are expected in order to implement federal, state, and *Water Quality Control Plan: Los Angeles Region Basin Plan for Coastal Watersheds of Los Angeles and Ventura Counties* (Basin Plan) requirements within the existing NPDES Permit. The activities would be completed by the Regional Water Board with assistance (as needed) provided by the City.

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[3] Examples of NPDES Permits with outfalls designated for environmental enhancement:
Order No. R2-2008-0090 (Sonoma Valley County Sanitation District, NPDES Permit No. CA0037800) – Identifies several outfalls for discharge of tertiary effluent to maintain/restore wildlife habitat in tidal wetlands.
Order No. R2-2011-0046 (City of American Canyon, NPDES Permit No. CA0038768) – Identifies an outfall for discharge of advanced secondary treated effluent to enhance wildlife habitat in constructed freshwater wetlands.
Order No. R2-2011-0058 (East Bay Regional Parks District et al, NPDES Permit No. CA0038636) - Identifies two outfalls for discharge of secondary effluent as a freshwater source for Hayward Marsh.

- Facility Description. The Regional Water Board will include a description of the Harbor AWTF treatment processes and any other added treatment processes for the discharge to the Facility Description in the permit findings.

- Beneficial Uses for Outfall 002. The Regional Water Board will include a separate list of beneficial uses for Machado Lake. The Basin Plan identifies the following existing beneficial uses for Machado Lake: Water Contact Recreation (REC-1), Non-contact Water Recreation (REC-2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), Rare, Threatened, or Endangered Species (RARE), and Wetland Habitat (WET).[4]

- Antidegradation Findings. To approve a new discharge location, the Regional Water Board must determine compliance with federal and state antidegradation policies. Typically this is accomplished by the Regional Water Board noting in the NPDES Permit Fact Sheet that discharges in conformance with the Order will not result in a lowering of water quality and therefore conform to the state and federal antidegradation policies, or if lowering of water quality is necessary that it is to the maximum benefit to the people of the state. The City may be required to complete the antidegradation analysis.

- Effluent Limitations for Outfall 002. Separate effluent limitations will be developed by the Regional Water Board for Outfall 002. The effluent limitations will be derived from the beneficial uses for Machado Lake (and downstream uses that must also be protected), applicable surface water Basin Plan water quality objectives, California Toxics Rule (CTR) water quality criteria, ambient water quality criteria, effluent quality, and TMDL wasteload allocations (WLAs) and implementation requirements. Depending on the identified constituents of concern, a mixing zone, dilution credits, and/or site-specific objectives may be needed for compliance purposes.

- Mixing Zones. The Basin Plan allows mixing zones on a case-by-case basis to determine compliance with water quality objectives in cases where ambient concentrations in the waterbody meet applicable water quality criteria/objectives. In lakes or reservoirs, the mixing zone "may not extend 25 feet in any direction from the discharge point, and the sum of mixing zones may not be more than 5% of the volume of the waterbody."[5] If a mixing zone is needed, the City will be required to model critical discharge conditions, define the extent of the mixing zone under these conditions, and determine appropriate dilution credits. The Regional Water Board will review the modeling results and decide if approval is warranted.

- Receiving Water Limitations for Outfall 002. Receiving water limitations will be established for Machado Lake by the Regional Water Board to include any constituents and/or narrative objectives that are necessary to protect the wetlands habitat and freshwater habitats of

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[4] The Regional Water Board has only conditionally designated the Municipal and Domestic Drinking Water Supply (MUN) beneficial use (P*) and at this time cannot establish effluent limitations designed to protect the conditional designation. That status cannot change until such time as the Regional Water Board conducts a review of the MUN use and amends the Basin Plan.
http://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/electronics_documents/bp2_beneficial_uses_tables.pdf
http://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/basin_plan_documentation.shtml
[5] Basin Plan at p. 4-30.

Machado Lake (and downstream uses). Receiving water limitations are typically based on Basin Plan constituent-specific or narrative objectives.

- Toxicity Monitoring. The Regional Water Board will identify separate toxicity test species, testing procedures, and accelerated monitoring triggers for the discharge to Machado Lake. The new requirements for effluent and receiving water testing will be based on Harbor AWTF effluent quality and discharge to a freshwater environment. The City will be required to conduct species screening with freshwater organisms for both acute and chronic toxicity monitoring. The proposed statewide "Policy for Toxicity Assessment and Control"[6] (Toxicity Policy) will impact toxicity effluent limitations, the type of species utilized during screening, the testing procedures (Test of Significant Toxicity), and the method of compliance assessment (effluent limits vs. accelerated monitoring). Specific Toxicity Policy requirements are still under development, but when it is adopted (estimated for early 2013), it will supersede the existing requirements of Section 4 of the *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays and Estuaries of California* (State Implementation Plan or SIP) and the Basin Plan. Under the new Toxicity Policy, numeric chronic toxicity limits and testing will become mandatory for discharges of 1 mgd or greater, but the Regional Water Board will have discretion to require acute toxicity testing.

- Effluent Monitoring. The Regional Water Board will identify a new effluent monitoring location (EFF-002) to evaluate effluent quality for the discharge to Machado Lake and determine compliance with effluent limitations. The City will likely be required to collect samples at various frequencies depending on the constituents being evaluated and the averaging period associated with the effluent limitations. The results of effluent monitoring required for the Harbor Water Recycling Project and the Dominguez Gap Barrier Project can be utilized to assess anticipated NPDES permit compliance.

- Receiving Water Monitoring. The Regional Water Board will identify receiving water monitoring locations in Machado Lake including upstream and downstream locations to assess compliance with receiving water limitations and determine impacts to beneficial uses. Monitoring locations will be identified within and outside the mixing zone (if authorized), depending on the constituents evaluated. The City will likely be required to collect samples on a weekly to monthly basis.

- Special Studies. The Regional Water Board may include special studies provisions in the NPDES Permit. The studies would be designed to determine impacts of effluent discharges and discharge operations not addressed by NPDES permit requirements.

4.2 Master Reclamation Permit

The Master Reclamation Permit for the Harbor AWTF includes requirements for managing the City's existing and proposed recycled water uses. Regulation of recycled water delivery and use at Machado Lake can be addressed through modifications of the TIWRP NPDES Permit, since the project will be considered a surface water discharge to Waters of the United States. Use of the Master Reclamation

[6] http://www.waterboards.ca.gov/water_issues/programs/state_implementation_policy/docs/draft_tox_policy_0612.pdf

Permit to regulate discharges to Machado Lake is not necessary or desired. However, the Regional Water Board has discretion to consult the California Department of Public Health (CDPH) to develop additional NPDES requirements based on public health considerations. The Master Reclamation Permit is discussed below to describe the regulatory context of the existing recycled water program and provide background for possible discussions with CDPH.

An Engineering Report was prepared by the City in 1998 and approved by the California Department of Health Services in 2001 (now California Department of Public Health, CDPH). The Engineering Report defined the recycled water quality produced at the Harbor AWTF and approved the appropriate uses for the recycled water. The recycled water quality produced at the Harbor AWTF is better than the highest recycled water quality defined in the Water Recycling Criteria of Title 22. For the purposes of this memorandum, the Harbor AWTF effluent is identified as purified recycled water.

Based on information provided in the Engineering Report (updated in 2009) the following recycled water uses are approved in the Master Reclamation Permit:

- Surface irrigation of food crops, parks and playgrounds, school yards, residential and freeway landscaping, unrestricted access golf courses, and other allowable irrigation applications specified in the Water Recycling Criteria with CDPH approval;
- Industrial or commercial cooling towers;
- Street sweeping;
- Dust control at permanent facilities;
- Industrial boiler feed; and
- Recreational Impoundments.

The definition of Recreational Impoundments in the Water Recycling Criteria is based on the level of public access that is allowed. "Restricted Recreational Impoundments" are "impoundment[s] of recycled water in which recreation is limited to fishing, boating, and other non-body-contact water recreational activities."[7] "Non-restricted Recreational Impoundments" are "impoundment[s] of recycled water, in which no limitations are imposed on body-contact water recreational activities."[8] Based on the definitions of recreational impoundments in the Water Recycling Criteria and the allowed recycled water uses in the Master Reclamation Permit, impoundments of recycled water could be allowed without restrictions on public access. The planned use of purified recycled water for Machado Lake Rehabilitation Project would produce significant dilution in the natural environment, and as such, would result in less public exposure to constituents than recreational impoundments of recycled water. The Master Reclamation Permit specifies that "actual delivery of recycled water to end-users is subject to approval by CDPH and/or its delegated local health agency."

5 Assessment of Implications of a Change in the Point of Discharge

This section assesses the potential implications of a change in the point of discharge from the TIWRP to Machado Lake pursuant to California Water Code (CWC) §1211. As discussed previously, the discharge to the Harbor from the TIWRP is currently regulated under Order No. R4-2010-0071 (NPDES Permit No. CA0053856). The Harbor has been defined as an enclosed bay and thus is subject to the *Enclosed Bays and Estuaries Policy* established by the State Water Board in 1974 that requires the cessation of

[7] Cal. Code Regs., tit. 22, § 60301.760.
[8] Cal. Code Regs., tit. 22, § 60301.620.

discharges from POTWs to enclosed bays at the earliest practicable date. The TIWRP NPDES Permit prohibits the discharge of treated municipal wastewater (except brine waste) to the Harbor by 2020 and shall be eliminated at the earliest practicable date. The City petitioned this provision in the TIWRP NPDES Permit to the SWRCB and the Petition is currently being held in abeyance (SWRCB/OCC File A-2101).

CWC §1211[9] requires that prior to making any change in the point of discharge, place of use, or purpose of treated wastewater, approval must be obtained from the SWRCB. This process is designed to ensure that the change will not injure any legal user of water or negatively impact beneficial uses of the water, including water supply, recreation, and wildlife.

It is understood, although not confirmed at this time, that the City did not apply to the SWRCB for a CWC §1211 Petition for Change (Petition) for diverting TIWRP effluent to the Harbor AWTF and its associated uses/discharge locations to supply recycled water for the potable and non-potable reuse projects. An argument can be made that a Petition was unwarranted because:

- No water rights were involved related to a discharge to the Harbor (the City retains the rights for the TIWRP effluent and there are no water rights for the Harbor *per se*).
- No beneficial uses were impacted because the potable and non-potable reuse projects help fulfill the *Enclosed Bays and Estuaries Policy* discharge prohibition (e.g., the ultimate goal is for no discharge of wastewater to the Harbor).

Similar arguments can be made that a Petition is not required for the discharge to Machado Lake because:

- LADWP is the primary water rights holder of all recycled water produced by the Harbor AWTF (e.g., the legal user will not be impacted).
- The West Coast Groundwater Basin is adjudicated; the types of water used for the Dominguez Gap Barrier are not mandated, but part of the basin groundwater management program.
- No groundwater beneficial uses will be impacted because the Dominquez Gap Barrier will continue to operate at its design capacity regardless of the availability of recycled water as a water source.
- Use of recycled water will help fulfill the SWRCB *Enclosed Bays and Estuaries Policy* discharge prohibition.

It would be beneficial for further legal evaluation of the need to "file" the Petition regardless of the arguments presented above as these may only be valid rationales to support approval for a change in discharge/use, but not negate the need to file the Petition with the SWRCB. If a Petition must be filed, it will be important to acknowledge the impact on implementation of a project to discharge to Machado Lake. The CWC §1211 process can be lengthy and challenging. It can take from one to two years to complete for non-controversial projects and to up to ten years to complete for controversial projects, where there are disputes over water rights, potential impacts to beneficial uses, or project opposition.

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[9] CWC Section 1211 states: "(a) Prior to making any change in the point of discharge, place of use, or purpose of use of treated wastewater, the owner of any wastewater treatment plant shall obtain approval of the board for that change. The board shall review the changes pursuant to the provisions of Chapter 10 (commencing with Section 1700) of Part 2 of Division 2."

Note: The City is aware of CWC §1211 obligations for the use of recycled water under consideration for the D.C. Tillman and Los Angeles-Glendale Water Reclamation Plants as part of the 2012 *Groundwater Recharge Master Plan Report* and *Non-potable Reuse Master Plan Report*. A training session addressing CWC §1211 was held with LADWP and Bureau staff on March 15, 2012.

6 Assessment of Discharging to Impaired Waters

There are three relevant TMDLs that must be considered when assessing potential regulatory implications of discharging purified recycled water to Machado Lake: two are for Machado Lake (Machado Lake Toxics and Machado Lake Nutrients) and one is for the Dominguez Channel and Los Angeles/Long Beach Harbor (Harbor Toxics). The three TMDLs are:

- **Machado Lake Toxics TMDL:** The TMDL for Pesticides and PCBs in Machado Lake, which was adopted by the Regional Water Board on September 10, 2010 and became effective on March 20, 2012, contains targets for water column concentrations and suspended sediment mass fractions for Total PCBs, DDT, DDE, DDD, Total DDT, Chlordane, and Dieldrin. WLAs were assigned to municipal separate storm sewer system (MS4) permittees (including the City), the California Department of Transportation (Caltrans), general construction and industrial stormwater permittees, and other non-stormwater NPDES permittees.

- **Machado Lake Nutrients TMDL:** The TMDL for Eutrophic, Algae, Ammonia, and Odors in Machado Lake, which was adopted by the Regional Water Board on May 1, 2008 and became effective on March 11, 2009, contains targets for total phosphorous (TP), total nitrogen[10] (TN), ammonia, dissolved oxygen, and chlorophyll *a*. WLAs were specifically assigned to MS4 discharges (including the City), Caltrans, and general construction and industrial responsible parties. There were no allocations for other non-stormwater NPDES permit holders. Interim WLAs were included in the TMDL. The schedule included a provision to re-evaluate the TMDL by September 2016 to revise numeric targets, WLAs, load allocations (LAs), and the implementation schedule as necessary.

- **Harbors Toxics TMDL:** The TMDL for Toxic Pollutants in Dominguez Channel and Greater Los Angeles and Long Beach Harbor Waters, which was adopted by the Regional Water Board on May 5, 2011 and became effective on March 23, 2012, contains water column, sediment, and fish tissue targets. Water column concentration targets included copper, lead, zinc, mercury, chlordane, 4,4'-DDT, Total PCBs, Benzo[a]pyrene, and Dieldrin. Sediment mass fraction targets included: cadmium, copper, lead, mercury, zinc, chromium, chlordane, dieldrin, toxaphene, total PCBs, Benzo[a]anthracene, Benzo[a]pyrene, Chrysene, pyrene, 2-methylnaphthalene, dibenz[a,h]anthracene, phenanthrene, high molecular weight (MW) PAHs, low MW PAHs ,total PAHs, and total DDT. Fish tissue targets included: chlordane, dieldrin, total DDT, total PCBs, total PAHs, and toxaphene. WLAs were specifically assigned to MS4 discharges (including the City), Caltrans, general construction and industrial permittees, and individual industrial permittees. The City MS4 was assigned WLAs in both the Inner and Outer Harbors. The TIWRP was assigned WLAs in the Outer Harbor.

[10] Total nitrogen is calculated as TKN + NO_3 + NO_2, TKN is generally ammonia and organic nitrogen.

6.1 Legal Background Related to Discharging to Impaired Waters

This subsection evaluates the implications of the requirements of Section 122.4(i) Title 40 of the Code of Federal Regulations (CFR) (Section 122.4(i)) in light of the *Pinto Creek* decision. *Pinto Creek* interprets Section 122.4(i) of Title 40 of the CFR (Section 122.4(i)). Section 122.4(i) applies to the permitting of discharges from new sources and new dischargers into waters identified as impaired on a state's CWA Section 303(d) list and states:

> No permit may be issued: . . . (i) To a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards. The owner or operator of a new source or new discharger proposing to discharge into a water segment which does not meet applicable water quality standards or is not expected to meet those standards even after the application of the effluent limitations required by sections 301(b)(1)(A) and 301(b)(1)(B) of CWA, and for which the State or interstate agency has performed a pollutants load allocation for the pollutant to be discharged, must demonstrate, before the close of the public comment period, that:
>
> (1) There are sufficient remaining pollutant load allocations to allow for the discharge; and
>
> (2) The existing dischargers into that segment are subject to compliance schedules designed to bring the segment into compliance with applicable water quality standards. The Director may waive the submission of information by the new source or new discharger required by paragraph (i) of this section if the Director determines that the Director already has adequate information to evaluate the request. An explanation of the development of limitations to meet the criteria of this paragraph (i)(2) is to be included in the fact sheet to the permit under § 124.56(b)(1) of this chapter.

The following summarizes the *Pinto Creek* decision and evaluates its potential implications for the discharge of purified recycled water from TIWRP, as presumably redefined in the permit to include the Harbor AWTF, to Machado Lake. In considering this discussion, the City should be aware that no legislation, case law, or SWRCB order following *Pinto Creek* alters its findings or conclusions.

6.1.1 Summary of *Pinto Creek*

Pinto Creek involved a challenge to a permit issued by the United States Environmental Protection Agency (USEPA) to a mining company under the NPDES program of the CWA. (*Pinto Creek*, *supra*, 504 F.3d at 1009.) The permit authorized discharges of copper from the construction and operation of a mine into Pinto Creek, a water body identified on the state of Arizona's CWA section 303(d) list as impaired for copper. (*Ibid*.) The permit required the mining company to remediate an abandoned mine upstream of Pinto Creek to offset the copper discharges. (*Id*. at 1012.) In an administrative challenge brought by nongovernmental entities (NGOs), the Environmental Appeals Board of USEPA issued an order upholding the permit. (*Id.* at 1009.) The NGOs appealed the order. (*Ibid.*)

On appeal, the 9th Circuit Court (Court) ruled that the permit violated Section 122.4(i). (*Pinto Creek*, *supra,* 504 F.3d at 1012.) The Court explained that Section 122.4(i) generally prohibits issuing an NPDES permit to a new source or new discharger, such as the mine,[11] "if the discharge will contribute to the violation of water quality standards." (*Ibid*.) The Court further explained that Section 122.4(i) provides an exception to this general rule where "a TMDL has been performed and the owner or operator demonstrates that *before the close of the comment period* two conditions [clauses (1) and (2) of Section 122.4(i)] are met." (*Ibid*, emphasis added.)

With regard to clause (1) of Section 122.4(i), the Court stated that the TMDL had to provide sufficient remaining pollutant load allocations for the discharge under existing circumstances. (*Pinto Creek*, *supra*, 504 F.3d at 1012.) The Court observed that the parties did not contend that the TMDL allocations represented the amount of pollution currently discharged from the point sources and nonpoint sources. (*Ibid.*) Further, the Court found that the TMDL merely provided for the manner in which Pinto Creek *could* meet the water quality standards if all of the TMDL allocations were met. (*Ibid.*) The Court noted the lack of any plan to effectuate the load allocations so as to bring Pinto Creek within the state's water quality standards. (*Ibid*.)

In addition, the Court concluded that USEPA and the mining company did not demonstrate that clause (2) of Section 122.4(i) was satisfied. (*Pinto Creek*, *supra*, 504 F.3d at 1013.) The Court explained that there were no compliance schedules or similar plans to bring Pinto Creek into compliance with water quality standards as required by clause (2). (*Id.* at 1013-1014.) In so ruling, the Court rejected USEPA's argument that the compliance schedule requirement pertains only to point sources that have an NPDES permit. (*Id.* at 1012.) Rather, the Court concluded that the requirement applies to *any* point source and that nonpoint source reductions may also be necessary. (*Id.* at 1013.) Further, the Court stated:

> If point sources, other than the permitted point source, are necessary to be scheduled in order to achieve the water quality standard, then the EPA must locate any such point sources and establish compliance schedules to meet the water quality standard before issuing a permit. If there are not adequate point sources to do so, then a permit cannot be issued unless the state or Carlota [mining company] agrees to establish a schedule to limit pollution from a nonpoint source or sources sufficient to achieve water quality standards. (*Id.* at 1014.)

The Court opined that the objective of Section 122.4(i)(2) is to show *how* water quality standards will be met if the new discharge is allowed. (*Pinto Creek*, *supra,* 504 F.3d at 1014.) The Court underscored that the remediation of the impaired water body does *not* have to be complete before the new source or new discharge may discharge into the water body. (*Ibid*.)

With regard to permit's provisions allowing offsets, the Court observed: "[T]here is nothing in the Clean Water Act or the regulation that provides an exception for an offset when the waters remain impaired and the new source is discharging pollution into the impaired water." (*Pinto Creek*, *supra,* 504 F.3d at 1012.) Accordingly, the Court did not account for the offsets that the permit would provide when determining whether the permit was appropriate under Section 122.4(i). (See *ibid.*)

[11] Implied in *Pinto Creek*, and not at issue in the case, was that the new mine would constitute "a new discharger" under Section 122.4(i). (*Pinto Creek*, *supra,* 504 F.3d at 1011-1012.)

6.1.2 Evaluation of the Proposed Discharge under *Pinto Creek*

As mentioned, *Pinto Creek* interprets Section 122.4(i) to prohibit the issuance of an NPDES permit for discharges from a new source or new discharger into impaired waters unless the two clauses of Section 122.4(i) are met. The first addresses whether the proposed discharge of purified recycled water to Machado Lake represents a new source or new discharger such the Section 122.4(i) is triggered. Secondly, the analysis assesses the discharge in the context of the first sentence of Section 122.4(i) regarding the potential violation of water quality standards, the exception of Section 122.4(i), and the potential for offsetting pollutant loads to Machado Lake. As described below, offsets may be relevant to determining whether the discharge would cause or contribute to water quality standards violations or whether the exception is met.

The proposed discharge to Machado Lake from TIWRP through the Harbor AWTF at a new Outfall 002 would not constitute a "new source" under Section 122.41(i), but would likely constitute a "new discharger." The term "new source" currently applies only to industrial dischargers. (*In the Matter of the Petition of Robert and Frederick Kirtlan,* State Water Board Order No. WQ 75-8 (April 2, 1975) at p. 6; see 33 U.S.C. Section 1316; 40 CFR. Section 122.2; 40 CFR Parts 405-471; *American Paper Institute v. Train* (D.C. Cir. 1976) 543 F.2d 328, 333.) As a municipally[12] owned treatment works used in the recycling or reclamation of municipal sewage, the TIWRP is a POTW and not an industrial discharger. (See 33 U.S.C. Section 1292; 40 CFR Section 122.2, 403.3(q), (r).) In particular, the federal regulations define "POTW" as:

> [A] treatment works as defined by section 212 of the Act, which is owned by a State or municipality … . This definition includes any devices and systems used in the storage, treatment, *recycling and reclamation of municipal sewage or industrial wastes of a liquid nature*. It also includes sewers, pipes and other conveyances only if they convey wastewater to a POTW Treatment Plant. (40 CFR Part 403.3(q), emphasis added.)

The regulations further state that a "POTW Treatment Plant" means "that portion of the POTW which is designed to provide treatment (including recycling and reclamation) of sewage and industrial waste." (40 CFR Part 403.3(r)) Section 212 of the Clean Water Act defines "treatment works" as:

> [A]ny devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature … or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, outfall sewers … other equipment, and their appurtenances; extensions, improvements, remodeling, additions, and alterations thereof … ." (33 U.S.C. §1292(2)(A).)

Based on these definitions, the TIWRP is a POTW and thus not a "new source." However, the TIWRP may be a "new discharger", which is defined generally in the federal regulations as:

> [A]ny building, structure, facility, or installation: (a) from which there is or may be a discharge of pollutants; (b) that did not commence the discharge of pollutants at a particular site prior to August 13, 1979; and which is not a new source; and (d) which

[12] The Clean Water Act defines "municipality" to include a city having jurisdiction over disposal of sewage or other waste. (33 U.S.C. § 1362(4).)

> has never received a finally effective NPDES permit for discharges at the site. (40 CFR Part 122.2, internal quotation marks omitted.)

For purposes of constituents regulated under the CTR (e.g., chlordane, DDT, dieldrin, and PCBs), the federal regulations state that "new discharger" means:

> [A]ny building, structure, facility, or installation from which there is nor may be a 'discharge of pollutants' (as defined in 40 CFR Part 122.2) to the State of California's inland surface waters or enclosed bays and estuaries, the construction of which commences after May 18, 2000. (40 CFR Part 131.38(e)(2).)

Neither the federal regulations nor CWA define "building," "structure," or "installation." However, "facility" is defined as "any NPDES 'point source' or any other facility or activity (including land or appurtenances thereto) that is subject to regulation under the NPDES program." (40 CFR Part 122.2.) In turn, a "point source" is "any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container … from which pollutants are or may be discharged." (40 CFR Part 122.2.) *Presumably, the City would have to construct or install and operate a new pipe or other conveyance for the discharge of purified recycled water at or near Machado Lake.* The Regional Water Board may consider the new pipe or conveyance to constitute a "facility," or perhaps a "structure" or "installation," thus satisfying an element of the "new discharger" definitions.

That the other elements of the "new discharger" definitions are satisfied in this case is more obvious. In particular, Machado Lake is an inland surface water of the state; the discharge would contain pollutants and not commence at the particular site (Machado Lake) prior to August 13, 1979, or May 18, 2000; the City has not received a finally effective NPDES permit for the particular discharge; and, as explained, the facility is not a "new source." Therefore, discharging to Machado Lake likely qualifies as a "new discharger" under Section 122.4(i).

Assuming that the discharge to Machado Lake represents a "new discharger," under *Pinto Creek* and the first sentence of Section 122.4(i),[13] the TIWRP may not discharge any constituent on the state's 303(d) list into Machado Lake unless the discharge will not cause or contribute to the violation of water quality standards. (Section 122.4(i); *Pinto Creek*, *supra,* 504 F.3d at 1012; see *In the Matter of Review on Its Own Motion of Waste Discharge Requirements for the Avon Refinery,* State Water Board Order No. WQ 2001-06 (March 7, 2001) at pg. 14 [Under Section 122.4(i), "no permit can be issued to a new source or new discharger if the discharge will cause or contribute to a water quality standards violation."]; see also *In Re City of Annandale* (2007) 731 N.W.2d 502, 523 (*Annandale*); *Crutchfield v. State Water Control Board* (2005) 45 Va.App. 546, 552, 558.) An exception exists where TMDLs are approved for the constituent and the Section 122.4(i) exception is met. (Section 122.4(i); *Pinto Creek*, *supra,* 504 F.3d at 1012.)

Accordingly, if a reasonable potential analysis (RPA) indicates that the discharge from proposed Outfall 002 would cause or contribute to the violation of a water quality standard for a constituent for which Machado Lake is identified as impaired on the state's 303(d) list, the Regional Water Board may interpret *Pinto Creek* to require that a TMDL be approved for that constituent and that the conditions of

[13] "No permit may be issued . . . (i) To a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards." (40 C.F.R. § 122.4(i).)

the exception of Section 122.4(i) be satisfied before the discharge may commence.[14] For the purposes of this memorandum, an RPA was conducted and the results are discussed in Section 6.3. (See 40 CFR Part 122.44(d).)

The City would need to demonstrate that the exception of Section 122.4(i) is met prior to the close of the comment period for the proposed permit. (Section 122.4(i); *Pinto Creek, supra,* 504 F.3d at 1012.) Clause (1) of Section 122.4(i) would require the City to establish that "[t]here are sufficient remaining pollutant load allocations to allow for the discharge." To satisfy this requirement, the City should provide support that the TMDL allocations represent the total amount of pollution currently discharged from all point sources and nonpoint sources and that there is sufficient remaining allocation for the new discharge. If a relevant TMDL does not include extra allocations for new sources or new dischargers, the Regional Water Board may choose to reopen the TMDL to adjust allocations to provide for the new discharge. The City should also provide evidence of an enforceable plan that effectuates the load allocations to bring Machado Lake into compliance with water quality standards.

Any such plan would also be relevant to demonstrate that "existing dischargers into [Machado Lake] are subject to compliance schedules to bring the segment into compliance with applicable water quality standards" as Section 122.4(i)(2) requires. In gathering support demonstrating that Clause (2) is met, the City would need to consider all point sources (not just point sources with NPDES permits) and non-point sources. The City may also propose a plan for nonpoint source reductions as appropriate. The City may need the Regional Water Board's assistance in identifying point sources and nonpoint sources and ensuring that there are necessary compliance schedules or other plans in place. The City should be prepared to show how these plans will lead to the state meeting the water quality standards for Machado Lake if the new discharge is allowed.

Notably, *Pinto Creek* can be interpreted to foreclose the use of offsets when determining whether a discharge may cause or contribute to the violation of water quality standards (i.e., when conducting an RPA). However, if appropriate, the City may approach the Regional Water Board regarding the use of offsets respecting this determination.[15] Prior to *Pinto Creek*, states and USEPA construed Section 122.4(i) to allow the use of offsets. (See e.g., *In Re Carlotta Copper Co.* (2004) 11 Envtl. Admin Decisions 692, 705; *Annandale, supra,* 731 N.W.2d at 524.) Moreover, when the mining company in *Pinto Creek* petitioned the U.S. Supreme Court to review the decision, USEPA argued against review. USEPA claimed that the court's error was merely case-specific and *Pinto Creek* applied only to the exception of Section 122.4(i)—not its first sentence, which relates to RPAs. (*Brief for Federal Respondent in Opposition, Carlotta Copper Company v. Friends of Pinto Creek* (Sept. 8, 2008) at pp. 20-21. USEPA's brief in the matter stated:

> To the extent that dictum in the court of appeals' opinion implies that the first sentence of Section 122.4(i) could not be reasonably interpreted to allow for the consideration of an offset, it is erroneous. The phrase "cause or contribute to the violation of water

[14] "Under the regulations to the CWA, there can be no 'new source' or 'new discharger,' if the discharge will contribute to a violation of water quality standards. 40 C.F.R. § 122.4(i). Thus there cannot be a new source or a new discharger if the water body is a WQLS [water quality limited segment] impaired waterway *unless* the state completes a TMDL for that WQLS beforehand." (*San Francisco Baykeeper v. Browner* (N.D. Cal. 2001) 147 F.Supp.2d 991, 995, emphasis in original.)

[15] It is our understanding that it may be difficult to offset some of the constituents at issue, such as nitrogen and banned pesticides.

quality standards is subject to more than one reasonable interpretation, and any court actually addressing its capability would need to consider and defer to EPA's own reasonable interpretation of that phrase. But '[t]his Court reviews judgments, not statements in opinions.' Accordingly, there is no need to address at this point whether EPA and state agencies may consider offsets or net effects on pollution in determining whether a proposed project would "cause or contribute to the violation of water quality standards" under the first sentence of Section 122.4(i). (*Ibid*, citations omitted.)

The U.S. Supreme Court declined to review *Pinto Creek*. (*Carlotta Copper Co. v. Friends of Pinto Creek* (2009) 555 U.S. 1097.) Based on a narrow interpretation of *Pinto Creek* USEPA's brief before the U.S. Supreme Court, the City may have a better chance of using offsets to demonstrate that the discharge would not cause or contribute to a water quality standards violation than to demonstrate that the exception of Section 122.4(i) (clauses (1) and (2)) is satisfied. If the City proposes to use offsets, it should develop a case demonstrating that such use would assist the state in achieving and maintaining water quality standards and would provide other environmental benefits.

6.2 Specific TMDL Considerations

Each of the three relevant TMDLs (Machado Lake Toxics and Nutrients and Harbors Toxics) were reviewed to evaluate whether the TMDLs would affect the ability to discharge purified recycled water into the Lake given the existing WLAs.

6.2.1 Machado Lake Toxics TMDL

The Machado Lake Toxics TMDL appears to be the most straight forward case of allowing purified recycled water discharge to Machado Lake. The TMDL WLAs contain allocations for "Other non-stormwater NPDES dischargers." Thus it appears that the discharge of TIWRP effluent should be allowed so as long as the suspended sediments in the purified recycled water meet the mass fraction concentrations, which are based on a 3-year averaging period, listed in Table 1.

Table 1. Mass Fraction Concentrations for Machado Lake Toxics TMDL.

Parameter of Concern	Numeric Target for Sediment	Waste Load Allocation for Suspended Sediment-Associated Contaminants[1]	
	Concentration (µg/kg dry weight)[2]	Concentration (µg/kg dry weight)	Compliance Averaging Period
Total PCBs	59.8	59.8	3-year average
DDT (all congeners)	4.16	4.16	3-year average
DDE (all congeners)	3.16	3.16	3-year average
DDD (all congeners)	4.88	4.88	3-year average
Total DDT	5.28	5.28	3-year average
Chlordane	3.24	3.24	3-year average
Dieldrin	1.9	1.9	3-year average

1. The WLA applies to all MS4 Permittees including the County, Caltrans, General Construction and, Industrial Stormwater Permittees, and other non-stormwater NPDES permittees.
2. Microgram per kilogram (µg/kg).

6.2.2 Machado Lake Nutrients TMDL

The Machado Lake Nutrients TMDL only provides WLAs for MS4 discharges and does not provide WLAs for any non-MS4 or construction or industrial general permit dischargers. As listed in Table 2, the currently final WLAs for TN and TP are 1.0 mg/L and 0.1 mg/L, respectively. As non-MS4 point source discharges are not explicitly or implicitly provided WLAs, it appears that additional point source discharges would not be allowed to the Lake without revision to the TMDL unless the discharge of purified recycled water could be classified as part of the MS4 system. It is unclear if the discharge can be classified as part of the MS4 system. However, if the discharge is allowed, the purified recycled water will presumably be required to meet the final concentration-based WLAs at the point of discharge.

It is acknowledged in the TMDL Staff Report that the critical condition for the TMDL is when, "reduced Lake volume during summer months provides less assimilative capacity." Additional flow through Machado Lake (for example using purified recycled water), to maintain volume, or provide flow through Machado Lake, would be beneficial to meeting the water column targets established in the TMDL and potentially constitute additional assimilative capacity. However, it is not clear if this benefit would override the adopted WLA constraint. Further guidance from the Regional Water Board is necessary to make this determination.

The Machado Lake Nutrients TMDL is scheduled for reassessment by September 2016 to "revise numeric targets, WLAs, LAs, and the implementation schedule as needed." Although the Regional Water Board need not wait until a scheduled reopener, the 2016 reopener could provide the opportunity for the City to demonstrate the WLAs could be revised to allow other non-MS4 NDPES dischargers. Additionally, the reopener provides an opportunity to potentially revise the targets and WLAs from the current values listed in Table 2. If the City were to supplement the flows through Machado Lake, and collect data demonstrating that the WLAs could be adjusted due to the increased assimilative capacity, there is a regulatory mechanism to affect the change before the final WLAs become effective. However, as a cautionary note, reopening a TMDL could also result in additional requirements on existing discharges that may or may not be problematic.

Table 2. Interim and Final Concentration Based WLAs for the Machado Lake Nutrients TMDL.

Schedule[(1)]	Interim Total Phosphorous (mg/L as P)[2]	Interim Total Nitrogen (mg/L as N)
Current	1.25	3.50
March 11, 2014	1.25	2.45
September 11, 2018	0.10	1.00

1. The TMDL is to be reassessed prior to September 2016, where the WLAs could be adjusted, in part, based on monitoring data completed by the responsible jurisdictions.
2. Milligrams per liter (mg/L)

6.2.3 Harbors Toxics TMDL

If purified recycled water is allowed to be discharged to Machado Lake, the Regional Water Board may consider water flowing from Machado Lake to have the potential to affect loadings to the Inner Harbor addressed by the WLAs presented in Table 3. If this was the interpretation, the flow from Machado Lake, through the wetlands, and to the storm drains would need to be classified as flow under the MS4 system as there are only explicit WLAs for the MS4 system, but no allocations for other non-MS4 permittees. As the MS4 WLAs are written as the sum total load of all MS4 jurisdictions per year to the Inner Harbor; it is possible that this overflow could be considered to count against the Inner Harbor MS4 load or, alternatively, it may be the regulatory stance that flows from Machado Lake were not considered in the TMDL and thus no allocations were established. Under that interpretation, it would be necessary to reopen the TMDL to explicitly assign WLAs to the Machado Lake overflow and corresponding responsible parties. Alternatively, the potential exists the TIWRP discharges could be considered addressable similar to the other non-MS4 point sources explicitly identified in the TMDL and require TIWRP discharges to meet the TMDL water quality targets.

Table 3. Harbors Toxics TMDL WLA for the Inner Harbor.

	Water Column		Load	
Constituent	Units	WLA	Units	WLA
Total Copper	µg/L	3.73	Kg/yr[1]	1.7
Total Lead	µg/L	8.52	Kg/yr	34.0
Total Zinc	µg/L	85.6	Kg/yr	115.9
Total PAHs	---	---	Kg/yr	0.088
Total DDT	µg/L	0.00059	g/yr[2]	0.051
Total PCBs	µg/L	0.00017	g/yr	0.059

1. Kilograms per year (Kg/yr)
2. Grams per year (g/yr)

6.2.4 Conclusions Regarding Specific TMDL Considerations

To allow the discharge of purified recycled water to Machado Lake, there would likely, but not necessarily, be some modifications required to one or more of the three pertinent TMDLs. If the discharge met the WLAs for toxics listed in Table 1, then it would be allowable under the Machado Lake Toxics TMDL. The Machado Lake Nutrients TMDL does not have an explicit allowance for discharges other than MS4 or construction or industrial general permittees. Potential solutions include, reopening the TMDL to explicitly include “non-MS4 NPDES permittees,” or obtaining a regulatory classification of the discharge as part of the MS4 system (if legally feasible). In either case, the discharge would likely have to meet the final WLAs listed in Table 2, unless the final WLAs are modified. It may be worthwhile for the City to further explore whether the purified recycled water may be classified as an MS4 discharge in the context of the Nutrients TMDL if it is discharged to Wilmington Drain.

As the purified recycled water would be discharged directly to Machado Lake, the Harbors Toxics TMDL may not be applicable to the discharge. However, as the overflow from Machado Lake enters the storm drain system and is discharged to the Inner Harbor, it is possible the regulatory view could affect the TIWRP NPDES Permit and/or the overflow would be considered part of the MS4 system. The MS4 WLAs for the Inner Harbor are mass-based and are shared between all responsible jurisdictions. Any load associated with flows originating from the Machado Lake overflow may count against the portion allotted to the City MS4 program. However, the TMDL could be reopened and concentration-based WLAs, similar to other non-MS4 NPDES discharges, could be developed.

6.3 Reasonable Potential Analysis

The SWRCB and USEPA Region IX adopted rules and policies to establish NPDES permitting procedures for California. These procedures are used to determine if discharges may cause, have reasonable potential to cause, or contribute to an excursion above any applicable water quality criterion/objective. As discussed in Section 6.1, with regard to the *Pinto Creek*, an RPA would determine if the proposed purified recycled water may cause, have reasonable potential to cause, or contribute to an excursion above any applicable water quality criterion/objective. The following describes the regulatory background, the RPA methodology, results, and summary. NPDES permitting procedures for California are established in:

- The State Implementation Plan (SIP), which contains procedures used by the Regional Water Boards to determine whether a priority pollutant has reasonable potential and to calculate final water quality-based effluent limitations (WQBELs) for priority pollutants from water quality criteria/objectives for NPDES permits.
- The *Technical Support Document for Water Quality-based Toxics Control* (TSD), developed by USEPA in 1991, and contains procedures used by the Regional Water Boards to determine whether a non-priority pollutant has reasonable potential and to calculate final WQBELs for non-priority pollutants from water quality criteria/objectives for NPDES permits.

Water quality criteria/objectives applicable to Machado Lake are established in:

- The CTR, which was promulgated by USEPA on May 18, 2000, and contains aquatic life and human health numeric water quality criteria for 126 toxic priority pollutants.
- The Basin Plan, which was adopted by the Regional Water Board on June 13, 1994, and contains the beneficial uses and water quality objectives for water bodies in the Los Angeles Region. Numerous Basin Plan Amendments have been subsequently adopted by the Regional Water Board.
- The Machado Lake Nutrient, Toxics, and Trash TMDLs as well as the Harbors Toxics TMDL.

6.3.1 RPA Methodology

Following the Regional Water Board staff procedures used to develop the TIWRP NPDES Permit, two methods are used to determine if a discharge may cause, have a reasonable potential to cause, or contribute to an excursion above any applicable water quality criterion/objective in the receiving water. SIP and TSD procedures are used to determine reasonable potential for priority pollutants and non-priority pollutants, respectively. The procedures are discussed in the following subsections.

6.3.1.1 SIP RPA Methodology

Under the SIP, the RPA involves identifying the maximum effluent concentration (MEC) and the maximum ambient background concentration (B) for each constituent. There are three triggers that result in reasonable potential, and the subsequent need for WQBELs:

- The first trigger (Trigger 1) is activated if the MEC is greater than or equal to the lowest applicable water quality criterion/objective, which has been adjusted for site-specific pH, hardness (for freshwater metals water quality criteria/objectives only), water-effect ratios, and translator, if appropriate. If the MEC is greater than or equal to the adjusted lowest applicable water quality criterion/objective, then the constituent has reasonable potential.

- The second trigger (Trigger 2) is activated if B is greater than the adjusted lowest applicable water quality criterion/objective and the constituent is detected in the effluent. Under these two conditions, the constituent has reasonable potential.
- The third trigger (Trigger 3) is activated if review of other information (i.e., TMDL) by the Regional Water Board determines that reasonable potential exists even if both MEC and B are less than the adjusted lowest applicable water quality criterion/objective, or effluent and/or ambient background data are unavailable or insufficient (e.g., all results were non-detect).

6.3.2 TSD RPA Methodology

Under the TSD, reasonable potential is determined by the following steps:

- Identify the MEC.
- Calculate the coefficient of variation (CV), which is the standard deviation divided by the arithmetic mean. For this analysis, these statistical parameters were calculated using the Larry Walker Associates Data Analysis Tool (DAT), which applies regression-on-order statistics to estimate average and standard deviation values if non-detect results are present. If non-detect results are not present, then the DAT calculates the actual average and standard deviation values. If the number of effluent data points is less than 10, or if at least 80 percent of the data are reported as non-detect, the CV is set equal to 0.60. If there are no detected data or insufficient detected data to calculate these statistics, then the analysis cannot be completed.
- USEPA multipliers for determining the projected maximum effluent concentration (PMEC) are calculated from an equation based on the CV and the number of samples in the data set. These multipliers are calculated to project to the 95% probability and 95% percentile confidence level, and the 99% probability and 99% confidence level.
- The PMEC is the value that the effluent concentration will be less than “most” of the time, calculated as the product of the MEC and the USEPA multiplier.
- The resultant in-stream concentration is calculated with the following equation:

$$C_{stream} = \frac{C_{eff} + D \times B}{1 + D}$$

Where:

C_{stream} = resultant in-stream concentration;

C_{eff} = projected maximum effluent concentration;

D = dilution credit (if applicable); and

B = maximum observed ambient background concentration.

- The resultant in-stream concentration is compared to the adjusted lowest applicable water quality criterion/objective to determine if the constituent has reasonable potential.

6.3.3 Reasonable Potential Analysis

Two RPAs were conducted to determine the potential impact of tertiary effluent from TIWRP and purified recycled water from the Harbor AWTF on Machado Lake. The first RPA was conducted using existing TIWRP effluent data (through tertiary treatment) to identify a short list of potential constituents of concern. Expected MECs through advanced treatment were then developed by CDM Smith to estimate constituent concentrations in purified recycled water that would be discharged to Machado Lake. A comparison of expected MECs to the lowest applicable water quality criterion/objective was conducted to determine if the discharge of purified recycled water to Machado Lake would result in reasonable potential. The following key assumptions were used to conduct the RPAs:

- TIWRP tertiary effluent data from January 2006 through December 2011 were used.
- There were no available ambient background data for Machado Lake.
- No dilution is allowed when determining reasonable potential for priority pollutants following the SIP method. However, dilution is allowed, where available, when determining reasonable potential for non-priority pollutants following the TSD method. For this analysis, it was conservatively assumed that there would be no dilution available (e.g., effluent is required to meet water quality criteria/objectives at the end-of-pipe).
- CTR criteria applicable to Machado Lake include freshwater acute and chronic aquatic life criteria and human health criteria (organism consumption only for non-MUN beneficial use).
- The CTR specifies that the receiving water hardness be used to calculate freshwater criteria for several metal constituents. No easily-accessible hardness data for Machado Lake were found. In August 2007, Aquatic Bioassay & Consulting Laboratories and CRG Marine Laboratories prepared the *Lake Machado Nutrient Flux Study*, which estimated that the hardness of Machado Lake was 310 mg/L as calcium carbonate ($CaCO_3$). This hardness value was used to calculate hardness-dependent water quality criteria for metals.
- USEPA default conversion factors were used to translate dissolved water quality criteria to total water quality criteria as site-specific metals translators were not used for this analysis.
- Basin Plan water quality objectives and Machado Lake Toxics and Nutrients TMDLs and the Harbors Toxics WLAs were also applied.

Based on the assumptions presented above, an RPA was conducted on TIWRP tertiary effluent. The constituents presented in Table 4 represent constituents of concern that required further evaluation to determine if they may cause or contribute to exceedances after advanced treatment.

Table 4. TIWRP Tertiary Effluent Constituents of Concern

Constituent	Units	MEC/ PMEC (1)	Lowest Applicable Water Quality Criterion/Objective	Criterion/ Objective Source (2)	Reasonable Potential Trigger (3)
Priority Pollutants (Water Column)					
Copper	µg/L	16.7	3.7 (4)	LAH TMDL SW Chronic Target	MEC ≥ C; Trigger 3
Lead	µg/L	14.8	1.3 (4)	LAH TMDL FW Chronic Target	MEC ≥ C; Trigger 3
Mercury	µg/L	DNQ 0.024	0.051	LAH TMDL HH	Trigger 3
Selenium	µg/L	15.8	5.0	CTR CCC	MEC ≥ C
Zinc	µg/L	35	67 (4)	LAH TMDL FW Chronic Target	Trigger 3
Cyanide	µg/L	11	5.2	CTR CCC	MEC ≥ C
Benzo(a)pyrene	µg/L	<0.0016	0.049	LAH TMDL HH	Trigger 3
Benzo(a)anthracene	µg/L	<0.0022	0.049	LAH TMDL HH	Trigger 3
Chrysene	µg/L	DNQ 0.013	0.049	LAH TMDL HH	Trigger 3
Pyrene	µg/L	0.08	11,000	LAH TMDL HH	Trigger 3
Chlordane	µg/L	<0.001	0.00059	LAH, ML TMDL	Trigger 3

Constituent	Units	MEC/ PMEC [1]	Lowest Applicable Water Quality Criterion/Objective	Criterion/ Objective Source [2]	Reasonable Potential Trigger [3]
				(CTR HH)	
4,4'-DDT	μg/L	<0.002	0.00059	LAH, ML TMDL (CTR HH)	Trigger 3
4,4'-DDE	μg/L	<0.0018	0.00059	ML TMDL (CTR HH)	Trigger 3
4,4'-DDD	μg/L	<0.001	0.00084	ML TMDL (CTR HH)	Trigger 3
Dieldrin	μg/L	<0.0009	0.00014	LAH, ML TMDL (CTR HH)	Trigger 3
Total PCBs	μg/L	<0.02	0.00017	LAH, ML TMDL (CTR HH)	Trigger 3
Non-Priority Pollutants (Water Column)					
Ammonia as N	mg/L	7.17/46	2.15	ML TMDL 30-day Average Target	MEC ≥ C; Trigger 3
Chloride	mg/L	1,730/8,100	230	BP 4-day average	MEC ≥ C
MBAS	mg/L	0.61/2.2	0.50	BP	MEC ≥ C
Total Nitrogen as N	mg/L	13.5/33	1.0	ML TMDL Monthly Average Target	MEC ≥ C; Trigger 3
Total Phosphorus as P	mg/L	[5]	0.1	ML TMDL Monthly Average Target	Trigger 3

1. MEC = maximum effluent concentration; PMEC = projected maximum effluent concentration. Because no dilution was assumed for this analysis, the PMEC is equal to the in-stream concentration (C_{stream}).
2. BP = Basin Plan; CTR = California Toxics Rule; CCC = criterion continuous concentration (chronic); TMDL WLA = Total Maximum Daily Load Wasteload Allocation; HH = human health criterion (organisms only); FW = freshwater; SW = saltwater; LAH = Los Angeles Harbor; ML = Machado Lake; DNQ = detected but not quantified (e.g., the concentration is less than the Minimum Level but greater than the Method Detection Limit).
3. C= lowest applicable water quality criterion/objective
4. Lowest water quality criterion for this constituent was based on a hardness of 50 mg/L as $CaCO_3$ from the numeric targets in the Los Angeles Harbor Toxics TMDL. Default conversion factors from the CTR were used to convert dissolved numeric targets to total numeric targets.
5. No TIWRP tertiary effluent data are currently available for this constituent.

Under the proposed project, TIWRP tertiary effluent will also undergo advanced treatment at the Harbor AWTF. The Harbor AWTF significantly reduces the pollutant concentrations in the tertiary effluent. For the constituents of concern identified based on the RPA for TIWRP tertiary effluent data and based on tertiary effluent MECs (Table 4), CDM Smith developed expected MECs for the constituents of concern in purified recycled water. A comparison of the lowest applicable tertiary effluent MECs, expected purified recycled water MECs, and historic MECs based on data from other advanced treatment facilities is presented in Table 5.

Table 5. Expected <u>Maximum Effluent Concentrations</u> for the Harbor AWTF Purified Recycled Water for Constituents of Concern

Constituent	Units	Lowest Applicable Water Quality Criterion/ Objective	TIWRP Tertiary Effluent MEC (1)	Expected Harbor AWTF Purified Recycled Water Effluent MEC (2,3)	OCWD Advanced Effluent MEC (2)	West Basin MWD Advanced Effluent MEC (2)
Priority Pollutants (Water Column)						
Copper	µg/L	3.7	16.7	0.17 (2)	ND (4)	5.8
Lead	µg/L	1.3	14.8	0.3	<0.1	0.17
Mercury	µg/L	0.051	DNQ 0.024	DNQ 0.00024	ND (4)	0.00004
Selenium	µg/L	5.0	15.8	2.4	<1	<2
Zinc	µg/L	67	35	0.35	ND (4)	3.6
Cyanide	µg/L	5.2	11	2.8	<5	<4.5
Benzo(a)pyrene	µg/L	0.049	<0.0016	<0.0016	N/A	<0.02
Benzo(a)anthracene	µg/L	0.049	<0.0022	<0.0022	N/A	<5
Chrysene	µg/L	0.049	DNQ 0.013	DNQ 0.0065	N/A	<5
Pyrene	µg/L	11,000	0.08	0.04	N/A	<5
Chlordane	µg/L	0.00059	<0.001	<0.001	N/A	<0.1
4,4'-DDT	µg/L	0.00059	<0.002	<0.002	N/A	<0.1
4,4'-DDE	µg/L	0.00059	<0.0018	<0.0018	N/A	<0.1
4,4'-DDD	µg/L	0.00084	<0.001	<0.001	N/A	<0.1
Dieldrin	µg/L	0.00014	<0.0009	<0.0009	N/A	<0.01
Total PCBs	µg/L	0.00017	<0.02	<0.02	N/A	<0.1
Non-Priority Pollutants (Water Column)						
Ammonia as N	mg/L	2.15	7.17 (6)	0.6	1.2	2.7
Chloride	mg/L	230	1,730	26	3.5	12.9
MBAS	mg/L	0.50	0.61	0.1	<0.02	<0.05
Total Nitrogen as N	mg/L	1.0	13.5 (7)	1.3 (8)	1.6	3.2
Total Phosphorus as P	mg/L	0.1	1.0 (3)	0.02	<0.01	–

1. Tertiary effluent data (maximums) from January 2006 to December 2011.
2. Expected Harbor AWTF Purified Recycled Water Effluent; Orange County Water District (OCWD); West Basin Municipal Water District (MWD); data provided by CDM Smith (09/04/12).
3. Estimated from information provided by CDM Smith (09/18/12).
4. ND = not detected below the method detection level.
5. TIWRP does not currently have any tertiary effluent data for total phosphorus. The MEC is an estimated MEC provided by CDM Smith (09/04/12).
6. Over the five years of data, only two ammonia as N measurements exceed 2 mg/L. The average concentration from 2006-2011 was 0.57 mg/L.
7. Maximum observed tertiary effluent concentration, which corresponds to a sample that was collected when TIWRP was not nitrifying.
8. The expected Harbor AWTF purified recycled water MEC takes into account 1 mg/L ammonia added upstream of the Harbor AWTF for biofouling control, estimated removal through reverse osmosis for each nitrogen compound, and replacement of chloramination with ultraviolet disinfection and advanced oxidation. The expected Harbor AWTF purified recycled water TN concentration also assumes that the existing membranes are used and breakpoint chlorination is not applied. The maximum predicted purified recycled water concentration corresponds to the highest concentration in tertiary effluent when TIWRP was nitrifying

(maximum effluent concentration of TN as N in tertiary effluent = 11.1 mg/L and the predicted Harbor AWTF purified recycled maximum water concentration is 1.3 mg/L). Note that the maximum tertiary effluent concentration was used (13.5 mg/L), which corresponded to an abnormal condition when TIWRP was not nitrifying (as indicated in Note 7).

Based on this analysis, the expected purified recycled water appears to have difficulty complying with the TN WLA in the Machado Lake Nutrients TMDL. However, it should be noted that this RPA was conducted on expected purified recycled water concentrations that are based on the current proposed treatment system. Further modeling conducted by CDM Smith (11/27/12) identified two variables (reverse osmosis membrane age and breakpoint chlorination) that will impact TN concentrations. CDM Smith estimated the purified recycled water TN concentrations presented in Table 6.

Table 6. Expected Total Nitrogen Concentration in Purified Recycled Water

Treatment Approach	Existing Reverse Osmosis Membranes	New Reverse Osmosis Membranes
No Breakpoint Chlorination	1.3 mg/L as N	1.0 mg/L as N
Breakpoint Chlorination (Low)	1.1 mg/L as N	0.7 mg/L as N
Breakpoint Chlorination (High)	1.0 mg/L as N	0.6 mg/L as N

Based on these estimates, replacing the existing reverse osmosis membranes and possibly considering some level of breakpoint chlorination will result in meeting the total nitrogen WLA in the Machado Lake Nutrients TMDL. Other additional treatment, such as ion exchange, may also be an option for removing TN. It appears that the purified recycled water from the Harbor AWTF should be able to meet water quality criteria/objectives for all other constituents of concern.

It is expected that the Regional Water Board will likely include effluent limitations in the revised NPDES permit for constituents that are regulated by TMDLs regardless of effluent quality due to Trigger 3 of the RPA. Also, as ambient background data were not available, it is possible that other constituents of concern may have reasonable potential due to RPA Trigger 2 (e.g., maximum ambient background concentration exceeds a water quality criterion/objective and the constituent is detected in the effluent), and result in reasonable potential and a subsequent effluent limitation. However, the State's 303(d) list usually includes most, if not all, constituents that exceed water quality criteria/objectives in ambient water.

Lastly, it should be noted that the RPA only compares existing effluent data to applicable water quality criteria/objectives. Future NPDES permits may include final WQBELs, which are calculated based on site-specific data, for any constituent, including the constituents of concern identified in this analysis, that are lower than the applicable water quality criteria/objectives used in the RPA based on the CV. Under those circumstances, there may be other constituents of concern to consider when determining the feasibility of discharging purified recycled water to Machado Lake.

6.4 Summary of Assessment of Discharging to Impaired Waters

The ability to permit the discharge of purified recycled water to Machado Lake may be affected by three TMDLs, including: Machado Lake Toxics TMDL, Machado Lake Nutrients TMDL, and the Harbors Toxics TMDL. Under applicable regulations and the *Pinto Creek* decision, the discharge of recycled water likely would be considered a "new discharger."[16] Under *Pinto Creek*, if the discharge would cause or contribute to a violation of water quality standards in Machado Lake of any constituent on the State of California 303(d) list, the Regional Water Board would likely decline to permit the discharge unless the exception of Section 122.4(i) is met.

Based on estimated concentrations in the purified recycled water, there may be difficulty in meeting final TN WLAs under the current proposed project. Given the established Machado Lake Nutrients TMDL and *Pinto Creek*, the City may have two options without revising the Machado Lake Nutrients TMDL: 1) modify and/or increase the level of treatment (e.g., replacing reverse osmosis membranes, incorporating breakpoint chlorination, adding ion exchange) to meet the final TN WLAs, or 2) advocate to the Regional Water Board that the City's Lake Water Quality Management Plan for Machado Lake could be used to effectively establish an offset providing the assimilative capacity for the nitrogen levels in the discharge. An offset approach could be difficult to establish since there are no Regional Water Board guidelines for establishing offsets or it could be challenged resulting in delay. Alternatively, the TMDL could be reopened and specific WLAs could be established that would allow purified recycled water to be discharged to Machado Lake.

The discharge to Machado Lake appears to fall under the "other non-MS4 NPDES permittees" WLA in the Machado Lake Toxics TMDL, and thus it does not appear this TMDL would preclude the discharge of purified recycled water based on expected effluent concentrations (Table 5).

Assuming any incremental flow from Machado Lake to the Inner Harbor would be considered an MS4 discharge, the flow may be subject to the water column concentration and annual WLAs listed in Table 3 for the Harbors Toxics TMDL. The RPA and expected concentrations in purified recycled water of the constituents addressed by the toxics TMDLs (Table 5) suggest that there is no reasonable potential to cause or contribute to an exceedance. However, as the WLAs do not appear to explicitly consider flows from Machado Lake, the Harbors Toxics TMDL may preclude the permitting of purified recycled water discharges from the TIWRP to Machado Lake. In this situation, it would be necessary to reopen the TMDL to explicitly assign WLAs to the Machado Lake overflow and corresponding responsible parties.

7 Regulatory Assessment Summary

The opportunity to discharge purified recycled water to Machado Lake meets multiple objectives not only in Machado Lake, but also the Dominguez Gap Barrier, and the Harbor. Benefits of the proposed project include:

- Potentially significantly reducing effluent discharge to the Harbor to move towards the goal of removing all non-brine discharge to the Harbor by 2020 (or the earliest practicable date);
- Improving Machado Lake water quality;
- Improving the riparian environment and habitats of Machado Lake;
- Increasing the potential water supply to the Dominguez Gap Barrier; and
- Increasing flood control capacity and geomorphic stability.

The existing TIWRP NPDES Permit will need to be amended to specify an outfall into Machado Lake (e.g., Outfall 002), expand the description of the TIWRP to include the facilities of the Harbor AWTF, and include effluent and receiving water limitations to allow for the discharge of purified recycled water

[16] Specifically, the new discharger would not be considered a new source.

from the Harbor AWTF to Machado Lake. While arguments can be made justifying that it is not necessary to file a CWC §1211 Petition for the change in discharge and use by TIWRP to the Harbor, it is recommended the City conduct a further legal evaluation.

Pinto Creek does not necessarily preclude discharge of purified recycled water to Machado Lake. The Machado Lake Toxics TMDLs assigns WLAs to non-MS4 NPDES permittees, which could include the TIWRP. Thus, if purified recycled water met the final WLAs, which is expected based on the estimated concentrations presented in Table 5, the Machado Lake Toxics TMDL does not appear to preclude the discharge. While the Harbors Toxics TMDL does assign WLAs to non-MS4 permittees, those non-MS4 permittees do not appear to include wastewater NPDES permit holders. The Machado Lake Nutrients TMDL only provides WLAs for MS4 discharges and does not provide WLAs for any non-MS4 permittees or construction or industrial general permit dischargers.

In assessing the potential regulatory issues associated with discharging purified recycled water from the TIWRP to Machado Lake, the two issues that appear to need further consideration and resolution are:

1. Machado Lake overflows may or may not be considered in MS4 allocations in the Harbors Toxics TMDL. WLAs are not currently assigned to NPDES permittees (MS4 or non-MS4 such as TIWRP) in the Machado Lake watershed.
2. The Machado Lake Nutrients TMDL does not assign WLAs to non-MS4 NPDES permittees.

These issues may be resolved through discussions with Regional Water Board staff regarding whether discharges from TIWRP could be considered addressable similar to the other non-MS4 point sources explicitly identified in the TMDL, as in the case of the Harbors Toxics TMDL, or through reopening and adding non-MS4 NPDES WLAs set equal to the concentration-based WLAs in the Machado Lake Nutrients TMDL and the Harbors Toxics TMDL.

Miluska Propersi

Subject: FW: GLAC P84, Round 3 - RMC Follow-Up Request for Information

From: Repp, Chris [mailto:Chris.Repp@ladwp.com]
Sent: Tuesday, June 10, 2014 4:36 PM
To: Miluska Propersi; Ching, Mark
Cc: Lamacchia, Chad; Brian Dietrick; Romy Sharafi; Reed, Greg; Lacombe, Sarah
Subject: RE: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Miluska/Brian,

I spoke with the individual group within LADWP that provides rough estimates on the breakdown between purchased SWP water vs. CRA water. The average is about 85% (SWP) / 15% (CRA).

Regards, Chris (213)367-4736

From: Ching, Mark [mailto:Mark.Ching@ladwp.com]
Sent: Monday, June 09, 2014 8:25 AM
To: Miluska Propersi
Cc: Repp, Chris; Lamacchia, Chad; Brian Dietrick
Subject: RE: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Hi Miluska,

Regarding the conference call, would you like to combine the call with Romy and the Burbank Interconnect Project? It is also our team that is working on that project and we may benefit from hearing each other's questions and concerns.

We are available this afternoon or tomorrow morning for the call, let us know what works for you. If neither, we can try to arrange for another time later this week. Thank you.

Regards,

Mark Ching
213.367.0794

From: Miluska Propersi [mailto:MPropersi@rmcwater.com]
Sent: Friday, June 06, 2014 1:37 PM
To: Ching, Mark
Cc: Repp, Chris; Lamacchia, Chad; Brian Dietrick
Subject: GLAC P84, Round 3 - RMC Follow-Up Request for Information

Dear Mark,

Thank you for working with our team the past couple of weeks to provide information for the Prop. 84, Round 3 grant application. We understand that it can be overwhelming. Because of your responsiveness, we have made incredible progress; and we anticipate that we will have drafts for you to review by mid-June. Note that this is a little later than originally planned.

The reasons we are delaying have to do with the Final PSP that was released on Monday. First, the application deadline has been moved to July 21st (from July 3rd). And second, the Final PSP indicates a few additional items that we will need to develop the best possible grant application.

To help make your life as easy as possible, **I would like to schedule a conference call at your earliest convenience** to walk through this additional request for information and answer any questions you may have. Please let me know when you are available.

The additional information we will need is summarized below:

1. **Detailed Budget** (template and example attached) – Originally we thought this would not be needed until Conditional Acceptance (expected Fall 2014), but now we are realizing that it would be prudent to confirm and document all cost information now. We only need to provide a budget summary by July 21st yet the summary is highly dependent on the detailed costs and reference documents (all of which need to be consistent).
2. **Reference Documents for Detailed Budget –** needed so that RMC can double-check all Budget information
3. **Drought Impacts information** (template attached) – the Final PSP gives more clarification on what DWR is expecting, so we have developed an approach that we could use your input on
4. **Specific Questions Related to the Manhattan Wells Improvement Project**:
    a. What is the percent blend of imported water for your agency (i.e., % SWP and % CRA)?
    b. Can you provide more detail on the container packaged treatment unit. Is this part of a second phase of the project? We want to clarify what the project is and guarantee that benefits will be provided, especially since we say that part of the reason the GW rights aren't used is because of contamination.
    c. How come WRD is administering the contract if LADWP is implementing the project?
    d. For the annual benefits, you indicated a portion (16.7%) will start in 2017 and full benefits will start in 2018. Since construction ends in October 2016, why don't we have the full benefits starting in 2017?
    e. In the "Watermaster Service in the Central Basin, 2009-2013, Table 1" reference, it is not clearly indicated that LADWP pumped 8,920 afy of groundwater from 2009-2013. Is there another table or reference that shows LADWP's pumping amount from 2009-2013 and the APA of 15,000 AFY?

Thanks again for your patience and cooperation in this very important grant process!

Sincerely,

Miluska
Miluska Propersi, P.E.
Water Resources Engineer

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2400 Broadway, Suite 300
Santa Monica, CA 90404
P: 310.566.6460

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Analysis of the Energy Intensity of Water Supplies for West Basin Municipal Water District

March, 2007

Robert C. Wilkinson, Ph.D.

Energy Intensity of Water Supplies for West Basin Municipal Water District

	af/yr	Percentage of Total Source Type	kWh/af Conveyance Pumping	kWh/af MWD Treatment	kWh/af Recycled Treatment	kWh/af Groundwater Pumping	kWh/af Groundwater Treatment	kWh/af Desalination	kWh/af WBMWD Distribution	Total kWh/af	Total kWh/year
Imported Deliveries											
State Water Project (SWP) [1]	57,559	43%	3,000	44	NA	NA	NA	NA	0	3,044	175,209,596
Colorado River Aqueduct (CRA) [1] (other that replenishment water)	76,300	57%	2,000	44	NA	NA	NA	NA	0	2,044	155,957,200
Groundwater[2]											
natural recharge	19,720	40%	NA	NA	NA	350	0	NA	0	350	6,902,030
replenished with (injected) SWP water [1]	9,367	19%	3,000	44	NA	350	0	NA	0	3,394	31,791,598
replenished with (injected) CRA water [1]	11,831	24%	2,000	44	NA	350	0	NA	0	2,394	28,323,432
replenished with (injected) recycled water	8,381	17%	205	0	790	350	0	NA	220	1,565	13,116,278
Recycled Water											
West Basin Treatment, Title 22	21,506	60%	205	NA	0	NA	NA	NA	285	490	10,537,940
West Basin Treatment, RO	14,337	40%	205	NA	790	NA	NA	NA	285	1,280	18,351,360
	35,843										
Ocean Desalination	20,000	100%	200	NA	NA	NA	NA	3,027	460	3,687	82,588,800

Notes:

NA Not applicable

1 Imported water based on percentage of CRA and SWP water MWD received, averaged over an 11-year period. Note that the figures for imports do not include an accounting for system losses due to evaporation and other factors. These losses clearly exist, and an estimate of 5% or more may be reasonable. The figures for imports above should therefore be understood to be conservative (that is, the actual energy intensity is in fact higher for imported supplies than indicated by the figures).

2 Groundwater values include entire basin, West Basin service area covers approximately 86% of the basin. Groundwater values are specific to aquifer characteristics, including depth, within the basin.

Miluska Propersi

From: Han, Andrew <Andrew.Han@ladwp.com>
Sent: Wednesday, July 09, 2014 9:52 AM
To: Miluska Propersi
Cc: Brian Dietrick
Subject: RE: TIWRP - Additional Information Needed
Attachments: DGBP Condition Assessment Cover.pdf; Water quality data for DWP (Amy)- rev1.xlsx; TIWRP AWPF Water Quality Data.zip

Hi Miluska:

Please find the information you requested in red below.

Thank you,

Andrew Han
P: 213-367-8753

From: Miluska Propersi [mailto:MPropersi@rmcwater.com]
Sent: Tuesday, July 08, 2014 3:14 PM
To: Han, Andrew
Cc: Brian Dietrick
Subject: TIWRP - Additional Information Needed

Hi Andrew,

Thank you again for all your help. We have a couple more questions and requests that came up and need your help:

- In Attachment 3, at the very end under "Project Analysis/Cost Effectiveness Analysis", it's states another alternative to the proposed Project was identified that would only supply recycled water to the southern portion of the LA Harbor. Can you provide/send the reference document where this alternative was analyzed?
    - I'm not sure if that alternative was formally analyzed. I was just referring to the fact that the northern portion of the pipeline is currently sitting empty and will continue to sit empty until a northern source of water is secured. Since the northern source of water has not been secured yet, the pipeline should be the fastest method of providing water to the northern pipeline.
- In Attachment 3, let us know once you hear back from BOS regarding the energy used/AF. We will update everything accordingly.
    - TI Staff did not have a number for me, but they provided an estimate of 1800 kWh/AF.
- In Attachment 4, under Task 8 permitting, it states "*TIWRP Expansion - 100% O Funding* (100%)". Can you clarify what this funding is?
    - BOE Staff clarified that they mistyped this. It should read 100% Funding Approval by Project Review Committee based on a Class "0" Estimate.
- For the *BOS Water Quality Data* reference, can you provide more information on the source of the table (i.e., date when the sample was taken, who provided the information, etc.)? You can send us another table with the information on top. If it came from a report, can you provide the cover page?
    - Unfortunately, the information on the data sheet did not come from a report. The data came from LASAN's Seung Tag Oh by the excel sheet attached above. The information missing in the excel sheet from Seung was filled in from the data in the ZIP folder above.
- For the *Dominguez Gap Barrier Project Condition Assessment*, can you provide the cover page of that report?
    - Attached above.

Let me know if you have any questions. Thank you!

Miluska

Miluska Propersi, P.E.
Water Resources Engineer

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TIWRP Advanced Water Purification Facility and Distribution System Expansion Project - Energy Calculations

				Reference/Notes
Information	~~Groundwater Pumping Cost:~~	$0	per acre-foot	
	~~Groundwater Pumping Cost (2014):~~	$0	per acre-foot	
	Average Annual Imported Water Offset	6,580	AFY	
	Lifespan of Project	20	Years	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	SWP Energy Required for Conveyance and Pumping	3,000	kWh/AF	
	CRA Energy Required for Conveyance and Pumping	2,000	kWh/AF	
	From SWP	85%		Per LADWP Communication
	From CRA	15%		Per LADWP Communication
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
Calculated	Energy Required to Treated AWT RW	1800	kWh/AF	Per LADWP Communication
	Net Energy Savings	1,050	kWh/AF	
	Energy Conserved with Project Annually	6,909,000	kWh/year	
	Energy Used to Import Water (Without Project)	18,753,000	kWh/year	
	Energy Used to Pump GW (With Project)	11,844,000	kWh/year	
	Energy Conserved over Lifespan	138,180,000	kWh	

TIWRP Advanced Water Purification Facility and Distribution System Expansion Project - GHG Calculations

Given Information	~~Groundwater Pumping Cost:~~	$0	per acre-foot	
	~~Groundwater Pumping Cost (2014):~~	$0	per acre-foot	
	Average Cost of Electricity (2014):	$0.178	per kWh	
	Energy Required for Conveyance and Pumping	2,850	kWh/AF	
	Average Annual Imported Water Offset	6,580	AFY	
	Lifespan of Project	20	Years	
	Energy Required to Treated AWT RW	1800	kWh/AF	Per LADWP Communication
	Conversion Factor	0.724	lbs of CO_2/kWh	
	Net Energy Savings	1,050	kWh/AF	
GHG Emissions Avoided	Net Energy Savings x Conversion Factor	760.2	lbs CO_2/AF	
	Net Energy Savings Converted to Metric Tons	0.3448	metric tons/AF	
	Avoided Carbon Emissions Annually	2,269	metric tons	
	Avoided Emissions Over Lifespan	45,378	metric tons	
GHG Emissions Without Project	Energy Required for Importing x Conv. Factor	2,063.4	lbs CO_2/AF	
	Energy Required for Importing Conv. To Met Tons	0.9359	metric tons/AF	
	GHG Emissions to Import Water Annually (Without Project)	6,159	metric tons	
GHG Emissions with Project	Energy Required to Treated AWT RW x Conv Factor	1303	lbs CO_2/AF	
	Energy Required Treated AWT RW Conv. to Met Tons	0.591	metric tons/AF	
	GHG Emissions to Pump GW Annually (With Project)	3,890	metric tons	

California Climate Action Registry General Reporting Protocol

Reporting Entity-Wide Greenhouse Gas Emissions

Version 3.1 | January 2009

Thus, regional/power pool emission factors for electricity consumption can be used to determine emissions based on electricity consumed. If you can obtain verified emission factors specific to the supplier of your electricity, you are encouraged to use those factors in calculating your indirect emissions from electricity generation. If your electricity provider reports an electricity delivery metric under the California Registry's Power/Utility Protocol, you may use this factor to determine your emissions, as it is more accurate than the default regional factor. Utility-specific emission factors are available in the Members-Only section of the California Registry website and through your utility's Power/Utility Protocol report in CARROT.

This Protocol provides power pool-based carbon dioxide, methane, and nitrous oxide emission factors from the U.S. EPA's eGRID database (see Figure III.6.1), which are provided in Appendix C, Table C.2. These are updated in the Protocol and the California Registry's reporting tool, CARROT, as often as they are updated by eGRID.

To look up your eGRID subregion using your zip code, please visit U.S. EPA's "Power Profiler" tool at www.epa.gov/cleanenergy/energy-and-you/how-clean.html.

Fuel used to generate electricity varies from year to year, so emission factors also fluctuate. When possible, you should use emission factors that correspond to the calendar year of data you are reporting. CO_2, CH_4, and N_2O emission factors for historical years are available in Appendix E. If emission factors are not available for the year you are reporting, use the most recently published figures.

U.S. EPA Emissions and Generation Resource Integrated Database (eGRID)

The Emissions & Generation Resource Integrated Database (eGRID) provides information on the air quality attributes of almost all the electric power generated in the United States. eGRID provides search options, including information for individual power plants, generating companies, states, and regions of the power grid. eGRID integrates 24 different federal data sources on power plants and power companies, from three different federal agencies: EPA, the Energy Information Administration (EIA), and the Federal Energy Regulatory Commission (FERC). Emissions data from EPA are combined with generation data from EIA to produce values like pounds per megawatt-hour (lbs/MWh) of emissions, which allows direct comparison of the environmental attributes of electricity generation. eGRID also provides aggregated data to facilitate comparison by company, state or power grid region. eGRID's data encompasses more than 4,700 power plants and nearly 2,000 generating companies. eGRID also documents power flows and industry structural changes. www.epa.gov/cleanenergy/egrid/index.htm.

Figure III.6.1 eGRID Subregions

Source: eGRID2007 Version 1.1, December 2008 (Year 2005 data).

Water Quality Constituents of Concern for
Harbor Industrial Customers
And Data from Current/Potential Water Sources

	Units	Proposed Nitrified Water	Current Potable Water	Current West Basin Advanced Treated Water	Current TIWRP AWPF Water	TIWRP AWPF Expansion Design Specification
Ammonia	mg/L	<0.1	N/A	2.35	1.09	< 0.5
Conductivity	uS/cm	N/A	N/A	170.00	186	186
pH	Std. Units	6.8-7.6	8.00	7.91	8.03	8.03
Calcium	mg/L	48.00	42.00	16.90	37.0	35.0
Magnesium	mg/L	22.90	17.00	<0.1	N/A	N/A
Calcium hardness[1]	mg/L	N/A	N/A	33.80	N/A	N/A
Total hardness	mg/L	212.60	157.00	33.80	73.4	73.4
Bicarbonate alkalinity[2]	mg/L	62.00	86.00	63.20	N/A	N/A
Carbonate alkalinity	mg/L	0.00	0.00	N/A	N/A	N/A
Total Alkalinity	mg/L	62.00	86.00	N/A	44.1	40.0
Chloride	mg/L	278.00	69.00	12.80	114	114
Sulfate	mg/L	125.00	122.00	<2	4	4
Silica	mg/L	18.30	17.00	0.68	N/A	N/A
Iron	mg/L	<0.1	<0.1	<0.1	ND	ND
Copper	mg/L	0.008	0.58	0.002	0.00075	0.00075
Sodium	mg/L	237.00	65.00	10.50	43.3	43.3
Potassium	mg/L	16.50	4.00	0.72	3.58	3.58
TDS	mg/L	828.00	397.00	71.00	333	333
Free Chlorine	mg/L	>2	1.70	N/A	0.55	0.55
TSS	mg/L	<1	N/A	N/A	N/A	N/A
Nitrate (as N)	mg/L	30.375	<2	N/A	*	*
O-Phosphate	mg/L	0.495	N/A	N/A	N/A	N/A
Boron	mg/L	0.48	0.15	N/A	0.51	0.51
Total Phosphate	mg/L	0.69	N/A	N/A	N/A	N/A
Bicarbonate	mg/L	238.00	N/A	N/A	N/A	N/A
TOC	mg/L	9.98	2.20	N/A	0.2	0.2
COD	mg/L	38.12	N/A	N/A	N/A	N/A
BOD	mg/L	ND	N/A	N/A	N/A	N/A
Manganese	mg/L	0.17	<0.02	N/A	DNQ	DNQ
Sulfide	mg/L	ND	N/A	N/A	N/A	N/A
Arsenic	mg/L	ND	<0.002	N/A	ND	ND
Cadmium	mg/L	ND	N/A	N/A	ND	ND
Chromium (total)	mg/L	ND	<1	N/A	N/A	N/A
Lead	mg/L	ND	0.0056	N/A	DNQ	DNQ
Nickel	mg/L	0.01	N/A	N/A	0.00153	0.00153
Silver	mg/L	ND	N/A	N/A	ND	ND
Zinc	ug/L	ND	< 50	N/A	3.02	3.02
Cyanide (Total)	mg/L	ND	N/A	N/A	N/A	N/A
Sources		**WorleyParsons:** Valero-RW Tech Eval (DRAFT- June 2013)	**LADWP:** 2011 Drinking Water Quality Report	**West Basin:** Gregg Oelker - August 2013**	**TIWRP AWPF:** Monthly and Quarterly Monitoring Reports	**TIWRP**

*N/A = Not Available *ND = Not Detected

**Note for West Basin Data: 5 years of data (August 2008 - July 2013) for Mg, Na, K, Fe, Cu, Calculated Hardness, and TDS
1 year of data (August 2012-July2013) for all others.

[1]Calcium hardness is not reported for Proposed Nitrified, Current Potable, and Current TITP-AWTF. However, total hardness for Current West Basin Advanced Treated Water is said to be from Ca as no Mg was detected.

[2]Bicarbonate alkalinity is the only contributor to alkalinity for Proposed Nitrified and Current Potable. Bicarbonate alkalinity is the dominant contributor for Current TITP-AWTF Water and Current West Basin Advanced Treated Water, but there is no definite claim of it being the only contributor to alkalinity.

DNQ = Detected, but Not Quantified

* TBD once nitrogen profile analysis is completed.

Final Report

Dominguez Gap Barrier Project Condition Assessment

Prepared for

County of Los Angeles Department of Public Works

Water Resources Division

November 2013

CH2MHILL®

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Executive Summary

The Los Angeles County Department of Public Works (LACDPW), acting on behalf of the Los Angeles County Flood Control District (LACFCD), retained CH2M HILL to conduct a condition assessment of the Dominguez Gap Barrier Project (DGBP) facilities, including pipelines, injection wells, and observation wells. LACDPW issued a Notice to Proceed with the condition assessment work to CH2M HILL on July 12, 2011. The field investigation work concluded in January 2013, with a draft assessment report completed in June 2013. This report presents the findings and recommendations from this condition assessment work.

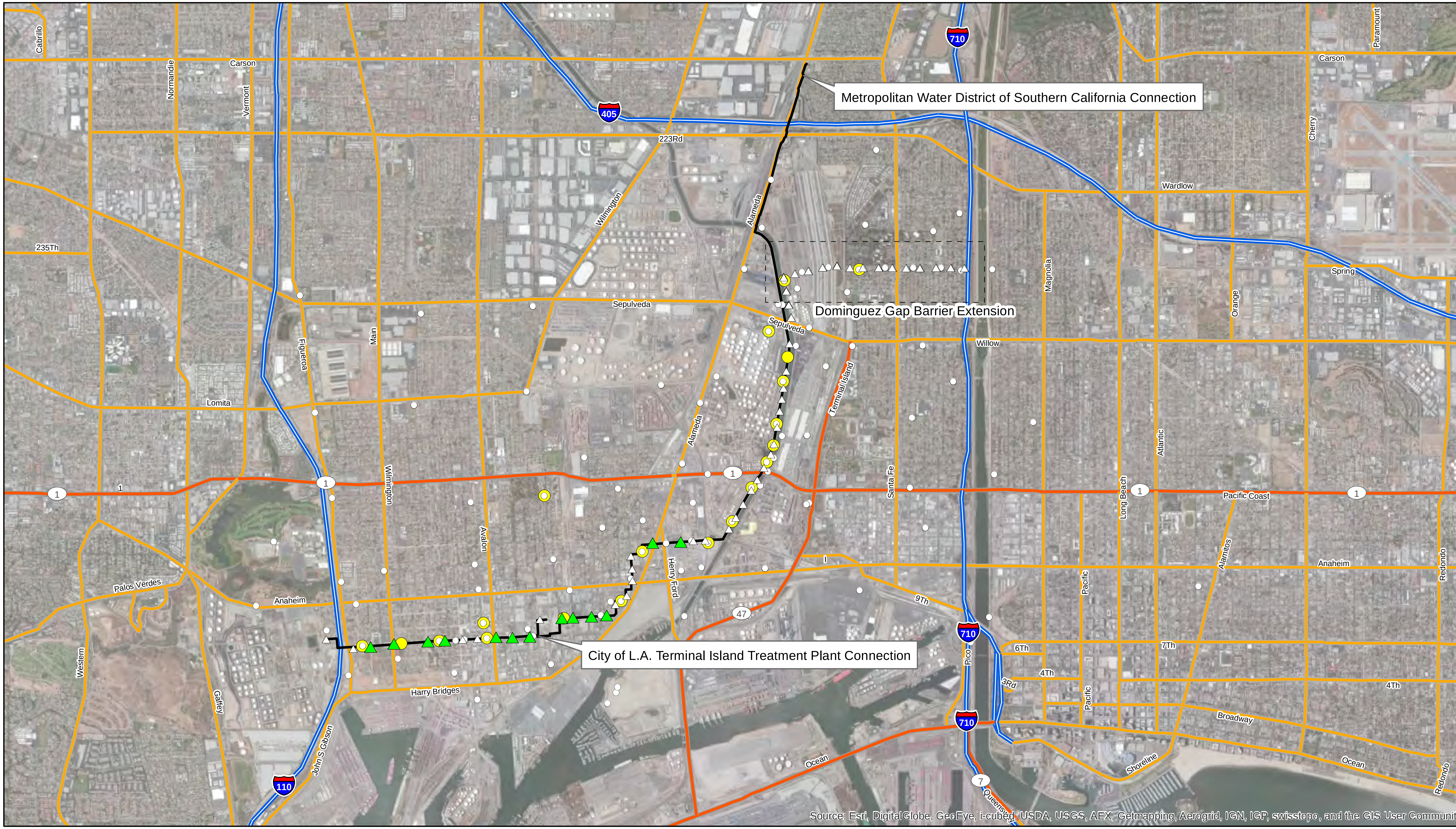
The DGBP, which began construction in 1969, is the newest and second largest of the three barriers constructed by LACFCD in response to seawater intrusion along the southern California coast. Because some of the DGBP facilities are over 40 years old, LACDPW desired a comprehensive assessment of these facilities to determine the risk of failure of the DGBP as a whole, as well as individual components. An extension of the barrier was completed in 2004. Because the 2004 portion of the barrier is less than 10 years old, it is not included in this condition assessment. Figure ES-1 shows the location of DGBP the facilities, including pipelines, injection wells, and observation wells, that were included in this condition assessment work.

LACDPW, including planning, engineering, design, and operations staff, have extensive knowledge of the DGBP facilities. LACDPW staff conducted a preliminary condition assessment of DGBP facilities, using the previous Corrpro assessments, as-built drawings, knowledge of prior issues, and experience with DGBP operations. Therefore, LACDPW staff developed a preliminary list of facilities, including mainline pipeline segments, selected injection wells, and selected observation wells, where they wanted CH2M HILL to focus their field condition assessments. The objective of this specific project was to assess the condition of the DGBP infrastructure, including pipelines, observation wells, and injections wells, by performing the following tasks:

- Conducting an acoustic survey of the DGBP pipeline (the pipeline) consisting of approximately 38,000 linear feet, which excludes the newer east-west leg referred to as Unit 7B, Phase 4A, Part 2B
- Excavating the water supply pipeline and conducting physical and visual examinations of eight sites and five soil analysis sites associated with the pipeline
- Conducting field evaluations of 50 observation wells
- Conducting field evaluations of 13 injection wells

The results of the detailed field assessments were used to extrapolate the condition of those facilities (pipeline types, injection wells, and observation wells) to those comparable facilities that could not be directly assessed in the field.

In addition to the condition assessment, LACDPW included three additional tasks to the scope of work: 1) development of a hydraulic model of the DGBP water supply distribution system, 2) scenario analysis of various annual water injection demand volumes and sources of supplies to meet those demands, and 3) review of pressure and flow oscillation issues observed by LACDPW staff.



Legend

DGBP Injection Wells **DGBP Observation Wells** Barrier Pipeline

▲ Assessed ○ Assessed

△ Not Assessed ○ Not Assessed

N

0 2,500 5,000 10,000 Feet

Figure ES-1

Dominguez Gap Barrier Project

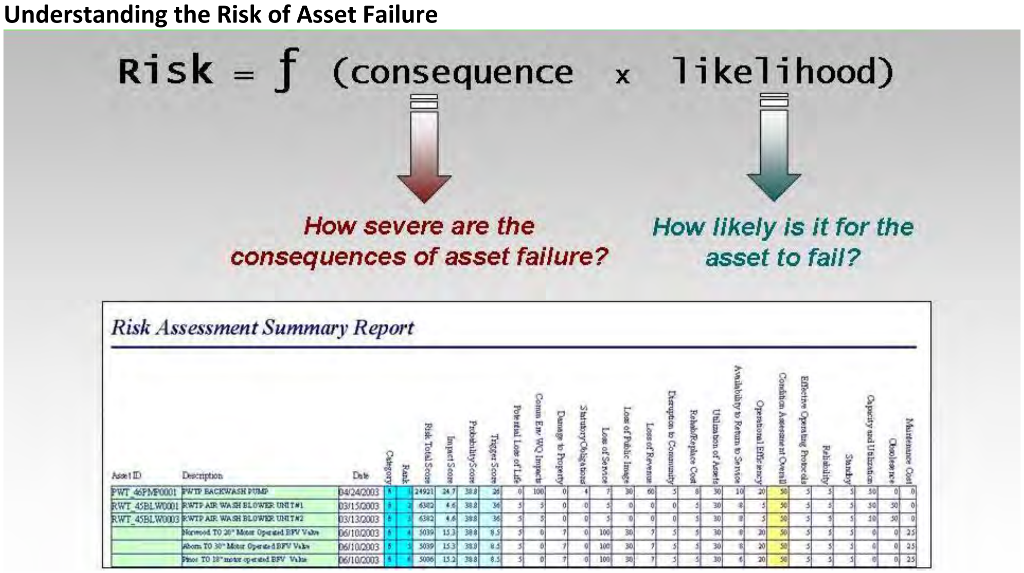
Facilities Overview Map

Path: \\cheron\projects\Los Angeles County DPW\425956DGBP\Mapping\GIS_projected\ArcMap\FigureES-1.mxd

Condition Assessment Using Risk-based Asset Management

CH2M HILL applied a risk-based asset management approach to assess the reliability of the DGBP pipeline, injection well, and observation well assets. The basic risk equation defines risk as a function of the ***consequence*** of asset failure (how severe are the consequences?) times the ***likelihood*** of failure (how likely is it for the asset to fail?) (Figure ES-2). The results of this evaluation and ranking for each asset or group of assets are summarized in a Risk Assessment Summary Report and provide data for other reports. Understanding the risk of asset failure provides key benefits, including the identification of projects that are candidates to reduce risk (that is, form the basis for a Capital Improvements Plan [CIP]).

FIGURE ES-2
Understanding the Risk of Asset Failure



CH2M HILL worked closely with LACDPW staff to develop an asset hierarchy, consequence and likelihood of failure matrixes, and overall risk ranking of assets, as described in this report. The consequence scores and likelihood of failure scores were used to calculate overall risk scores. LACDPW requested that results of the consequence scores/ranks and likelihood scores/ranks also be shown independently for pipelines, injection wells, and observation wells in order to clearly distinguish high risk because of high consequence alone and from high risk because of high likelihood alone. High-risk assets with high consequences but low likelihood are typically good candidates for increased monitoring; conversely, high-risk assets with high likelihood are candidates for capital improvement projects prioritized by consequence. Likelihood, consequence, and risk scores are all included in this report to provide the reader with a comprehensive view of the basis of the risk-based asset assessment. Overall, as shown in Section 4, the risk scores are not significantly high, with the highest score being 23.1 out of a total score of 100, which suggests that overall, the DGBP system is in relatively good condition.

In general, the water supply pipeline appears to be in good condition, with only limited exceptions. The condition of the DGBP water supply pipelines was assessed using acoustic methods and direct observations, and provided the key input to the risk assessment likelihood of failure scoring. Information collected from these assessments was used to estimate the potential remaining life of the water supply pipeline segments. Direct physical observations and general life expectancies suggest that the majority of the pipeline is expected to provide ongoing, reliable service. To this end, no capital projects are recommended for the DGBP pipeline; however, incorporating additional preventive maintenance projects, beyond normal maintenance such as repetition of acoustic surveys on a regular basis (for example, every 10 years), is recommended. Additional preventive maintenance includes repairing mortar coating on steel pipeline in vaults as observed for the vault where the recycled water pipeline connects to the DGBP water supply pipeline (for example, see Section 2.3.1 and Appendix A4).

In addition, during the acoustic survey of the DGBP pipeline, it was noticed that the injection well laterals installed as a part of Unit 7B, Phase 4A, Part 1 did not include cathodic protection. It is recommended that these laterals be investigated for electrical continuity along their length. If there is continuity, then cathodic protection should be installed to minimize the potential for corrosion of the steel pipe. The cost of this investigation is estimated to be approximately $27,000. If there is not electrical continuity, then it is likely cost-prohibitive to install cathodic protection because the entire length of the laterals would likely need to be excavated, given the large number of joints shown on the as-built drawings.

In contrast to the pipeline, video logging was used to assess the observation wells, and in addition, casing thickness logging was used to assess the condition of injection wells, which showed that many wells are in poor condition, resulting in high likelihood of failure scores in the risk assessment. Based on age, material, and condition, a large number of the asbestos-concrete injection and mild steel observation wells may need to be replaced within the next 31 years. A schedule for well replacement is included in a proposed CIP.

Hydraulic Modeling, Surge Modeling, and Pressure and Flow Oscillation Assessments

CH2M HILL developed a hydraulic model of the DGBP system using InfoWater software to simulate the existing and potential future operational scenarios in order to identify potential system deficiencies, analyze the potential to increase injection rates to 10,100 acre-feet per year (AFY) using recycled water from the City of Los Angeles Terminal Island Treatment Plant (TITP), and assess potential improvements to address identified deficiencies. The hydraulic model was calibrated to existing field conditions. Twelve DGBP operational scenarios were set up and modeled using the hydraulic model developed for this project. The hydraulic model analysis shows that there are some potential deficiencies in the DGBP pipeline, but these deficiencies are not significant enough to warrant capital improvement projects. However, if in the future the barrier is supplied by 100 percent recycled water from the TITP, system pressure monitoring should be increased to confirm that potential decreases (that is, pressures below 40 psi) and increases (that is, pressures above 65 psi) remain within acceptable limits and do not pose any unacceptable deviations. If actual observed pressures deviate from those simulated in the model, or are found to be operationally challenging by LACDPW, then upgrades to the conveyance system may be warranted. However, the Los Angeles Department of Water and Power (LADWP) is investigating potential expansion of their recycled water distribution system in the South Bay, including the potential for additional connections to the DGBP, so that even the potential deficiencies identified in this study will no longer be an issue.

Bentley's Hammer software was used to model potential surge conditions within the system and to simulate potential effectiveness of surge protection measures. Undesirable surge conditions were identified for barrier operations that included a blend of recycled water and imported water. These surge conditions can be addressed simply by installing a surge tank at the TITP recycled water pump station and adding vacuum relief valves at the pressure-reducing valves (PRVs) where the recycled water pipeline connects to the barrier supply pipeline.

LACDPW staff have observed instances of flow and pressure surge in the DGBP. After reviewing conditions associated with a number of these events and discussions with LADWP and LACDPW staff, we provide the following specific recommendations, based on minimizing the required amount of work to remedy the situation, and considering that higher flows may be needed in the future.

1. First, isolate one of the 24-inch DGBP PRVs so only one is in operation.
2. Reduce the valve opening speed on the 24-inch DGBP PRVs until the oscillations are reduced and preferably eliminated. The recommended starting set point for the speed control needle valve is one full

turn open from the completely closed position. It may be necessary to install a valve speed control on the valves, but this should be a relatively simple installation and should be done by Singer Valve.

3. If reducing the valve opening speed does not remedy the problem, and/or if future low flows cause the problem to resurface, schedule a visit by the Singer Valve representative to review the installation and operating data and make recommendations and/or adjustments to make the valves work properly. The Singer Valve representative should first physically inspect the valve and document what specific features exist on the valve. He should then review operating flows and pressures and set the valve to work with those flows and pressures.
4. If the Singer Valve representative cannot help, consider one of the following:
   a. Consider replacing one of the 24-inch DGBP PRVs with a smaller valve. The size of any replacement valve should consider the magnitude of flows required through the valves, both now and in the future.
   b. Or, consider eliminating the 24-inch DGBP PRVs and modifying the Metropolitan Water District of Southern California (MWD PRV) station by installing anti-cavitation valves. If this option is seen as desirable to the County, an evaluation of valve life expectancy, service requirements, and associated costs should be conducted.
5. Compare the design of the isolation and air release valves of the old leg of the wells to the new, east-west leg. If that comparison shows a large discrepancy between the two designs, find locations in the east-west leg where isolation valves and additional air release valves may be needed and install these.
6. Because the 10-inch PRV at the MWD PRV station may not have been in service for some time, inspect the valve and ready it for future use if required.

Capital Improvements Plan Projects

Following are recommended CIP projects. Table ES-1 summarizes the capital projects and the estimated 5-year CIP cost schedule for pipeline, observation well, and injection well projects.

1. Pipeline CIP Projects

The DGBP water supply pipeline surge analysis identified the need for two capital improvements for surge protection of the facilities:

- A 5,000-gallon surge tank at the recycled water pumps, estimated at $277,000
- Two vacuum relief valves on both sides of the DGBP GAP PRV station, where the recycled water supply line connects to the barrier pipeline, estimated at $35,000 (total)

These projects are recommended to be completed immediately (even under current operating conditions), as year one of the capital improvement program schedule (2015).

2. Injection Well CIP Projects

Based on remaining life estimates, 31 asbestos cement injection wells may need to be replaced between 2034 and 2044. The cumulative total injection well replacement cost is estimated to be $28,105,000.

3. Observation Well CIP Projects

Based on remaining life estimates, 49 mild steel observation wells may need to be replaced between 2015 and 2041. The total injection well replacement costs are estimated to be $7,856, 000.

TABLE ES-1
Well Capital Improvement Projects
DGBP Condition Assessment

Project Year	2015-2019	2020-2024	2025-2029	2030-2034	2035-2039	2040-2044
Injection Well Repacement Projects				26J 351Q 26J 351U	24B 322K 26Y 361AD 26Y 361AH 24E 322L 25C 342L 25H 342H 26B 351R 26D 351P 26D 351W 26N 361AB 26N 361AK 27Y 370AD 27Y 370AF	27F 360U 28C 879AD 28C 879AE 27B 361AE 27F 360R 27T 370AC 27T 370AE 23Y 322J 24H 322M 24M 332K 24Q 332L 24V 332M 24X 332N 24Z 332P 25E 342G 25Q 342K 25T 342F 25W 352J 25Y 352K 26B 351V 26T 361AC 26T 361AG 27B 361AJ 27M 370AB
Observation Well Repacement Projects	25V 47 341R 25V 47 341S 25V 47 341P	27A'111 393A 28R 7 879X 28R 7 879W 28R 7 879Y 28R0.1 879CC 28R0.1 879DD 27C'100 392F 27C'49 371B 27C'49 371A 27F' 3 361C 27F' 3 361B 27F' 3 361D 27J 29 360H 27J 29 360G 27M' 3 370N 27M'94 392G 27M'94 392H 27R'64 381L 27R'64 381J 27R'64 381K 28H' 3 879RR 28H' 3 879PP 28H' 3 879QQ 28R'73 899L 28R'73 899M	24C 26 321B 24C 26 321A 25R'28 352B 25T'28 352A 26N'15 361J 26N'15 361K 26N'15 361H 27J'19 371J 27J'20 371G 27J'20 371E 27J'20 371D 27K' 3 370H 28C'135 411A 28J'92 400 28K'27 889Q 28K'27 889R 28K'27 889P 27T' 3 370T		25H' 1 342M 25T'6 352M	26K'12 351S
Injection Well CIP Costs	**$0**	**$0**	**$0**	**$1,567,000**	**$9,318,000**	**$17,220,000**
Observation Well CIP Costs	**$519,000**	**$3,923,000**	**$3,230,000**	**$0**	**$132,000**	**$52,000**
Total CIP Costs	**$519,000**	**$3,923,000**	**$3,230,000**	**$1,567,000**	**$9,450,000**	**$17,272,000**

Notes
28H' 3 879RR = Project and FCD Numbers
Costs are in 2013 dollars

5 Hydraulic Model, Surge Analysis, and Analysis of Oscillation Issues of the Dominguez Gap Barrier Project Pipeline

5.1 Introduction

LACDPW included three additional tasks in the DGBP condition assessment scope of work: 1) development of a hydraulic model of the DGBP water supply distribution system, 2) scenario analysis of various annual water injection demand volumes and sources of supplies to meet those demands, and 3) review of pressure and flow oscillation issues. This section presents the work completed, findings, and recommendations relative to those three scope items.

5.2 Hydraulic Model

A computer model that simulates the hydraulics of the DGBP system is an important tool for analysis of the system. The computer model is composed of the following two main parts:

- A data file that defines the physical system
- A computer program that solves a series of hydraulic equations for pressure and flow

The data file includes information specific to the system being analyzed: the DGBP system facilities, operational characteristics, and injection flow rate data unique to the DGBP. Injection flow rates are referred to as "demands" in the computer model. The system facilities include pipes, junction nodes (connection points for pipes and location of demands), valves, pumps, Metropolitan Water District of Southern California (MWD) supply, and Terminal Island Treatment Plant (TITP) recycled water supply. Operational characteristics include parameters that control how the water moves through the system, such as on and off settings for pumps; or pressure controls for hydraulically actuated valves. Data for production and consumption determine where the water enters and exits the system.

An accurate computer model was developed by entering the correct information into the data file, then calibrating the model to match existing conditions in the field. The resulting model was used to simulate the existing and future systems, identify system deficiencies, analyze impacts from increased demands, and determine how effective proposed changes and or improvements are for the system. The computer model developed for this project was used to identify system deficiencies as well as provide a foundation for analyzing potential surge conditions.

5.2.1 Hydraulic Model Development

The DGBP hydraulic computer model was developed using InfoWater 8.0 software and was based on the geographic information system (GIS) and as-built data provided by LACDPW staff. The project team worked with LACDPW staff to verify the accuracy of the data being provided for this project; specifically, checking pipe diameters and materials and making corrections as appropriate. Valve and pump settings were updated based on current operational settings in the field. All data were verified for accuracy prior to input to the model. All system facilities – including nodes (wells), pipelines, pump curves and status, updated settings for pressure-reducing valves (PRVs), and supplies – were entered into the model. The demands, based on average injection flow rates, are discussed below under Water Demands in the Model.

The hydraulic computer model reflects real-world coordinates based on the State Plane Coordinate System NAD 83. The use of real-world coordinates made it easier to verify model scale, which is important for obtaining accurate pipe lengths.

Data Review

The following data were reviewed and entered into the model input files:

- As-built plans for existing pipes – including length, material, and elevation
- Injection flow rates and pressure data from January 2010 through September 2011
- Recycled water supply for September 2010 through to August 2011
- Recycled water pump station pump curves and results of a pump test conducted on November 17, 2003
- MWD flow to the original north to south alignment and the DGBP extension along Spring Street, as well as pressure data for the upstream and downstream PRVs for January 2010 through to September 2011
- Information provided by Corrpro (2003), including a hydraulic profile(at design flow), the barrier pipe profile, system elevations, and a data set for each injection well

Water Demands in the Model

Water demands were placed in the model based on periodic injection well flow data from January 2010 to September 2011. The average flow rate was calculated as the average of all effective readings for each injection well. Data points indicating malfunctioning meters, line breaks, inoperability or flooding were excluded from the model. Of the 94 injection wells analyzed, 11 were not in operation. For the remaining 83 wells, model junctions were placed near each injection well's actual location. The total average flow rate was 4,673 gallons per minute (gpm, 10.41 cubic feet per second [cfs], 6.73 million gallons per day [mgd]) as shown in Table 5-1. Injection well demands were applied on the closest node along the pipeline. For wells located in the same vault, two distinct demand fields were used so that each well can be turned on and off by applying a zero/one factor. Figure 5-1 shows an example of Well Vault 26N and how the demands are split between two demand fields. For all scenario analyses described below, these flows were scaled up or down according as a ratio of these total demands (10.41 cfs) divided by the scenario total demands being analyzed.

TABLE 5-1
DGBP Injection Well Flow Rates

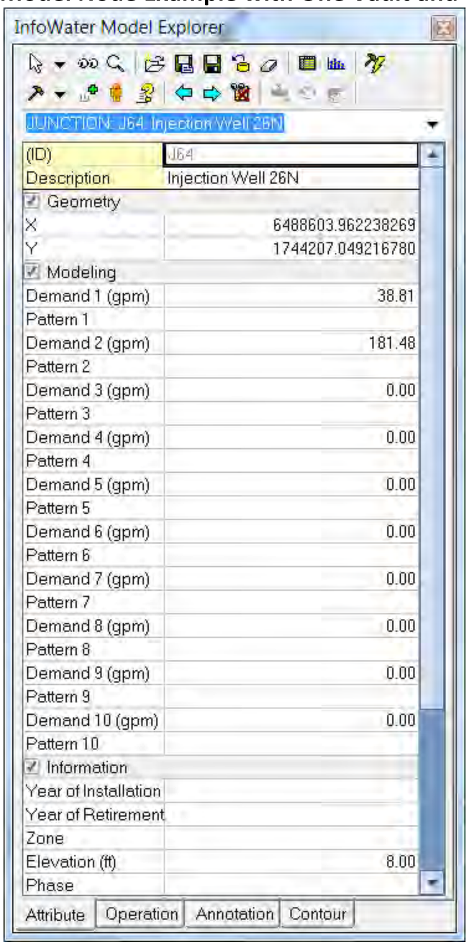
Well	Flow rate (gpm)	Flow Rate (cfs)	Well	Flow rate (gpm)	Flow Rate (cfs)	Well	Flow rate (gpm)	Flow Rate (cfs)
23T	91.61	0.204	26A	54.9	0.122	28R	41.29	0.092
23Y	42.08	0.094	26B	118.93	0.265	28T	72.02	0.160
24B	86.96	0.194	26C	84.74	0.189	28W	54.42	0.121
24E	102.1	0.227	26D	185.51	0.413	28Y	42.63	0.095
24H	87.07	0.194	26J	122.78	0.274	28Y1	63.36	0.141
24M	30.36	0.068	26N	220.29	0.491	28Y2	42.83	0.095
24Q	22.44	0.050	26R	227.68	0.507	28Z	82.75	0.184
24V	22.44	0.050	26T	223.31	0.498	28Z1	63.1	0.141
24X	17.95	0.040	26Y	131.27	0.292	28Z2	50.42	0.112
24Z	21.24	0.047	27B	261.15	0.582	28Z3	96.24	0.214
25C	22.14	0.049	27J	94	0.209	29A	80.33	0.179
25E	23.23	0.052	27M	66.76	0.149	29A1	67.62	0.151
25H	30.86	0.069	27Q	47.52	0.106	29A2	72.37	0.161
25K1	27.21	0.061	27T	168.79	0.376	29A3	75.9	0.169
25Q	27.23	0.061	27W	190.46	0.424	29A4	76.38	0.170

TABLE 5-1
DGBP Injection Well Flow Rates

Well	Flow rate (gpm)	Flow Rate (cfs)	Well	Flow rate (gpm)	Flow Rate (cfs)	Well	Flow rate (gpm)	Flow Rate (cfs)
25T	26.93	0.060	27Y	307.28	0.685	29B	57.66	0.128
25W	19.95	0.044	28A	255.54	0.569	29B1	73.61	0.164
25Y	13.46	0.030	28H	83.82	0.187			

Total Average Flow Rate = 4,673 gpm (6.73 mgd, 10.41 cfs)

FIGURE 5-1
Model Node Example with One Vault and Two Wells



Existing Supplies in the Model

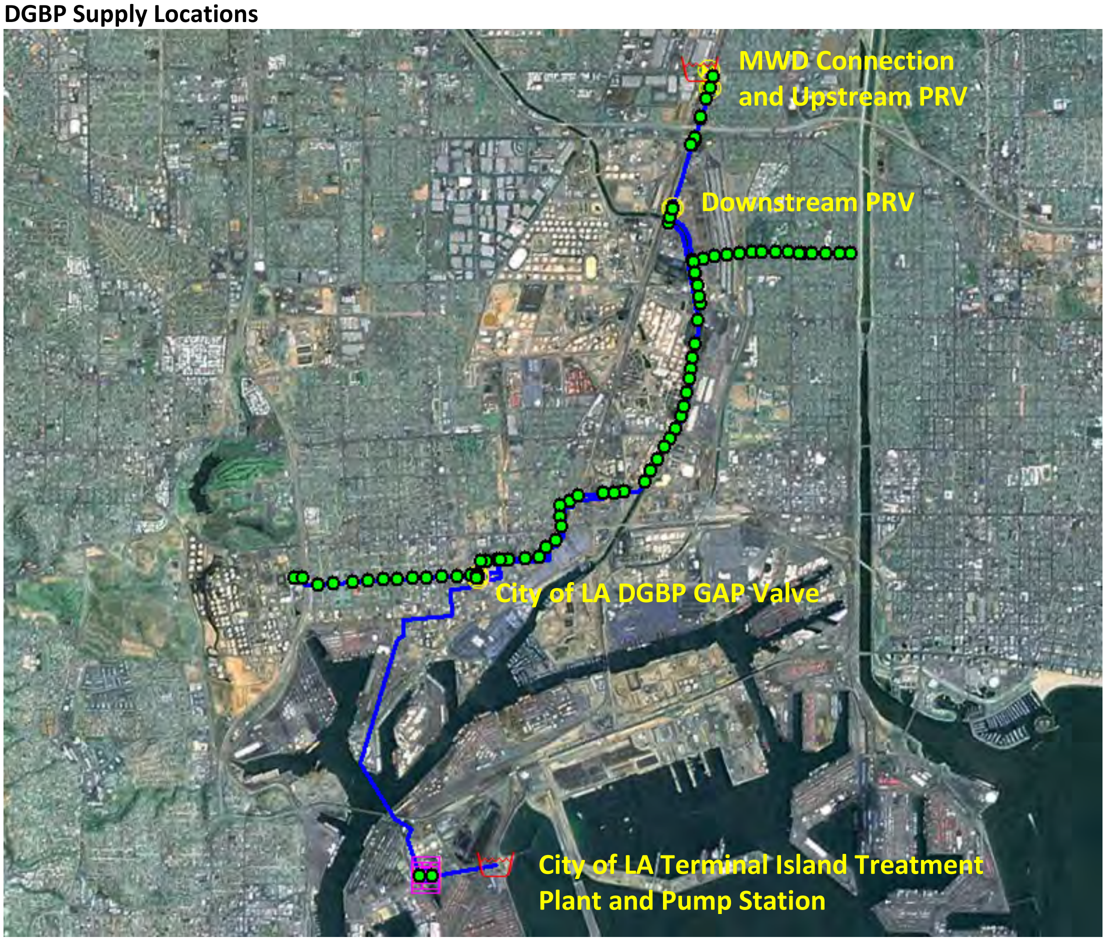
For the model development simulation period, which averages conditions from January 2010 through September 21, 2011, the DGBP included two supplies; a northern connection to MWD that supplies imported water, and a southern connection to the TITP that supplies recycled water from advanced treatment facilities. The location of each of these supplies is shown in Figure 5-2.

LACDPW staff provided the MWD connection average flow rate of 1,784 gpm (about 3.98 cfs), which is modeled as a fixed head reservoir at 545 feet of head, connected to the system by a series of PRVs to regulate the flow rate. Based on the September 21, 2010, readings provided by LACDPW staff, the upstream

PRV on Alameda and 218 Streets was set to 120 psi, and the downstream PRV on Alameda Street and Dominguez Channel was set to 55 psi. Both of these settings were verified during a meeting with LACDPW in July 2012.

The TITP recycled water connection had an average flow rate of 2,796 gpm (6.23 cfs) and was modeled as a fixed head reservoir at 8 feet of head based on the pump station pump test. The recycled water flow is supplied to the system by a pump station and a PRV. Pump test curves were used because LACDPW indicated an inconsistency between the pump test curves and the original manufacturer pump curves. The existing condition within the model was configured with two pumps running and one pump in standby (off) to meet flow and head. Each pump has a design point of 2,100 gpm (4.68 cfs) at 197 feet of head. During model calibration it was determined that the pump test curves from November 2003 were to be used for modeling purposes rather than the manufacturer's curve. LACDPW indicated an inconsistency between the pump test curves and the original manufacturer pump curves. This is a typical protocol because as a pump ages its flow and head ratings will adjust. The existing condition within the model was configured with two pumps running and one pump in standby (off) to meet flow and head. The recycled water PRV, also known as the DGBP GAP Valve, was set at 60 psi based on field- observed averages. Pressures must be below 65 psi in the pipeline north of the DGBP GAP Valve to avoid excessive pressure in the wells that could damage the well seals.

FIGURE 5-2
DGBP Supply Locations



5.2.2 Model Calibration

The hydraulic computer model gauges how the system will respond under several given sets of circumstances. After running a scenario, it is possible to test the accuracy of the computer model by comparing the results observed in the field against the results of the computer model simulation results.

Calibration

One steady-state model simulation, or scenario, was created in the computer model to represent existing conditions (average over the period January 2010 through September 2011). The calibration process required that the model simulations duplicate the boundary conditions. Boundary conditions include sources of supply such as valve and pump station settings. These locations of known flows and/or pressures were assumed not to change during the calibration period.

If, during calibration, significant differences were revealed between the model simulation results and the actual existing conditions, the model input was rechecked. This included verifying pipe diameters and pump station information and similar data. If these data appeared to be correct, additional steps were taken to verify connections between pipes, verify PRV settings, and perform similar checks. The calibration process attempted to correct errors found in the model input data before calibrating friction coefficients or suggesting that unknown field conditions might exist.

As a general rule, changes were not made unless sufficient justification was shown to support the change. Any changes made to the model were reviewed with LACDPW for concurrence. Examples of typical changes include changing a pump's status to on or off, and adjusting pressure settings for PRVs.

Once the model pumps and valves appeared to be operating correctly, adjustments to the pipe friction coefficients (C-factors for the Hazen-Williams equation) were made to reflect the observed head loss through the pipelines.

Pipe Friction Coefficients

Preliminary C-factors and pipe classes shown in Table 5-2 were assigned based on standard published values for pipes of similar material and age. Adjustments to the C-factors were not necessary during model calibration because the results produced from the estimates generated favorable simulation results. However, adjustments to the model for pipe diameters and material were made after the project team noted discrepancies between as-built drawings and LACDPW GIS data.

TABLE 5-2
Pipe Classes by Material And Age

Class Number	Pipe Material	Installation Year	Age (years)	Percent of Total (%)	Typical C-factor Range	C-factor used in model
1	ACP	before 1970	35+	66	100–130	120
3	CC	before 1970	35+	1	100-120	120
6	CML STL	After 1970	0–42	6	140-150	130
9	STL	after 1970	0–35	27	130–150	130
10	STL CC	before 1970	35+	<1	120	130

ACP: asbestos-cement pipe; CML: cement mortar-lined; CC: concrete cylinder
STL: steel pipe; STL CC: steel concrete cylinder

Note: CC and SCCP installation years are based on pipes with known year of installation in proximity.

Static Calibration

September 21, 2010 data from the new injection wells installed along the new east-west barrier leg, located along Spring Street, were used for model calibration and setup verification. These data were used because the metered flow into the system from both sources, the MWD connection and TITP recycled water connection, was 4,580 gpm (6.59 mgd) as provided by LACDPW staff for this date. This flow was only 2 percent below the calculated average flow rate of 4,673 gpm (6.73 mgd) for the model simulation period averages. During this simulation the following model results against field results were captured:

- TITP flow rate in the model was 2,787 gpm compared with 2,796 gpm average flow.
- MWD flow rate in the model was 1,885 gpm compared with 1,784 gpm average flow.
- The new pipe pressure range calculated in the model was 52.7 to 52.8 psi compared with the typical range between 52 and 53 psi in the new east-west barrier leg, located along Spring Street.

5.3 Modeled Operational Scenarios

LACDPW staff provided an initial set of DGBP operational scenarios on June 25, 2012 for analysis using the hydraulic model of the DGBP. These operational scenarios included three demand sets (that is, total volume of water injected into the Barrier injection wells in a given year), ranging from 9 cfs to 14 cfs, in addition to existing Barrier operations (10.41 cfs). These three demand sets were run first assuming that 5 mgd (7.735 cfs) of recycled water is available for all demand sets (5 mgd is the current recycled water capacity), but vary in the quantity of imported water, as described below. Then, these same three demand sets, plus the existing demand, were run again, but assuming that all the supply would be recycled water from the City of Los Angeles Terminal Island Treatment Plant (TITP) through the Los Angeles Department of Water and Power's Terminal Island pipeline, which connects to the DGBP pipeline at the GAP PRV (Figure 5-2). The initial results of the hydraulic model analysis indicated some minor hydraulic deficiencies under some operating conditions, so two additional scenarios that assumed alternative piping configurations were analyzed in order to remove these minor hydraulic deficiencies, as described below.

LADWP requested that two additional recycled water supply scenarios be analyzed using the hydraulic model after submittal of the DGBP Condition Assessment Report. LADWP is expanding their recycled water distribution system in the South Bay area, so they wanted to assess the potential hydraulic effects of two alternative connection points compared to the GAP PRV location that was analyzed. CH2M HILL provided a scope and budget for these two additional scenarios and this work was authorized by LACDPW on September 4, 2013.

Twelve alternative DGBP operational scenarios were set up for analysis using the hydraulic model, as follows:

- EXISTING – existing configuration – current well injection rates (average used in the model development simulation period - 10.41 cfs)
- DGBP_LOW - representing the low volume (9 cfs) demand set, with 5 mgd of recycled water
- DGBP_HIGH – representing the high volume (12 cfs) demand set, with 5 mgd of recycled water
- DGBP_THEORETICAL – representing a theoretical (14 cfs) demand set, with 5 mgd of recycled water
- DGBP_ALLRW_EXISTING – all injection well demands being met by recycled water using the existing volume demand set
- DGBP_ALLRW_LOW – all injection well demands being met by recycled water using the low volume demand set

- DGBP_ALLRW_HIGH – all injection well demands being met by recycled water using the high volume demand set
- DGBP_ALLRW_THEORETICAL – all injection well demands being met by recycled water using the theoretical volume demand set
- DGBP_ALLRW_THEO_PIPEREPLACE – all injection well demands being met by recycled water using the theoretical volume demand set and replacing a portion of 18-inch pipeline with 20-inch pipeline to remove headloss per 1,000 feet issues. The pipeline replaced in the model is shown in Figure 5-3.
- DGBP_ALLRW_THEO_NEWPIPE – all injection well demands being met by recycled water using the theoretical volume demand set and paralleling a portion of pipeline with 12-inch pipeline to remove headloss per 1,000 feet issues. The pipeline added in the model is shown in Figure 5-4.

Attachment A to Resolution No. R08-006

Amendment to the Water Quality Control Plan – Los Angeles Region

to Incorporate the

Total Maximum Daily Load for Eutrophic, Algae, Ammonia, and Odors (Nutrient) in Machado Lake

Adopted by the California Regional Water Quality Control Board, Los Angeles Region on May 1, 2008

Amendments

Table of Contents
Add:

List of Figures, Tables, and Inserts
Add:

Chapter 7. Total Maximum Daily Loads (TMDLs)
Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL

This TMDL was adopted by:

The Regional Water Quality Control Board on May 1, 2008.

This TMDL was approved by:

The State Water Resources Control Board on **[Insert date].**
The Office of Administrative Law on **[Insert date].**
The U.S. Environmental Protection Agency on **[Insert date].**

This TMDL is effective on **[Insert Date]**

The elements of the TMDL are presented in Table 7-29.1 and the Implementation Plan in Table 7-29.2

Table 7-29.1. Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL: Elements

TMDL Element	Regulatory Provisions
Problem Statement	Excessive loadings of nutrients, in particular nitrogen (including ammonia) and phosphorus, cause eutrophic effects, including algae and odors, which impair the beneficial uses of Machado Lake. The nutrient enrichment results in high algal productivity; algal blooms have been observed in the lake during summer months. In addition, high nutrient concentrations contribute to excessive and nuisance macrophyte growth. Algae respiration and decay depletes oxygen from the water column creating an adverse aquatic environment. Machado Lake was placed on the Clean Water Act 303(d) list of impaired waterbodies in 1998, 2002, and 2006 for ammonia, algae, odors, and eutrophic. Applicable Water Quality Objectives for this TMDL are narrative objectives for Biostimulatory Substances and Taste and Odor; and numeric objectives for Dissolved Oxygen and Ammonia. The beneficial uses of Machado Lake include beneficial uses associated with recreation (REC 1 and REC 2), aquatic life (WARM, WILD, RARE, and WET) and water supply (MUN). This TMDL addresses the eutrophic, algae, ammonia, and odor listings which impair these uses.
Numeric Targets	The total phosphorus target for Machado Lake is 0.1 mg/L as a monthly average concentration in the water column, which is based upon US EPA Nutrient Criteria Technical Guidance Manual for Lakes and Reservoirs. A ratio of total nitrogen to total phosphorus of 10 is the basis for the total nitrogen (TKN + NO_3-N + NO_2 –N) numeric target of 1.0 mg/L as a monthly average concentration in the water column. The total nitrogen target incorporates all forms of nitrogen including TKN, which is the sum of organic nitrogen and ammonia nitrogen, nitrate nitrogen (NO_3-N), and nitrite nitrogen (NO_2-N). The total nitrogen target expressed as a monthly average is protective of chronic aquatic life exposure for ammonia. There is a separate numeric target for ammonia of 5.95 mg/L as an hourly average to be protective of acute aquatic life exposure. The chlorophyll *a* target is 20 ug/L based on EPA guidance and the Carlson Trophic Status Index. The dissolved oxygen target is a single sample concentration of no less than 5 mg/L measured at 0.3 meter above the sediments based on the Basin Plan objective. The following table provides the numeric targets for the Machado Lake TMDL.

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td></td><td>
<table>
<tr><th>Indicator</th><th>Numeric Target</th></tr>
<tr><td>Total Phosphorus</td><td>0.1 mg/L monthly average</td></tr>
<tr><td>Total Nitrogen (TKN + NO_3-N + NO_2 –N)</td><td>1.0 mg/L monthly average</td></tr>
<tr><td>Ammonia - N</td><td>5.95 mg/L one-hour average</td></tr>
<tr><td>Ammonia - N</td><td>2.15 mg/L 30 day average</td></tr>
<tr><td>Dissolved Oxygen</td><td>5 mg/L single sample minimum measured 0.3 meter above the sediments.</td></tr>
<tr><td>Chlorophyll *a*</td><td>20 µg/L monthly average</td></tr>
</table>
</td></tr>
<tr><td>Source Analysis</td><td>The point sources of nutrients into Machado Lake are stormwater discharges from the municipal separate storm sewer system (MS4), California Department of Transportation (Caltrans), and general construction and industrial discharges. Stormwater discharges to Machado Lake occur through the following subdrainage systems: Drain 553, Wilmington Drain, Project 77/510, and Walteria Lake. Discharges from Walteria Lake and Drain 553 are tributary to the Wilmington Drain, which then directly discharges in the northern portion of Machado Lake. Approximately, 88 % of the discharge into the lake enters through the Wilmington Drain.

The major nonpoint source of nutrients to Machado Lake is internal nutrient loading (nutrient flux from sediments). Atmospheric deposition is also a nonpoint source of total nitrogen. Nutrient loads from wind resuspension, bioturbation, birds, and general surface runoff are minor sources. Special studies may be conducted to further evaluate sources.</td></tr>
<tr><td>Linkage Analysis</td><td>The linkage analysis focuses on the relationship between the nutrient loading to the lake and the numeric targets established to measure attainment of beneficial uses. The Nutrient Numeric Endpoints BATHTUB Spreadsheet Model, which was developed by Tetra Tech for US EPA, was used to establish the linkage between nutrient loading to Machado Lake and the predicted water quality response. The model performs water and nutrient balance calculations under steady-state conditions. Eutrophication related water quality conditions are expressed in terms of total phosphorus, ortho-phosphourus, total nitrogen, inorganic nitrogen, chlorophyll a, transparency (Secchi depth), and hypolimnetic oxygen depletion rates. The linkage analysis demonstrates that assigning waste load and load allocations for total nitrogen and total phosphorus will address eutrophication related water quality conditions.</td></tr>
<tr><td>Waste Load Allocations</td><td>Waste load allocations are assigned to urban stormwater dischargers (MS4, Caltrans, general construction and general industrial) in both wet and dry weather. The final waste load allocations are assigned as concentration based allocations of 0.1 mg/L and 1.0 mg/L as monthly averages for total phosphorus and total nitrogen (TKN + NO_3-N + NO_2 –N), respectively.</td></tr>
</table>

TMDL Element	Regulatory Provisions
	Interim WLAs are based on current in-lake concentrations. The effective date interim total nitrogen and total phosphorus waste load allocations are set as the 95th percentile of current concentrations in the lake. The 5 year interim total nitrogen WLAs are established as a 30 percent reduction from current in-lake concentrations. Concentration-based interim and final WLAs will be included in stormwater permits in accordance with NPDES guidance and requirements. The tables below present the interim and final waste load allocations for the stormwater discharges.

Waste Load Allocations	Total Phosphorus	Total Nitrogen ($TKN + NO_3\text{-}N + NO_2\text{-}N$)
	Final WLA (mg/L)	Final WLA (mg/L)
MS4 Permittees[1] Caltrans, General Construction and Industrial stormwater permits	0.1	1.0

1. Municipal Separate Storm Sewer System (MS4) Permittees that are responsible for discharges to Machado Lake include: Los Angeles County, Los Angeles County Flood Control District, and the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance.

Waste Load Allocations	Years After Effective Date	Interim Total Phosphorus WLAs (mg/L)	Interim Total Nitrogen (TKN + NO3-N + NO2-N) WLAs (mg/L)
MS4 Permittees, Caltrans, General Construction and Industrial Stormwater permits	At Effective Date[1]	1.25	3.50
	5[2]	1.25	2.45
	9.5 (Final WLAs[3])	0.10	1.00

[1] The compliance point for all effective date interim WLAs is measured in the lake.
[2] The compliance point for all year 5 interim WLAs is measured as specified in Implementation Plan Section II of Table 7-29.1
[3] The compliance point for all final WLAs is measured as specified in Implementation Plan Section II of Table 7-29-.1

TMDL Element	Regulatory Provisions
Load Allocations	Load allocations are assigned for nonpoint source discharges to the lake, primarily internal loading from the lake. The final load allocations for internal loading are concentration based allocations of 0.1 mg/L and 1.0 mg/L as monthly averages for total phosphorus and total nitrogen (TKN + NO_3-N + NO_2 –N), respectively. Concentration based load allocations are appropriate and can be evaluated by monitoring the nutrient concentrations in the water column. Interim LAs are based on current in-lake concentrations. The effective date interim total nitrogen and phosphorus load allocations are set at the 95th percentile of current concentrations in the lake. The 5 year interim total nitrogen LAs are established as a 30 percent reduction from current in-lake concentrations. The tables below present the final and interim load allocations for the nonpoint sources.

Load Allocations	Total Phosphorus	Total Nitrogen (TKN + NO_3-N + NO_2-N)
	Final LA (mg/L)	Final LA (mg/L)
Internal Nutrient Load (City of Los Angeles Department of Recreation and Parks)	0.1	1.0

Load Allocations	Years After Effective Date	Interim Total Phosphorus LAs (mg/L)	Interim Total Nitrogen (TKN + NO3-N + NO2-N) LAs (mg/L)
Internal Nutrient Load (City of Los Angeles Department of Recreation and Parks)	At Effective Date	1.25	3.50
	5	1.25	2.45
	9.5 (Final LAs)	0.10	1.00

TMDL Element	Regulatory Provisions
Margin of Safety	The uncertainties associated with this TMDL are due to limited data from the stormdrains entering the lake and the inherent seasonal and annual variability in delivery of phosphorus and nitrogen for external sources and nutrient cycling within the lake. To address these uncertainties, conservative numeric targets were selected by establishing the targets under a critical lake volume. Likewise, the waste load and load allocations are based on a constant value for internal loading. Moreover, the lake conditions under which the load capacity was developed were based on dry weather critical conditions when the lake level is

<table>
<tr><th>TMDL Element</th><th>Regulatory Provisions</th></tr>
<tr><td></td><td>reduced and therefore loading capacity is reduced. These conservative approaches provide an implicit margin of safety.</td></tr>
<tr><td>Seasonal Variations and Critical Conditions</td><td>The external nutrient loading to Machado Lake generally occurs during winter and spring months, in conjunction with storm events. During the dry season the lake receives minimal external loading. In the summer there is the release of nutrients from the sediments. At the same time there is very little water inflow and a decreased lake level due to evaporation. These seasonal variations cause increased nutrient concentrations. Moreover, the reduced lake volume during the summer months provides less assimilative capacity. The critical condition for the attainment of beneficial uses at Machado Lake occurs during the summer months. Also, the critical conditions for dissolved oxygen impairments related to algae growth are during the warm dry summer months when algal respiration is highest. The Machado Lake nutrient TMDL accounts for seasonal and critical conditions of the summer months by assigning a load allocation to the lake sediments and requiring a reduction in this source of nutrients to the lake, and by assigning WLAs to urban stormwater dischargers year-round.</td></tr>
<tr><td>Special Studies and Monitoring Plan</td><td><u>Special Studies</u>

Additional monitoring and special studies may be undertaken by dischargers and responsible agencies to evaluate the uncertainties and assumptions made in the development of this TMDL. (The results of special studies may be used to reevaluate waste load allocations and load allocations when the Machado Lake Nutrient TMDL is reconsidered.)

Optional Study #1: Core flux study to estimate the nutrient flux from sediments under equilibrium conditions. Results from this study would be beneficial to gauge the success of implementation measures such as aeration.

Optional Study #2: A study to understand factors such as nitrogen and phosphorus sedimentation rates (particulate settling velocities), the overall lake sedimentation rate, and sediment resuspension rate. These factors would be important for a Machado Lake nutrient budget and gauging the potential need for periodic hydraulic dredging.

Optional Study #3: A work plan for permittees to assess compliance with TMDL WLAs on a mass basis for total nitrogen and total phosphorous. The work plan should detail testing methodologies, BMPs, and treatments to be implemented to attain and demonstrate a reduction of total nitrogen and phosphorous loading on a mass basis. A final report including the results shall be submitted to the Regional Board for Executive Officer approval.

Additional special studies proposed by stakeholders are optional and will be considered at the 7.5 year TMDL reconsideration. All proposed special study work plans and documents shall be submitted to the Regional Board for Executive Officer approval prior to special studies being initiated.</td></tr>
</table>

TMDL Element	Regulatory Provisions
	<u>Monitoring Plan</u> A Monitoring and Reporting Program (MRP) plan to assess compliance with LAs and WLAs measured in lake must be submitted to the Executive Officer for approval within one year of the effective date. Monitoring will begin 60 days after the Executive Officer has approved the monitoring plan. This MRP plan will be required as part of the Lake Water Quality Management Plan as discussed in the Implementation Section. The MRP plan will be designed to monitor and implement this TMDL. The monitoring plan is required to measure the progress of pollutant load reductions and improvements in water quality. The monitoring plan shall ▪ Determine attainment of total phosphorus, total nitrogen, ammonia, dissolved oxygen, and chlorophyll *a* numeric targets. ▪ Determine compliance with the waste load and load allocations for total phosphorus, and total nitrogen. ▪ Monitor the effect of implementation actions on lake water quality Responsible jurisdictions shall be required to begin monitoring sixty days after the Executive Officer approves the MRP. Field samples and water samples shall be collected bi-weekly on a year-round basis. The lake sampling sites will be located in the open water portion of the lake with one in the northern portion and one in the southern portion of the lake. *In situ* measurements of water quality shall be made. The water quality probes will be calibrated immediately prior to departure to the field against known pH, EC, and DO solutions. Secchi depth, a measurement of transparency, will also be measured with a standard Secchi disk or other approved method. Additionally, a staff gauge shall be placed in an appropriate location at the lake to measure changes in lake elevation. The monitoring plan shall consider stratification for the collection of water samples. Water samples shall be analyzed for constituents including but not limited to the following. ▪ Total nitrogen ▪ Total phosphorus ▪ Nitrate (NO_3-N) ▪ Total ammonia (NH_3-N) ▪ Ortho-phosphorus (PO_4) ▪ Total Dissolved Solids ▪ Total Suspended Solids ▪ Chlorophyll a ▪ Turbidity

TMDL Element	Regulatory Provisions
	Detection limits shall be less than the numeric targets in this TMDL. A monitoring report shall be prepared and submitted to the Regional Board annually within six months after the completion of the final sampling event of the year. If an alternative WLA compliance option is selected, an appropriate separate TMDL compliance MRP Plan and TMDL Implementation Plan must be submitted for Executive Officer approval. Annual monitoring reports demonstrating compliance or non-compliance with WLAs shall be submitted for Executive Officer approval. All compliance monitoring must be conducted in conjunction with a Regional Board approved Quality Assurance Project Plan (QAPP). The QAPP shall include protocols for sample collection, standard analytical procedures, and laboratory certification.

TMDL Element	Regulatory Provisions
Implementation Plan	Compliance with the TMDL is based on the assigned WLAs and LAs. Compliance with this TMDL will require the implementation of NPDES stormwater permit limits and lake management activities to reduce nutrient loading to the lake, reduce nutrient concentrations in the lake, prevent excessive algal biomass growth, and maintain an adequate dissolved oxygen concentration. Table 7-29.2 contains a schedule for responsible jurisdictions to implement BMPs and a Lake Water Quality Management Plan to comply with the TMDL. I. Implementation and Determination of Compliance with LAs Compliance with the LAs will be measured in the lake and will be achieved through a combination of implementation of lake management projects and BMPs to reduce external and internal nutrient loading to the lake and to reduce and manage internal nutrient sources. Load allocations will be implemented through the following: (1) Memorandum of Agreement (MOA), or (2) Clean Up and Abatement Order or Other Regulatory Order The responsible jurisdictions for the load allocations shall be allowed one year from the effective date of this TMDL to enter into a Memorandum of Agreement (MOA) with the Executive Officer, detailing the voluntary efforts that will be undertaken to attain the load allocations. The MOA shall comply with the <u>Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options</u> ("Policy"), including part II, section 2 c ii and related provisions, and shall be consistent the requirements of this TMDL. If the MOA is timely adopted, and so long as it is implemented, the program described in the MOA shall be deemed "certified", pursuant to the Policy, subject to the conditions of Policy section 2 e. The MOA shall include development of a Lake Water Quality Management Plan (LWQMP), must be approved by the Executive Officer, and may be amended with Executive Officer approval, as necessary. If a MOA is not established with responsible jurisdictions within one year or if responsible jurisdictions do not comply with the terms of the MOA, a cleanup and abatement order pursuant to Water Code section 13304, or another appropriate regulatory order, shall be issued to implement the load allocations. Furthermore, the implementation of the MOA must result in attainment of the TMDL load allocations. If the MOA and LWQMP are not implemented or otherwise do not result in attainment of load allocations, the certification shall be revoked, the MOA rescinded, and the load allocations shall be implemented through a cleanup and abatement order, or other order, as described above. Implementation of the MOA shall be reviewed annually by the Executive Officer as part of the Monitoring and Reporting Program (MRP) annual reports. To the satisfaction of the Executive Officer the LWQMP shall meet the following criteria:

TMDL Element	Regulatory Provisions
	■ One and one half years from the effective date of the TMDL responsible jurisdictions shall submit a LWQMP, MRP Plan and QAPP for approval by the Executive Officer. ■ The LWQMP shall include a list of cooperating parties. ■ The LWQMP shall address appropriate water quality monitoring and a timeline for the implementation of management practices to reduce and manage nutrient loading to the lake. The timeline shall ensure that the implementation actions are underway prior to Regional Board reconsideration of the TMDL. The LWQMP shall present a comprehensive management plan and strategy for achieving the LAs at Machado Lake and attaining numeric targets and beneficial uses. The LWQMP shall include a schedule for implementation actions. ■ The LWQMP shall achieve compliance with the load allocations through the implementation of lake management strategies to reduce and manage internal nutrient sources. The lake management implementation actions may include, but are not limited to the following: ■ Wetland restoration ■ Aeration system ■ Hydraulic Lake dredging ■ Hydroponic Islands ■ Alum treatment ■ Fisheries Management ■ Macrophyte Management and Harvesting ■ Maintain Lake Level – Supplemental Water ■ The LWQMP shall include a MRP Plan. The MRP shall include a requirement that the responsible jurisdictions report compliance and non-compliance with load allocations as part of annual reports submitted to the Regional Board. Compliance with the load allocations shall be measured in the lake at two locations, one in the north portion and one in the south. The average of these two sampling locations shall determine compliance with the load allocations. MRP protocols may be based on Surface Water Ambient Monitoring Program (SWAMP) protocols for water quality monitoring or alternative protocols proposed by dischargers and approved by the Executive Officer. ■ A QAPP shall also be submitted to the Regional Board for approval by the Executive Officer to ensure data quality. The QAPP shall include protocols for sample collection, standard analytical procedures, and laboratory certification. The QAPP may be based on SWAMP protocols for water quality monitoring and quality assurance or alternative protocols proposed by dischargers and approved by the Executive Officer.

TMDL Element	Regulatory Provisions
	■ The MOA and LWQMP program shall include assurances that it will be implemented by the responsible jurisdiction. ■ Implementation of the LWQMP program should include a Health and Safety Plan to protect personnel. The Executive Officer may require a revised assessment under the MOA and LWQMP: (a) To prevent nutrients from accumulating or recycling in the lake in deleterious amounts that impair water quality, contribute to negative eutrophic conditions or adversely affect beneficial uses; (b) To reflect the results of nutrient assessment or special studies Cleanup and Abatement Order or Other Regulatory Order: Alternatively, responsible jurisdictions may propose, or the Regional Board may impose, an alternative program which would be implemented through a cleanup and abatement order, or any other appropriate order or orders, provided the program is consistent with the allocations, reductions, and schedule described in Table 7-29.2. ❖ Determination of Compliance with Interim LAs Responsible parties shall comply with numeric interim LAs or may be deemed in compliance with the interim LAs through implementation of lake sediment removal and/or lake management implementation actions in accordance with the LWQMP schedule as approved by the Regional Board Executive Officer. II. Implementation and Determination of Compliance with WLAs WLAs will be incorporated into NPDES stormwater permits. Stormwater permittees may be deemed in compliance with waste load allocations by actively participating in a LWQMP and attaining the waste load allocations for Machado Lake. Stormwater permittees and the responsible party for the lake may work together to implement the LWQMP and reduce external nutrient loading to attain the TMDL waste load allocations measured in the lake. Alternatively, MS4 Permittees may be deemed in compliance with waste load allocations by demonstrating reduction of total nitrogen and total phosphorous on an annual mass basis measured at the stormdrain outfall of the permittee's drainage area. The annual mass based allocation shall be equal to a monthly average concentration of 0.1 mg/L TP and 1.0 mg/L TN based on approved flow conditions. Permittees must demonstrate total nitrogen and total phosphorous load reductions to be achieved in accordance with a special study workplan approved by the Executive Officer. Compliance may also be demonstrated as concentration based monthly averages

TMDL Element	Regulatory Provisions
	for TP and TN measured at the stormdrain outfall of the permittee's drainage area. MS4 Permittees shall be required to develop and implement a MRP plan and TMDL Implementation Plan. The MRP plan shall include a requirement that the responsible jurisdictions report compliance and non-compliance with waste load allocations as part of annual reports submitted to the Regional Board. ❖ Determination of Compliance with Interim WLAs Responsible parties may comply with the numeric interim WLAs or may be deemed in compliance with the interim WLAs through implementation of external nutrient source reduction projects in accordance with the TMDL Implementation Plan schedule as approved by the Regional Board Executive Officer. The Regional Board may revise these WLAs and the compliance point based on the collection of additional information developed through special studies or monitoring conducted as part of this TMDL. The Regional Board will reconsider the TMDL at 7.5 years from the effective date based on water quality monitoring and special studies.

TMDL Element	Regulatory Provisions

	III. APPLICATION OF ALLOCATIONS TO RESPONSIBLE JURISDICTIONS
	
	Responsible jurisdictions to attain WLAs for this TMDL include but are not limited to:
	• Caltrans
	• General Stormwater Permit Enrollees
	• MS4 Permittees including:
	  ➢ Los Angeles County
	  ➢ Los Angeles County Flood Control District
	  ➢ Cities of Carson,
	  ➢ City of Lomita,
	  ➢ City of Los Angeles,
	  ➢ City of Palos Verdes Estates,
	  ➢ City of Rancho Palos Verdes,
	  ➢ City of Redondo Beach,
	  ➢ City of Rolling Hills,
	  ➢ City of Rolling Hills Estates,
	  ➢ City of Torrance.
	
	The City of Los Angeles, Department of Recreation and Parks is responsible jurisdiction to implement the assigned Load Allocations for this TMDL.

Table 7-29.2 Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL: Implementation Schedule

Task Number	Task	Responsible Jurisdiction	Date
1	Effective date interim waste load (WLA) and load allocations (LA) for total nitrogen and total phosphorus apply.	California Department of Transportation (Caltrans), Municipal Separate Storm Sewer System Permittees[4] (MS4 Permittees), City of Los Angeles – Department of Recreation and Parks	Effective Date of TMDL
2	Responsible jurisdictions shall enter into a Memorandum of Agreement (MOA) with the Regional Board to implement the load allocations.	City of Los Angeles – Department of Recreation and Parks	1 year from effective date of TMDL
3	Regional Board staff shall begin development of a Clean Up and Abatement Order or other regulatory order to implement the load allocations if an MOA is not established with responsible jurisdictions.	Regional Board Staff	1 year from effective date of TMDL
4	Clean Up and Abatement Order or other regulatory order adopted by the Regional Board if an MOA is not established with responsible jurisdictions. The Clean Up and Abatement Order or other regulatory order shall reflect the TMDL Implementation Schedule.	Regional Board Staff	1.5 years from effective date of TMDL
5	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall submit a Monitoring and Reporting Program (MRP) Plan to the Executive Officer for approval.	Caltrans, MS4 Permittees	One year from effective date of TMDL
6	Responsible jurisdictions shall submit a Lake Water Quality Management Plan, MRP Plan and Quality Assurance Project Plan for approval by the Executive Officer to comply with MOA.	City of Los Angeles – Department of Recreation and Parks	1.5 years from effective date of TMDL
7	Responsible jurisdictions shall submit a work plan for optional special study #3 (if responsible jurisdictions choose to conduct this special study) for approval by the Executive Officer.	Caltrans, MS4 Permittees	One year from effective date of TMDL

[4] Municipal Separate Storm Sewer System (MS4) Permittees that are responsible for discharges to Machado Lake include: Los Angeles County, Los Angeles County Flood Control District, and the Cities of Carson, Lomita, Los Angeles, Palos Verdes Estates, Rancho Palos Verdes, Redondo Beach, Rolling Hills, Rolling Hills Estates, and Torrance.

Task Number	Task	Responsible Jurisdiction	Date
8	Responsible jurisdictions shall submit work plans for optional special studies #1 and #2 (if responsible jurisdictions choose to conduct special studies) for approval by the Executive Officer.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	1.5 years from effective date of TMDL
9	Responsible jurisdictions shall begin monitoring as outlined in the approved MRP plan.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	Sixty days from date of MRP Plan approval
10	Responsible jurisdictions shall begin implementation of Lake Water Quality Management Plan.	City of Los Angeles – Department of Recreation and Parks	Sixty days from date of Lake Water Quality Management Plan approval
11	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall submit a TMDL Implementation Plan including BMPs to address discharges from storm drains.	Caltrans, MS4 Permittees	Two years from effective date of TMDL
12	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall begin implementation of BMPs to address discharges from stormdrains	Caltrans, MS4 Permittees	Sixty days from date of Implementation Plan approval
13	Responsible jurisdictions shall submit annual monitoring reports. The monitoring reports shall include a requirement that the responsible jurisdictions demonstrate compliance with the MOA. If the MOA and Lake Water Quality Management Plan are not implemented or otherwise do not result in attainment of load allocations, the Regional Board shall revoke the MOA and the load allocations shall be implemented through a Clean Up and Abatement Order or other regulatory order.	City of Los Angeles – Department of Recreation and Parks	Annually – from date of Lake Water Quality Management Plan approval
14	Responsible jurisdictions whose compliance is determined as concentration based WLAs measured at end of pipe shall submit annual monitoring reports.	Caltrans, MS4 Permittees	Annually – from date of MPR Plan approval
15	Optional Special Study #3 completed and final report submitted for Executive Officer approval.	Caltrans, MS4 Permittees	Within 2.5 years of effective date of TMDL

Task Number	Task	Responsible Jurisdiction	Date
16	Responsible jurisdictions shall submit a MRP Plan and TMDL Implementation Plan for the alternative mass based WLA compliance option (if selected), to the Executive Officer for approval.	Caltrans, MS4 Permittees	Within 2.5 years of effective date of TMDL
17	Responsible jurisdictions shall begin monitoring and implementing projects/programs as outlined in the approved MRP and TMDL Implementation Plan for the alternative mass based WLA compliance option.	Caltrans, MS4 Permittees	Sixty days from date of MRP/ Implementation Plan approval
18	Responsible jurisdictions whose compliance is determined as mass based WLAs measured at end of pipe shall submit annual monitoring reports.	Caltrans, MS4 Permittees	Annually – from date of MPR/ Implementation Plan approval
19	Optional Special Studies completed and Special Study final reports submitted for Executive Officer approval.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	Within 6 years of effective date of TMDL
20	Regional Board staff and responsible jurisdictions will present an Information Item to the Regional Board on the progress of TMDL implementation efforts and compliance with implementation schedules.	Regional Board staff and responsible jurisdictions	4 years from effective date of TMDL
21	5 Year interim total nitrogen WLA and LA apply.	Caltrans, MS4 permittees, City of Los Angeles – Department Recreation and Parks	Within 5 years of effective date of TMDL
22	Regional Board will reconsider the TMDL to include results of optional special studies and water quality monitoring data completed by the responsible jurisdictions and revise numeric targets, WLAs, LAs, and the implementation schedule as needed.	Regional Board	7.5 years from effective date of TMDL
23	Responsible jurisdictions shall achieve Final WLAs and LAs for total nitrogen (including ammonia) and total phosphorus and demonstrate attainment of numeric targets for total nitrogen, ammonia, total phosphorus, dissolved oxygen, and chlorophyll a. Responsible parties shall demonstrate attainment of water quality standards for total nitrogen, ammonia, total phosphorus, dissolved oxygen, and biostimulatory substances in accordance with federal regulations and state policy on water quality control.	Caltrans, MS4 Permittees, City of Los Angeles – Department of Recreation and Parks	Within 9.5 years of effective date of TMDL