Chapter Four

Recycled Water

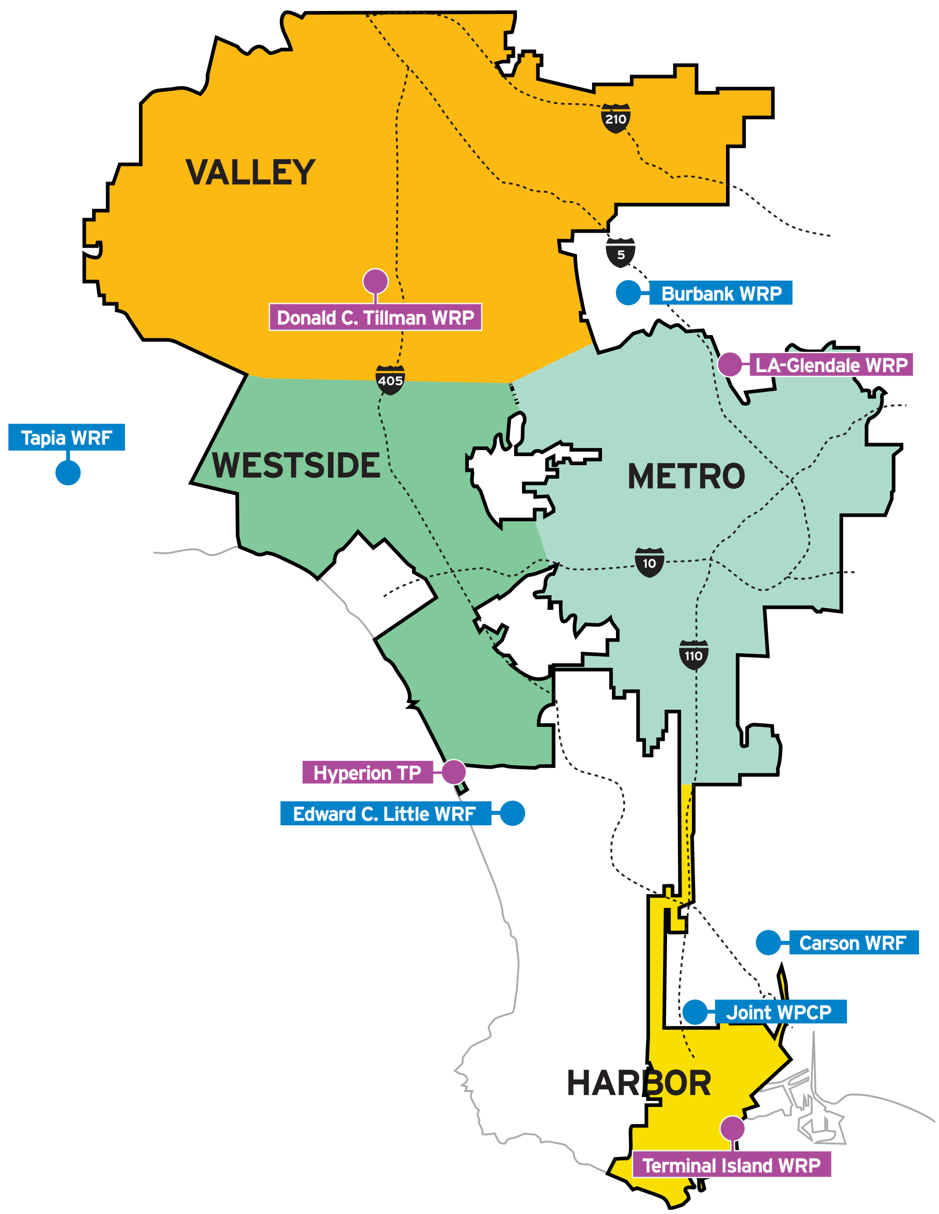
4.0 Overview

LADWP is committed to significant expansion of recycled water in the City's water supply portfolio. In response to multiple factors that are decreasing the reliability of imported water supplies and the ongoing drought, Mayor Eric Garcetti released Executive Directive No. 5 (ED5) on October 14, 2014 and the Sustainable City pLAn (pLAn) on April 8, 2015. ED5 established the goal of reducing purchased imported potable water use by 50 percent by 2024. The pLAn extends the purchased imported potable water use reduction goal to 2025 and sets an additional goal of increasing local water sources to 50 percent by 2035. Expansion of recycled water use to offset potable demands has been recognized as one method that will help achieve these goals. Concurrently, the pLAn document establishes specific goals for recycled water use as described in Section 1.2.2 of this UWMP. In order to meet these goals, LADWP is working in conjunction with the Los Angeles Department of Public Works Bureau of Sanitation (LASAN) and Bureau of Engineering (BOE), to develop non-potable reuse projects for irrigation and industrial uses. In addition, the City is pursuing a groundwater replenishment (GWR) project to replenish the San Fernando Groundwater Basin with highly treated recycled water. Additional opportunities to further expand the City's recycled water use over the long-term are also being studied.

LADWP's water recycling program is dependent on the City's wastewater treatment infrastructure and wastewater treatment facilities located within and outside of the City's boundaries. Wastewater in the City of Los Angeles is collected and transported through approximately 6,500 miles of major interceptors and mainline sewers, more than 11,000 miles of house sewer connections, 46 pumping plants, and four wastewater treatment plants. LASAN is responsible for the planning and operation of the City's wastewater treatment infrastructure and wastewater treatment facilities. The City's wastewater system serves 573 square miles, 456 square miles of which are within the City. Wastewater service is also provided to 29 non-City agencies through contract services. The treated effluent from the City's four wastewater plants is utilized by LADWP to meet recycled water demands both inside and outside the City.

LADWP's water recycling program also utilizes wastewater facilities located outside of the City. Currently, the Hyperion Water Reclamation Plant (HWRP) serves a portion of its secondary treated wastewater to West Basin Municipal Water District's (WBMWD) Edward C. Little Water Recycling Facility (ECLWRF) where it undergoes further treatment in order to meet recycled water standards. A portion of the product water from the ECLWRF is returned to LADWP to meet the City's recycled water needs. Upon completion of currently planned recycled water projects, LADWP will enter into agreements with neighboring agencies to obtain recycled water from their wastewater treatment plants for use in LADWP's service area. These facilities and respective agencies include: Carson Regional Water Recycling Facility (Carson Facility) operated by WBMWD, Burbank Water Reclamation Plant (BWRP) operated by the City of Burbank Department of Public Works, and Tapia Water Reclamation Facility (TWRF) operated by Las Virgenes Municipal Water District (LVMWD). The Joint Water Pollution Control Plant (JWPCP), operated by Sanitation Districts of Los Angeles County, is being evaluated in partnership with the Metropolitan Water District of Southern California to become a water reclamation plant, which will become a future source of recycled water for the City. Exhibit 4A shows the City's four recycled water service areas in relation to the City's four wastewater treatment plants (purple) and existing and future sources of recycled water located outside of the LADWP service area (blue).

Exhibit 4A
Wastewater Treatment Plants and Existing and Future Sources of Recycled Water for LADWP Service Area



As early as 1960, the City recognized the potential for water recycling and invested in infrastructure that produced water of tertiary quality, a high treatment standard for wastewater. These investments resulted in the construction of tertiary wastewater treatment plants (Donald C. Tillman WRP, LA-Glendale WRP) instead of enlarging the two existing terminus treatment plants (Hyperion WRP, Terminal Island WRP). These system enhancements facilitated the City's expanded use of recycled water, which now offset a significant amount of imported water supplies. The original policy allowing the use of recycled water was ultimately adopted by the State Legislature in 1969.

In 1979, LADWP began delivering tertiary quality recycled water to the Department of Recreation and Parks for irrigation of various areas in Griffith Park. This service was later expanded to include Griffith Park's golf courses. In 1984, freeway landscaping adjacent to the park began to be irrigated with recycled water. When the Donald C. Tillman Water Reclamation Plant (DCTWRP) came online in 1985, the City created the Japanese Garden, Lake Balboa, and the wildlife lake in the Sepulveda Basin as environmental mitigation. The Greenbelt Project, which carries recycled water from the Los Angeles-Glendale Water Reclamation Plant (LAGWRP) to Forest Lawn Memorial Park, Mount Sinai Memorial Park, Lakeside Golf Club of Hollywood and Universal Studios, began operating in 1992, and was LADWP's first project to supply recycled water to non-governmental customers. LADWP continues to expand the use of recycled water to various customers. In 2009, Phase 1 of the Playa Vista development began receiving recycled water. Playa Vista is the first planned development in the City that uses recycled water for all landscape needs. LADWP serves approximately 48 locations in the City with recycled water for irrigation, industrial, and environmental beneficial uses. There are approximately 200 individual customer service accounts, with several projects containing multiple customer accounts at a single location. Future recycled water projects will continue to build on the successful implementation of these prior projects so that recycled water becomes a more prominent component of the City's water supply portfolio.

The City's water recycling program seeks to displace the use of potable water with recycled water for non-potable uses where infrastructure is available. In compliance with the California Water Code Section 13550-13557 recycled water served by LADWP meets all of the following conditions:

- The source of recycled water is of adequate quality for these non-potable uses.
- The recycled water may be furnished for these uses at a reasonable cost to the user.
- The use of recycled water from the proposed source will not be detrimental to public health.
- The use of recycled water will not adversely affect downstream water rights or degrade water quality.

In addition, the California Water Code mandates that public agencies, such as the LADWP, serve recycled water for non-potable uses if suitable recycled water is available.

LADWP is expanding irrigation and industrial/commercial uses of recycled water. LADWP is also planning to implement a GWR project utilizing highly treated recycled water to recharge the San Fernando Groundwater Basin. Demand for recycled water has expanded as customer acceptance of recycled water as a viable economical alternative to traditional potable supplies has increased. Outreach efforts designed to inform the public on the viability of recycled water and its potential uses are an essential part of the process as the City's recycled water program expands.

4.1 Regulatory Requirements

Recycled water use is governed by regulations at the State and local levels. These regulations are based on multiple factors including the type of use and the quality of the recycled water. LADWP currently provides recycled water for non-potable uses and is pursuing indirect potable reuse through a GWR project. Requirements for non-potable and indirect potable categories of recycled water use are different. This section provides a summary of non-potable and indirect potable recycled water regulations.

4.1.1 Non-Potable Reuse Regulations

Non-potable water reuse regulations in the City of Los Angeles are governed by the State Water Resources Control Board (SWRCB), Los Angeles Regional Water Quality Control Board (LARWQCB), and the Los Angeles County Department of Public Health (LACDPH). The SWRCB Division of Drinking Water (DDW), previously under the jurisdiction of the California Department of Public Health, was transferred to the SWRCB on July 1, 2014.

State Water Resources Control Board (SWRCB) and Los Angeles Regional Water Quality Control Board (RWQCB)

Criteria and guidelines for the production and use of recycled water were established by the SWRCB in the California Code of Regulations, Title 22, Division 4, and Chapter 3 (Title 22), updated June 14, 2014. Title 22, also known as the Uniform Statewide Recycling Criteria, establishes required wastewater treatment levels and recycled water quality levels dependent upon the end use of the recycled water. Title 22 additionally establishes recycled water reliability criteria to protect public health.

Title 22 specifies recycled water use restrictions based on the potential degree of public exposure to the water and the distance of drinking water wells and edible crops from the area of intended use. Recycled water use applicability also depends on the different levels of treatment. A higher quality water will have a wider variety of applicable uses than a lower quality water. At a minimum, secondary treatment of wastewater is required for recycled water use. In Los Angeles, however, all recycled water used is treated, at a minimum, to tertiary levels with additional disinfection. Title 22 allows for other treatment methods, subject to SWRCB approval. The reliability of the treatment process and the quality of the product water must meet Title 22 requirements specified for each allowable treatment level. Wastewater treatment levels are discussed in detail in subsection 4.2 of this chapter. Exhibit 4B provides a summary of the currently approved recycled water uses.

Exhibit 4B
Allowable Title 22 Recycled Water Uses

Irrigation Uses
Food crops where recycled water contacts the edible portion of the crop, including all root crops
Parks and playgrounds
School yards
Residential landscaping
Unrestricted access golf courses
Any other irrigation uses not prohibited by other provisions of the California Code of Regulations

Food crops, surface irrigated, above ground edible portion, and not contacted by recycled water
Cemeteries
Freeway landscaping
Restricted access golf course
Ornamental nursery stock and sod farms where no recycled water use occurs 14 days prior to harvesting , retail sale, or access by the public
Pasture for milk animals for human consumption
Non edible vegetation with access control to prevent use as park, playground or school yard
Orchards with no contact between edible portion and recycled water
Vineyards with no contact between edible portion and recycled water
Non-food bearing trees, including Christmas trees not irrigated less than 14 days before harvest
Fodder and fiber crops and pasture for animals not producing milk for human consumption
Seed crops not eaten by humans
Food crops undergoing commercial pathogen destroying processing before consumption by humans
Supply for Impoundment Uses
Non restricted recreational impoundments, with supplemental monitoring for pathogenic organisms in lieu of conventional treatment
Restricted recreational impoundments and publicly accessible fish hatcheries
Landscape impoundments without decorative fountains
Supply for cooling or air conditioning
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative
condenser, or spraying that creates a mist
Other Uses
Dual plumbing systems (flushing toilets and urinals)
Priming drain traps
Industrial process water that may contact workers
Structural fire fighting
Decorative fountains
Commercial laundries
Consolidation of backfill material around potable water pipelines
Artificial snow making for commercial outdoor uses
Commercial car washes, not heating the water, excluding the general public from washing process
Industrial process water that will not come into contact with workers
Industrial boiler feed
Nonstructural fire fighting
Backfill consolidation around non potable piping
Soil compaction
Mixing concrete
Dust control on road and streets
Cleaning roads, sidewalks and outdoor work areas
Flushing sanitary sewer
Groundwater recharge

Sites where recycled water is used must meet regulatory requirements. Title 22 stipulates use area requirements to protect public health. Use area regulations include requirements addressing recycled water application methods, and requirements addressing runoff near domestic water supply wells, drinking fountains, and residential areas. Other requirements include posting signs notifying the public where recycled water is being used, utilization of quick couplers instead of hose bibs, and the prohibition against connecting recycled water systems with potable water systems. Dual-plumbed recycled water systems in buildings are also addressed. These systems must meet additional reporting and testing requirements.

To protect public health, Title 22 requires reliability mechanisms. During the design phase, a Title 22 Engineering Report is required to be submitted to SWRCB and the local Regional Water Quality Control Board (RWQCB) for approval. Contents of the report include a description of the system and an explanation regarding how the system will comply with Title 22 requirements. Redundancy in treatment units or other means to treat, store, or dispose of recycled water are required in case the treatment unit is not operating within specified parameters. Alarms for operators are required to indicate treatment plant process failures or power failures. In case of power failures, either back-up power, automatically activated short-term or long-term recycled water storage, or a means of recycled water disposal is required. Furthermore, system performance must be monitored by water quality sampling and analyses. The SWRCB continues to develop regulations and guidance for recycled water use. Future regulations regarding the augmentation of surface water with recycled water are currently under development. These regulations are required to be adopted by December 31, 2016. By this time, the SWRCB must also report to the Legislature regarding the feasibility of developing uniform criteria for direct potable use of recycled water.

As mentioned previously, cross-connections between the potable and recycled water systems are not permitted. The California Code of Regulations, Title 17, Division 1, Chapter 5, Group 4, updated June 18, 2014, was developed to prohibit cross-connections between potable water supply systems and recycled water supply systems. Title 17 requires water suppliers to implement both cross-connection control programs and backflow prevention systems. Draft regulations for Cross Connection Control, first released in 2005, are now in the process of being further revised by the SWRCB. In addition to Title 22 and Title 17 requirements, SWRCB has additional regulations and guidance established in the following documents:

- Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water (2001)
- Draft Analysis and Reporting of Non-Target Volatile Organic Compounds (2003)
- Draft Analysis and Reporting of Non-Target Semi-Volatile Organic Compounds (2003)
- Guidance Memo No. 2003-02: Guidance for the Separation of Water Mains and Non-Potable Pipelines (2003)
- Alternative Treatment Technology for Recycled Water (2014)

In May 2009, the SWRCB adopted the "Recycled Water Policy" developing uniform standards across all RWQCB's for interpreting the "Anti-Degradation Policy". In 2013 the "Recycled Water Policy" was amended to reduce priority pollutant monitoring for landscape irrigation using recycled water and established requirements for monitoring constituents of emerging concern and their surrogates when recycled water is utilized for groundwater recharge. When planning and implementing recycled water projects the following must be taken into consideration:

- Benefits of recycled water – use of recycled water when sufficiently treated to not adversely impact human health and the environment has a beneficial impact, especially when recycled water substitutes for potable water use.

- Mandate for recycled water use – encourages recycled water use and establishes targets to increase use.

- Salt/nutrient management plans – requires submittal of salt/nutrient management plans by 2016 or an anti-degradation analysis will be required.

- Landscape irrigation projects' control of incidental runoff and streamlined permitting – addresses controlling incidental runoff and streamlining permit processes for recycled water use in landscape areas.

- Groundwater replenishment – establishes requirements for groundwater replenishment projects, including review on a project-by-project basis.

- Anti-degradation – establishes that salt and nutrient management plans can address groundwater quality impacts.

- Constituents of emerging concern – a blue-ribbon advisory panel developed a report on constituents of emerging concern leading to the latest "Recycled Water Policy" amendment; the report will be updated by the panel every five years.

- Incentives for recycled water – establishes that priority funding may be available for projects with major recycling components; waste load allocations will be assigned for municipal wastewater sources to provides an incentive for recycling; and allows less stringent monitoring for stormwater treatment and reuse projects than projects with untreated stormwater discharges.

Water recycling requirements for each of the City's applicable wastewater treatment plants engaged in water recycling are issued by the LARWQCB. These requirements specify end-users of recycled water and enforce treatment and use area requirements.

In July 2009, the SWRCB adopted a general landscape irrigation permit, "General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water" (General Permit). The General Permit streamlines the regulatory approval for landscape irrigation using recycled water. Agencies with existing water recycling requirements, such as the City, are not required to apply for the General Landscape Irrigation Permit.

Earlier in April 2009, the LARWQCB adopted a general region-wide permit, "General Waste Discharge and Water Recycling Requirements for Non-Irrigation Uses over the Groundwater Basins Underlying the Coastal Watersheds of Los Angeles and Ventura Counties" for non-irrigation uses of recycled water. Similar to the General Permit, this permit streamlines the permitting process and specifies the application process for qualifying projects.

Los Angeles County Department of Public Health (LACDPH)

Title 22 and Title 17 water use regulations are enforced by the LACDPH, Environmental Health Division. LACDPH has published "A Guide to Safe Recycled Water Use, Pipeline Construction and Installation" requiring compliance with Title 22, SWRCB, and LARWQCB requirements. After SWRCB has approved the plans and specifications and the City has an agreement to serve the customer, LACDPH reviews and approves all plans and specifications prior to construction. After construction LACDPH inspects the systems and conducts cross-connection, pressure, and back-flow prevention device tests. Recycled water use must be in compliance with the Los Angeles County Recycled Water Advisory Committee's "Recycled Water Urban Irrigation User's Manual". Each site must also have a site supervisor responsible for recycled water use.

City of Los Angeles

Recycled water responsibilities of the City of Los Angeles include complying with all LARWQCB permits for the wastewater treatment plants and production of recycled water, approving recycled water use sites, conducting post-construction inspections, and periodically inspecting use areas and site supervisor records.

LADWP customers are permitted to use recycled water when service is available per LADWP Ordinance No. 170435 (subsequently amended by Ordinance No. 182047 in 2012). Customers expressing interest in recycled water deliveries must enter into an agreement with LADWP, subject to approval of the Board of Water and Power Commissioners. Users are responsible for the operation and maintenance of their recycled water systems up to the connection point with LADWP. Users are required to use recycled water in accordance with Titles 22 and 17 and the "Recycled Water Urban Irrigation User's Manual". If the users fail to follow these regulations, LADWP may cease delivery of recycled water.

4.1.2 Indirect Potable Reuse (IPR) Regulatory Requirements

Regulations governing IPR and GWR are established by the DDW and LARWQCB under the SWRCB. The City's GWR project as described in section 4.4.2 will be subject to these regulations.

For GWR, the City is planning to implement a spreading project that may include the following treatment technologies: microfiltration, reverse osmosis, ozone, biological activated carbon, and/or advanced oxidation. Pilot projects are being conducted to determine the most cost-effective treatment strategy that will help the City maximize groundwater replenishment with recycled water.

Regulatory oversight of IPR projects is provided by the DDW and LARWQCB. The DDW regulates IPR projects under Title 22, making recommendations on a case-by-case basis to the LARWQCB after a public hearing. Title 22 was amended on June 18, 2014 to include requirements for groundwater replenishment with recycled water. Regulations are provided for both subsurface and surface applications of recycled water. As previously stated for non-potable reuse, Title 22 regulations are designed to protect public health.

IPR projects are approved on a case-by-case basis by the LARWQCB. As part of the application process, a Title 22 Engineering Report must be submitted. Specific requirements of the Engineering Report are provided in Title 22. Prior to project review and before the DDW submits their recommendations to the LARWQCB, the project sponsor must hold a public hearing. A public hearing must also be held if a project sponsor wants to increase the use of recycled water recharge beyond the approved permit limits. After the public hearing, the LARWQCB reviews the recommendations by DDW with considerations of the provisions in Title 22, and the adopted Los Angeles Basin Plan for the LARWQCB region, applicable State policies (including the DDW Recycled Water Policy), and applicable federal regulations if recycled water is discharged to "Waters of the U.S.". The Basin Plan establishes water quality objectives for surface water and groundwater to protect beneficial uses.

Prior to operation of an IPR project, the sponsor must prepare an Operation Optimization Plan for review and approval by the DDW and LARWQCB. The plan describes the operations of the project, specifies how the project will meet minimum standards and ongoing monitoring requirements in Title 22, maintenance procedures, analytical methods to be used, and describes how results will be reported to the DDW and LARWQCB.

4.2 Sources of Recycled Water

Recycled water production relies on treated wastewater obtained from the City's wastewater treatment plants and in the future will include wastewater treatment plants operated by neighboring agencies. There are four wastewater treatment plants owned and operated by LASAN. City wastewater treatment consists of a series of processes that, at a minimum, remove solids to a level sufficient to meet regulatory water quality standards. During the preliminary, primary, secondary, and tertiary treatment processes, progressively finer solid particles are removed. Preliminary treatment removes grit and large particles through grit removal basins and screening. Primary treatment relies on sedimentation to remove smaller solids. With most of the grit, large particles, and solids already removed, secondary treatment converts organic matter into harmless by-products and removes more solids through biological treatment and further sedimentation. At the end of secondary treatment, most solids will have been removed from the water. Tertiary treatment follows secondary treatment to eliminate the remaining impurities through filtration and chemical disinfection. At this stage, sodium hypochlorite (the chemical contained in household bleach) provides disinfection.

All recycled water used within the City undergoes, at a minimum, tertiary treatment and disinfection. In West Los Angeles, recycled water produced via WBMWD's ECLWRF provides varying levels of advanced treatment based on customer needs including reverse osmosis (RO), microfiltration/reverse osmosis (MF/RO), and double pass RO. MF/RO is a two-stage process using high-pressure membrane filters to remove microscopic impurities from the source water. Double pass RO involves passing the water through a reverse osmosis system twice to produce highly purified water.

Exhibit 4C summarizes the treatment levels, capacity, and FY 2014/15 wastewater flows at the four City plants and the four plants outside the City. Among the plants outside the City, the ECLWRF uses treated wastewater from HWRP, with a portion of ECLWRF's tertiary treated effluent going to the Carson Facility for further treatment. The other three facilities treat wastewater generated outside the City.

Exhibit 4C
Sources of Recycled Water Summary

Sources of Recycled Water	Wastewater Collection/ Treatment Agency	Treatment Level(s)	Wastewater Treatment Capacity (AF)	Treated Wastewater FY 14/15[6] (AF)	Recycled Water Served to LA FY 14/15[6] (AF)	In-plant/ RW Served Outside LA FY 14/15 (AF)	Discharged Treated Wastewater FY 14/15 (AF)
Located within City of Los Angeles							
Donald C. Tillman Water Reclamation Plant (DCTWRP)[1]	LA Department of Public Works - LASAN	Tertiary to Title 22 Standards with Nitrification/ De-nitrification	89,600	38,000	28,200	3,400	6,400

Los Angeles - Glendale Water Reclamation Plant (LAGWRP)[1]	LA Department of Public Works - LASAN	Tertiary to Title 22 Standards with Nitrification/ De-nitrification	22,400	16,000	2,500	2,500[2]	11,000
Terminal Island Water Reclamation Plant (TIWRP)[1]	LA Department of Public Works - LASAN	Tertiary, Title 22 Standards with Advanced Treatment of 6 mgd MF/RO	33,600	18,000	4,300	1,200	12,500
Hyperion Water Reclamation Plant (HWRP)[1]	LA Department of Public Works - LASAN	Secondary	504,000	294,000	0	50,500[3]	243,500
Located Outside City of Los Angeles							
Edward C. Little Water Recycling Facility (ECLWRF)[1,5]	WBMWD	Tertiary to Title 22 Standards; RO; MF/RO; MF with double-pass RO	N/A	N/A	900	37,400	N/A
Carson Regional Water Recycling Facility (Carson Facility)[1,4,5]	WBMWD	MF/RO/ Nitrification	N/A	N/A	0	6,720	N/A
Burbank Water Reclamation Plant (BWRP)[1,4]	City of Burbank Department of Public Works	Tertiary to Title 22 Standards with Nitrification/ De-nitrification	11,200	8,960	0	8,960	N/A
Tapia Water Reclamation Facility (TWRF)[1,4]	LVMWD	Tertiary to Title 22 Standards with Nitrification/ De-nitrification	17,920	8,960	0	8,960	N/A
Joint Water Pollution Control Plant (JWPCP)[1,4]	Sanitation District of Los Angeles County	Secondary[7]	448,000	313,600	0	0	313,600

1. Sources: DCTWRP, LAG, TIWRP, and HWRP - Department of Public Works - Bureau of Sanitation Recycled Water Table FY 2014/15; ECLWRF and Carson Facility – West Basin staff; BWRP - Burbank Water and Power Staff; TWRF Las Virgenes Municipal Water District staff; Joint WPCP – LACSD Website
2. In FY 14/15 1,700 AF of recycled water was delivered to City of Glendale from LAGWRP.
3. HWRP delivered 38,300 AF of secondary treated water to ECLWRF for treatment to Title 22 recycled water standards.
4. Recycled water deliveries to LADWP customers from Carson Facility, BWRP, JWPCP and TWRF are pending completion of current water recycling projects.
5. Tertiary treated recycled water from ECLWRF is advanced treated at Carson Facility. Amounts should not be double counted when totaled.
6. Treated wastewater can only be considered recycled if treated to the tertiary level or higher, to meet Title 22 standards.
7. Sanitation Districts of Los Angeles County and the Metropolitan Water District have jointly proposed to increase the treatment level at the JWPCP to meet Title 22 standards, which will create a new source of recycled water.

4.2.1 Recycled Water Facilities within Los Angeles

4.2.1.1 Donald C. Tillman Water Reclamation Plant

In service since 1985, DCTWRP has an average dry-weather flow capacity of 80 million gallons per day (mgd), currently (FY 2014/15) treats approximately 34 mgd of wastewater, and produces 25 mgd of recycled water. The current level of treatment is Title 22 (tertiary) with nitrogen removal (nitrification/de-nitrification (NdN)). DCTWRP provides recycled water for the Japanese Garden, Wildlife Lake, Lake Balboa, treatment plant reuse, and irrigation and industrial uses. All recycled water produced from the facility is used within the LADWP service area. Irrigation uses in the area include golf courses, parks, churches, a high school, and a sports complex. Industrial uses include LADWP's Valley Generating Station. In FY 2014/15 5.6 mgd of tertiary treated wastewater was discharged to the Los Angeles River for operational safety needs. An advanced water purification facility project is being planned that will purify 44 mgd of DCT effluent, producing 35 mgd of advanced treated water to recharge the San Fernando Groundwater Basin via spreading basins. The Groundwater Replenishment project will ultimately recharge up to 30,000 AFY.

4.2.1.2 Los Angeles-Glendale Water Reclamation Plant

LAGWRP is a joint project of the City of Los Angeles and City of Glendale. LAGWRP began treating wastewater in 1976. Its average dry-weather flow capacity is 20 mgd, currently (FY 2014/15) treats approximately 14 mgd, and produces 4 mgd of recycled water. Each city is entitled to 50 percent of the plant's capacity. The City of Pasadena purchased rights to 60 percent of Glendale's capacity but has not yet exercised these rights. The current level of treatment is Title 22 (tertiary) with nitrogen removal (NdN). All of LADWP's portion of the recycled water is used within its service area. Recycled water from the LAGWRP provides landscape irrigation to multiple areas, including, Griffith Park, the Los Angeles Greenbelt Project, Caltrans landscaping, multiple golf courses and parks, and the LA Zoo parking lot. The Los Angeles Greenbelt Project includes Forest Lawn Memorial Park, Mount Sinai Memorial Park, Universal Studios, and the Lakeside Golf Course. The City of Glendale is entitled to half of the recycled water produced at the plant and serves a number of customers in their service area as discussed in their UWMP. As with the DCTWRP, in FY 2014/15 9.6 mgd of tertiary-treated water from LAGWRP was discharged into the Los Angeles River for operational safety needs.

4.2.1.3 Terminal Island Water Reclamation Plant

Originally built in 1935, TIWRP has been providing secondary treatment since the 1970s. Tertiary treatment systems were added in 1996. TIWRP has an average dry-weather flow capacity of 30 mgd. The plant's Advanced Water Treatment Facility adds MF/RO treatment to a portion of the treated effluent producing 4 mgd of recycled water in 2014/15. Recycled water is supplied to two users within the service area, the Water Replenishment District for the Dominguez Gap Seawater Intrusion Barrier to reduce seawater intrusion into drinking water aquifers, and to LADWP's Harbor Generating Station for landscape irrigation. The remaining TIWRP effluent is discharged to the Los Angeles Harbor. In FY 2014/15 approximately 10 mgd of treated wastewater was discharged. Future recycled water production is expected to increase the supply available to the Dominguez Gap Seawater Intrusion Barrier along with other potential customers in the Harbor Area.

4.2.1.4 Hyperion Water Reclamation Plant

Operating since 1894, HWRP is the oldest and largest of the City's wastewater treatment plants. Its $1.2 billion construction upgrade, completed in 1999, allows for full secondary treatment. The average dry-weather flow capacity of HWRP is 450 mgd, with an average FY 2014/15 wastewater flow of 263 mgd. A majority of the treated water is discharged through a 5-mile outfall into the Santa Monica Bay. The remainder, approximately 45 mgd in FY 2014/15, was used at HWRP or was sold to WBMWD for treatment at the ECLWRF to meet recycled water demands in the WBMWD service area and in parts of the City of Los Angeles.

4.2.2 Recycled Water Facilities outside Los Angeles Which Serve the City

4.2.2.1 Edward C. Little Water Recycling Facility – West Basin Municipal Water District

Recycled water to meet specific end users requirements is produced at the ECLWRF operated by WBMWD. In FY 2014/15, 35 mgd of secondary treated water was purchased from HWRP and treated to recycled water standards. WBMWD's water purchase agreement with the City does not limit the volume of water that may be purchased from HWRP and is not expected to contain a limit when it is renegotiated in 2016. WBMWD's ability to purchase water is limited by their pumping capacity. The pump station has a firm capacity of 50 mgd and total capacity of 70 mgd. The pump station is being expanded to a firm capacity of 83 mgd and a total capacity of 98 mgd. Dependent upon the end use of the recycled water, treatment processes include tertiary treatment, RO, MF/RO, and MF with double-pass RO. On average over the period FY 2010/11 – FY 2014/15 the facility produced 43 mgd of product water. A portion of this water is purchased by LADWP to serve customers in West Los Angeles, and the balance is used to meet recycled water demands in WBMWD's service area. In FY 2014/15 approximately 900 AF was purchased and distributed in the LADWP service area. Customers in West Los Angeles include Loyola Marymount University, Playa Vista, multiple parks, street medians, LADWP's Scattergood Generating Station, and irrigation at Los Angeles International Airport. Recycled water is also supplied to the Water Replenishment District for injection into the West Coast Groundwater Barrier to reduce seawater intrusion.

An additional portion of the flows are routed to WBMWD's Carson Facility for further treatment to meet end-user requirements.

4.2.3 City of Los Angeles Actual and Projected Wastewater Volume

Average dry-weather wastewater influent projections for the City's wastewater treatment plants are expected to increase by approximately 20 percent over the next 25 years. Projections include flows from 29 agencies outside of the City with contracts for wastewater treatment. Wastewater effluent that is not recycled is discharged to either the Pacific Ocean via the Los Angeles River, or to outfalls leading directly to the Pacific Ocean. Wastewater treatment projections of average dry-weather flows through 2040, and associated disposal methods, are provided in Exhibit 4D.

Exhibit 4D
City of Los Angeles Wastewater Treatment Plants Average Dry-Weather Flows, Reuse and Discharge Method

Wastewater Treatment Plants	Reuse and Discharge Method	Actual FY 14/15	Average Dry Weather Flow Projections (AFY)				
			FY 19/20	FY 24/25	FY 29/30	FY 34/35	FY 39/40
Donald C. Tillman Water Reclamation Plant (DCTWRP)	Recycling and Pacific Ocean via Los Angeles River	38,000	54,000	74,000	76,000	79,000	81,000
Los Angeles - Glendale Water Reclamation Plant (LAGWRP)	Recycling and Pacific Ocean via Los Angeles River	16,000	33,000	21,000	21,000	21,000	21,000
Terminal Island Water Reclamation Plant (TIWRP)	Recycling and Pacific Ocean via Outfall in Los Angeles Harbor	18,000	15,000	23,000	24,000	24,000	24,000
Hyperion Water Reclamation Plant (HWRP)	Conveyance to ECLWRF for Recycling and Pacific Ocean Outfall	294,000	287,000	361,000	377,000	393,000	410,000
	Total	366,000	389,000	479,000	498,000	517,000	536,000

Source: Los Angeles Department of Public Works - Bureau of Sanitation

4.3 Existing Recycled Water Deliveries

The City has several recycled water projects currently providing recycled water for landscape irrigation, industrial, and commercial uses spread throughout the following four service areas:

- Harbor – located in the southern portion of the City and currently served by TIWRP.
- Central City (Metro) – located in the central/eastern portion of the City and served by LAGWRP.
- San Fernando Valley – located in the northern portion of the City and served by DCTWRP.
- Westside – located in the central/western portion of the City and served by HWRP through the WBMWD's ECLWRF.

Locations of the service areas are depicted in Exhibits 4G, 4I, 4K and 4M provided with the discussion of each service area. Recycled water service areas coincide with potable water service areas. Recycled water produced for FY 2014/15 was 36,738 AFY, inclusive of municipal and industrial, and environmental reuse, as summarized in Exhibit 4E. The highest use was for environmental uses at 26,317 AF followed by irrigation at 5,379 AF.

Exhibit 4E
Recycled Water Use FY 2014/15 by Service Area

Recycled Water Service Area	Existing Annual Demand (AFY)
Irrigation	
Harbor Area	1
Metro Area	2,432
Valley Area	2,052
Westside Area	894
Subtotal Irrigation	5,379
Industrial	
Valley Area	596
Subtotal Industrial	596
Dust Control	
Metro Area	14
Subtotal Dust Control	14
Environmental	
Valley Area	26,317
Subtotal Environmental	26,317
Seawater Barrier	
Harbor Area	4,432
Subtotal Seawater Barrier	4,432
Total	36,738

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

4.3.1 Harbor Area

Recycled water in the Los Angeles Harbor Area is currently produced at the Advanced Water Treatment Facility (AWTF) located at the TIWRP. The AWTF began operating in 2002 with first deliveries to the Dominguez Gap Seawater Barrier in 2006. This project was developed jointly by LADWP, LASAN, and BOE. Operation and maintenance is provided by LASAN with funding from LADWP. Recycled water, treated using microfiltration and reverse osmosis, is used for groundwater injection with FY 2014/15 demands of 4,432 AFY. Two meters to receive recycled water were installed at the LADWP Harbor Generating Station and are supplying recycled water for irrigation. Treatment capacity of the AWTF is approximately 5,600 AFY. Excess recycled water is discharged into the Los Angeles Harbor. Exhibit 4F summarizes estimated annual demands in the Harbor Area based on FY 2014/15. Exhibit 4G depicts the service area, existing users, potential users, and the location of the AWTF at TIWRP.

Water Replenishment District

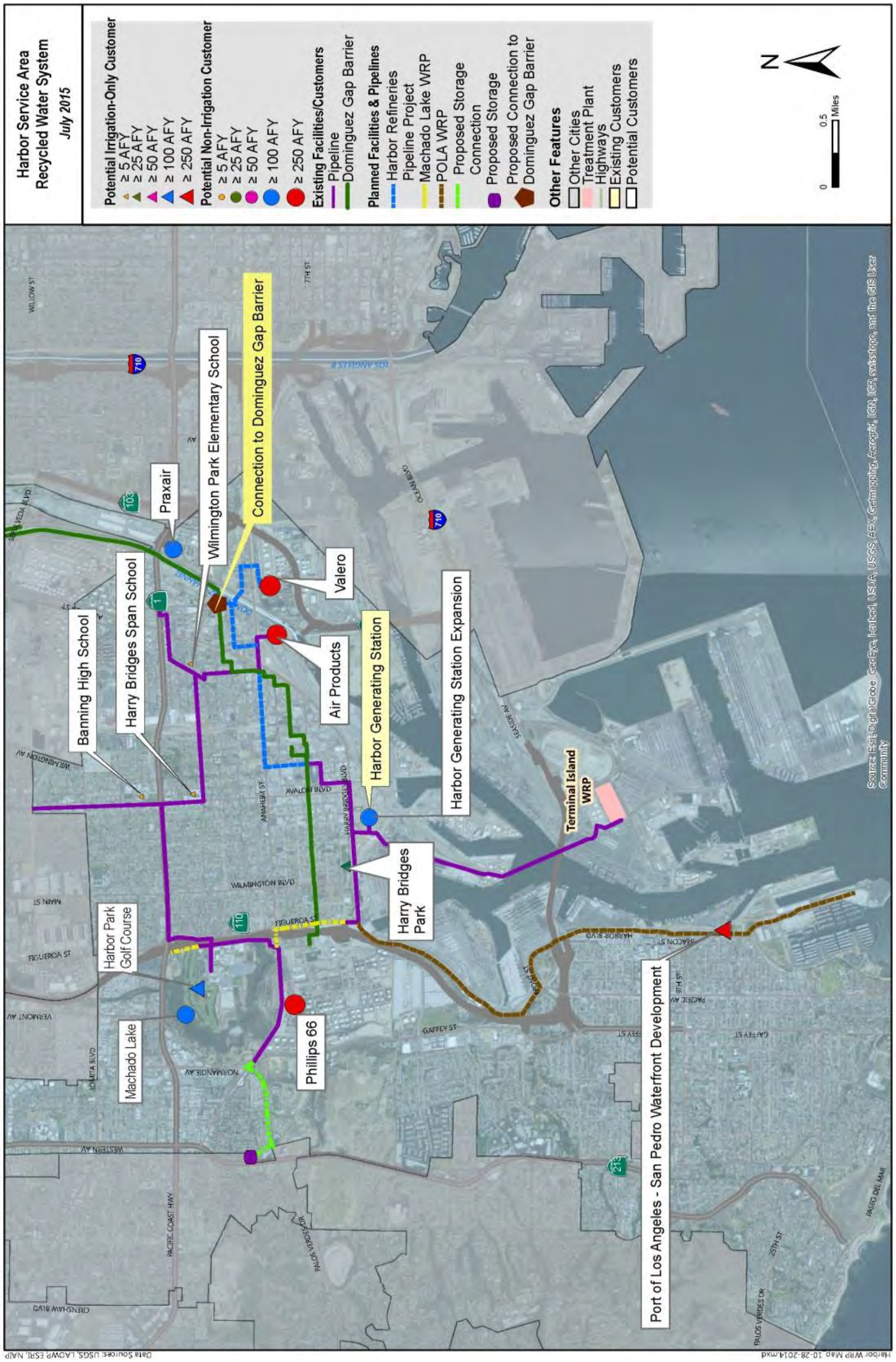
The Water Replenishment District may receive up to 5,000 AFY of recycled water for groundwater injection for the Dominguez Gap Seawater Intrusion Barrier. A blend of fifty percent recycled water and fifty percent imported water is injected into the barrier to protect the West Coast Groundwater Basin from seawater intrusion. In April 2016, recycled water supply is expected to increase to 6,000 AFY upon completion of a 10,000-gallon surge tank at TIWRP. Upon completion of the TIWRP expansion in April 2017, we are anticipating increasing supply to the GAP to 7,500 AFY.

Exhibit 4F
Harbor Recycled Water Existing FY 2014/15 Annual Demand

Project	Existing Annual Demand (AFY)
Irrigation	
Harbor Generating Station	1
Irrigation Subtotal	1
Seawater Barrier	
Dominguez Gap Barrier (Water Replenishment District)	4,432
Seawater Barrier Subtotal	4,432
Total Harbor Water Recycling Projects	4,433

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

Exhibit 4G
Harbor Recycled Water Service Area



4.3.2 Metro Area

The Metro Recycled Water System has supplied the Metro Service Area with recycled water produced at LAGWRP to irrigation customers since 1979. LAGWRP provides recycled water treated to a tertiary level meeting Title 22 standards with nitrogen removal. As previously stated, recycled water produced at LAGWRP is equally split between the cities of Los Angeles and Glendale. Griffith Park was the City's first recycled water project. In 1992 the Greenbelt project was the City's first recycled water project providing water to non-government entities. Recycled water service was established in the Taylor Yard area beginning in 2009 with service to Rio de Los Angeles State Park. Current recycled water demands (FY 2014/15) for the Metro Recycled Water System service area are 2,446 AFY. Almost all recycled water use in the Metro Service Area is used for irrigation with a small amount used for dust suppression at the Headworks Construction Project which is expected to continue through FY 2017/18. As of the end of FY 2014/15 there were 16 water recycling customers online. Between 2009 and May 2015, eleven (11) additional projects were completed. One additional project, the Los Feliz Golf Course began recycled water service in May 2014 with negligible water use during FY 2014/15. Any unused recycled water is discharged to the Los Angeles River. Exhibit 4H summarizes current demands on the Metro Recycled Water System. Exhibit 4I depicts the service area, existing users, potential users, and LAGWRP.

Exhibit 4H
Metro Recycled Water FY 2014/15 Annual Demand

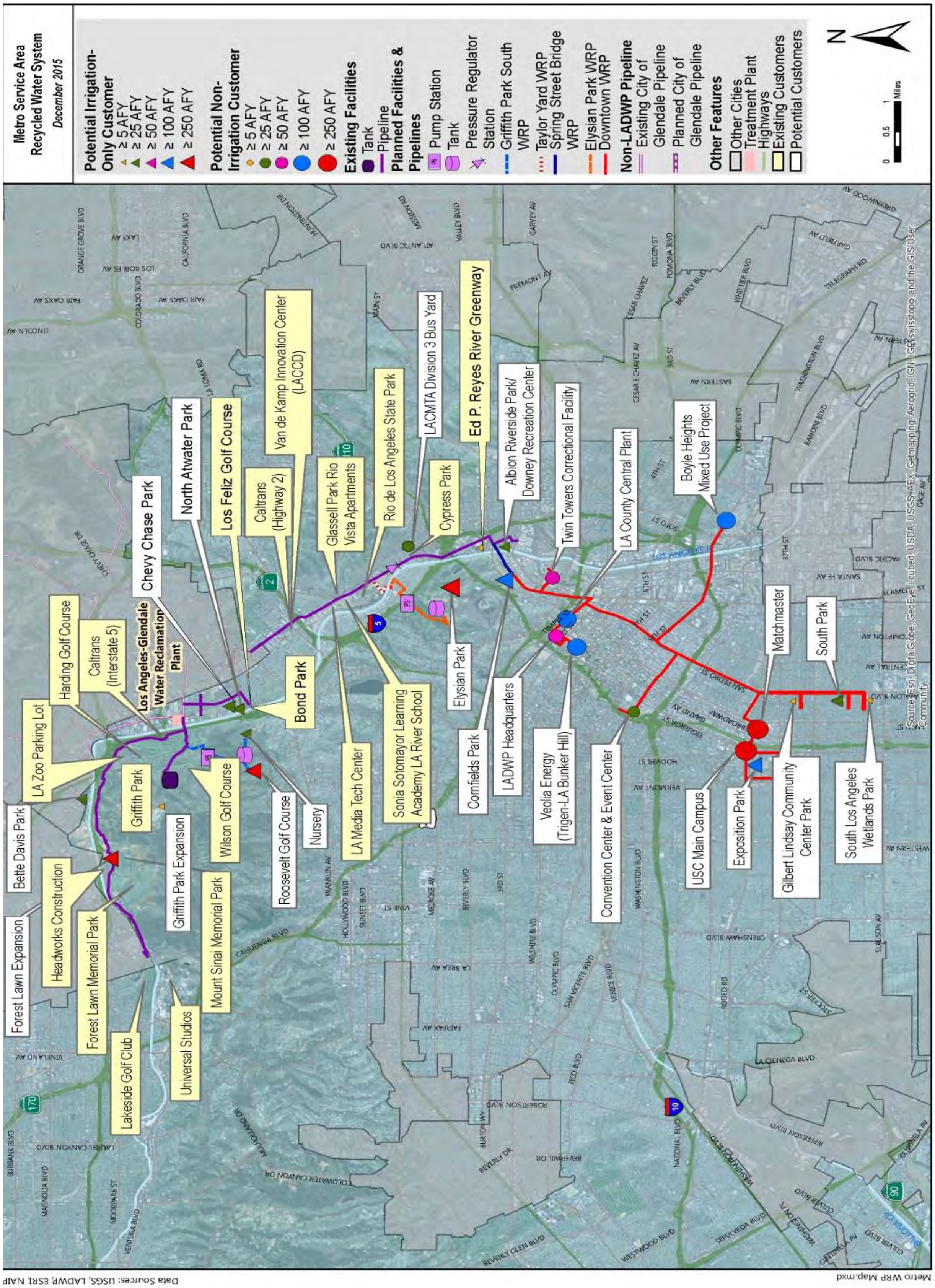
Project	Existing Annual Demand (AFY)
Irrigation	
Caltrans (Interstate 5)[1]	0
Forest Lawn Memorial Park	658
Bond Park	1
Griffith Park	296
Harding and Wilson Golf Courses	565
Lakeside Golf Club	362
Mount Sinai Memorial Park	270
Universal Studios	175
Cypress Park	5
LA Zoo Parking Lot	13
Glassel Park Rio Vista Apartments	1
Rio de Los Angeles State Park	42
LA Media Center	15
Sonia Sotomayor Learning Academy LA River School	12
Caltrans (Highway 2)	2
Van de Kamp Innovation Center	2
Ed P. Reyes River Greenway	1
Los Feliz Golf Course	12
Subtotal Irrigation	2,432
Dust Control	
LADWP Headworks Construction[2]	14
Subtotal Dust Control	14
Total Metro Water Recycling Projects	2,446

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

1. Undetermined amount of use.

2. Water is used for dust suppression during construction. Water is expected to be used through FY 17/18.

Exhibit 4I
Metro Recycled Water Service Area



4.3.3 San Fernando Valley Area

The Valley Recycled Water System receives water from DCTWRP to satisfy irrigation, environmental, and industrial demands. Recycled water is treated to a tertiary level meeting Title 22 standards with nitrogen removal. FY 2014/15 estimated recycled water demands for the San Fernando Valley Area are 28,965 AFY. Recycled water produced in excess of demand is discharged to the Pacific Ocean via the Los Angeles River. Exhibit 4J summarizes FY 2014/15 demands for the Valley Recycled Water System. The East Valley trunkline, a 54-inch-diameter pipeline, was previously constructed to replenish the San Fernando Basin with recycled water. It is now the backbone of the Valley Recycled Water System's distribution system to deliver water throughout the San Fernando Valley for irrigation, commercial, and industrial use. As of FY 2014-15, fifteen customers are served by the Valley Recycled Water System, excluding DCTWRP in-plant use, and environmental uses. Exhibit 4J summarizes current demands for Valley Recycled Water System. Exhibit 4K depicts the service area, existing users, potential users, and DCTWRP.

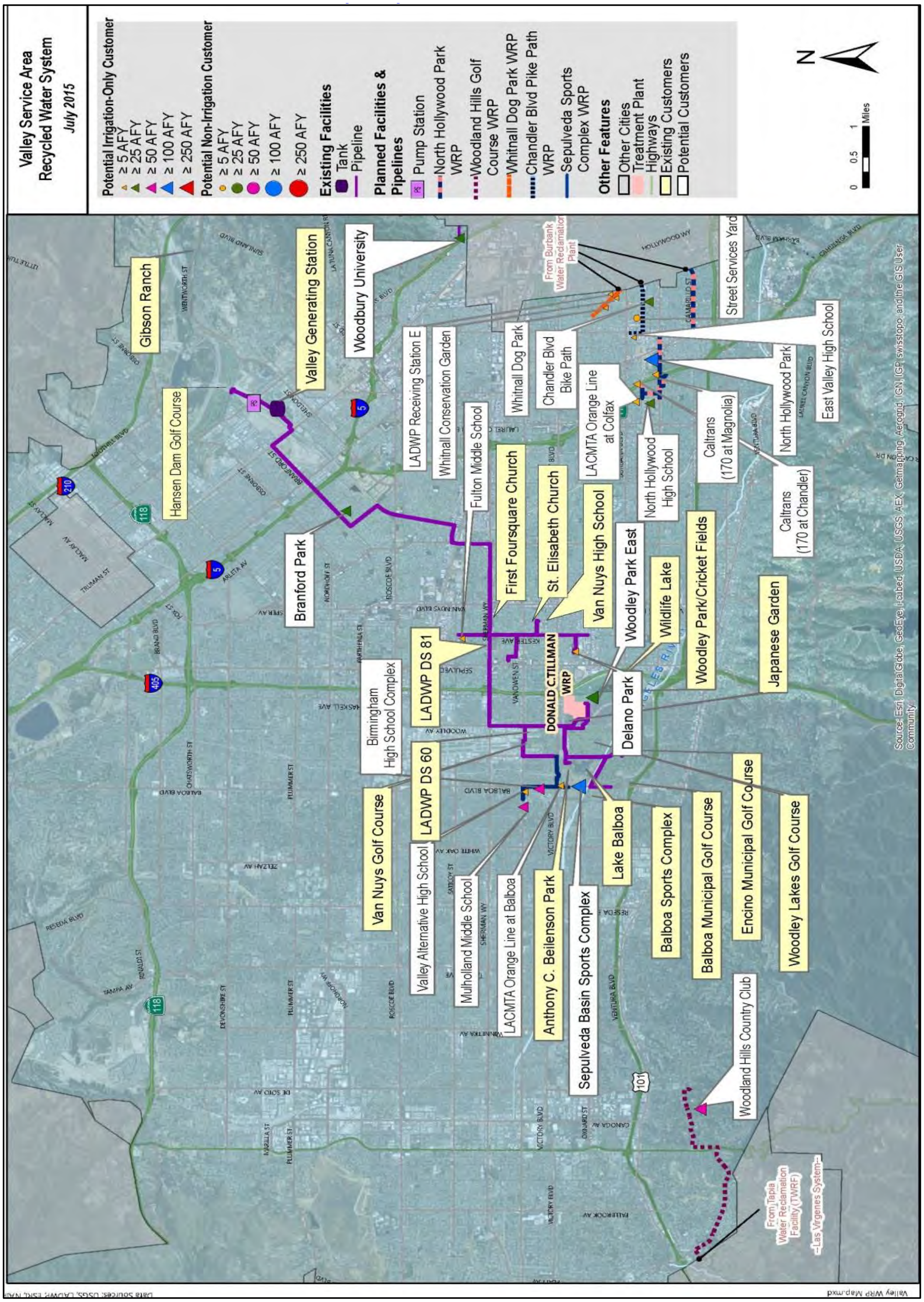
Exhibit 4J
Valley Recycled Water FY 2014/15 Annual Demand

Project	Existing Annual Demand (AFY)
Irrigation	
Balboa Municipal Golf Course	301
Encino Municipal Golf Course	305
Woodley Lakes Municipal Golf Course	677
St. Elisabeth Church	1
Balboa Sports Complex	130
Van Nuys Golf Course	174
Van Nuys High School	25
First Foursquare Church	9
Anthony C. Beilenson Park	99
LADWP Distribution Station 60[1]	0.1
Woodley Park/Cricket Fields	99
LADWP Distribution Station 81[1]	0.3
Gibson Ranch[2]	2
Hansen Dam Golf Course	230
Subtotal Irrigation	2,052
Industrial	
Valley Generating Station	596
Subtotal Industrial	596
Environmental Use	
Japanese Garden	4,531
Wildlife Lake	5,140
Lake Balboa	16,646
Subtotal Environmental Use	26,317
Total Valley Water Recycling Projects	28,965

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

1. Irrigation and equipment wash. 2. Dust control and irrigation.

Exhibit 4K
Valley Recycled Water Service Area



Irrigation

Recycled water from DCTWRP is used at 14 locations, including Hansen Dam Golf Course connected in 2015. Irrigation users include golf courses, park, churches, schools, sports fields, a ranch, and LADWP electrical distribution stations. LADWP Distribution stations 60 and 81 both use water for irrigation purposes and equipment washing. FY 2014/15 irrigation demands in the Valley were 2,051 AFY.

Industrial

Recycled water is used for industrial purposes at LADWP's Valley Generating Station and DCTWRP for in-plant purposes. FY 2014/15 industrial demands were 3,827 AFY. Recycled water service began in 2008 at the Valley Generating Station and demands in FY 2014/15 were approximately 596 AFY. Recycled water is used in a cooling tower for one of the generation units at the Valley Generating Station. Recycled water at DCTWRP is used for in-plant purposes. DCTWRP demands vary from year to year based on actual needs. DCTWRP in plant re-use is estimated at 3,231 AFY for FY 2014/15.

Environmental Use

Recycled water from DCTWRP has provided environmental benefits since 1984, commencing with deliveries to the Japanese Garden and followed by deliveries to Lake Balboa in 1990 and wildlife lake in 1991. For planning purposes demands are estimated at 26,600 AFY with actual deliveries varying year to year. In FY 2014/15 deliveries were estimated at 26,317 AFY based on historical data. Overflows from the lakes and the garden are discharged to the Los Angeles River in conjunction with variable and intermittent direct discharges from DCTWRP for operational safety.

Japanese Garden

The 6.5-acre Japanese Garden is located at the Sepulveda Dam Recreation Area. The Japanese Garden receives more than 10,000 visitors per year. Historically, DCTWRP provides approximately 4,000 AFY of recycled water for the lake and landscaping at the Japanese Garden.

Wildlife Lake

Located in the Sepulveda Basin Wildlife Reserve, the wildlife lake uses approximately 5,600 AFY of recycled water from DCTWRP for wildlife habitat management.

Lake Balboa

Lake Balboa is the centerpiece of the Sepulveda Dam Recreation Area and is a popular recreational facility located in Anthony C. Beilenson Park. Approximately 17,000 AFY of recycled water is provided for this lake from DCTWRP.

Japanese Gardens are supplied with 4,000 AF of recycled water annually

4.3.4 Westside Area

Recycled water supplied to the Westside Recycled Water System is provided by WBMWD via the ECLWRF, located in the City of El Segundo, for irrigation and commercial (toilet flushing) demands. The ECLWRF can treat up to 62.3 mgd of secondary-treated effluent received from HWRP to a tertiary level meeting Title 22 standards. A portion of the water, based on customer needs, undergoes advanced treatment using RO, MF/RO, and double-pass RO. Under an agreement between WBMWD and the City, WBMWD purchases secondary-treated effluent from HWRP, and LADWP has a right to purchase up to 25,000 AFY of recycled water from the ECLWRF. Approximately 38,300 AF of secondary-treated effluent was purchased from HWRP in FY 2014/15. Recycled water not purchased by LADWP is sold to users within WBMWD's service area.

Deliveries of recycled water from the Westside Recycled Water System first began in 1996. To increase the use of recycled water in West Los Angeles, LADWP has constructed more than five miles of distribution trunk lines to serve the Westchester, Los Angeles International Airport, and Playa Vista development areas. Recycled water demands in the Westside during FY 2014/15 were 894 AF as shown in Exhibit 4L. Exhibit 4M depicts the service area, existing users, potential users, and ECLWRP and HWRP.

Recycled water from ECLWRF is used at 10 locations to meet irrigation demands. Irrigation users include a golf course, parks, street medians, Los Angeles International Airport, LADWP Scattergood Generating Station, Loyola Marymount University, the Parking Spot, HWRP, and various users in Playa Vista. Recycled water is also used at HWRP and Playa Vista Phase 1 to flush toilets in dual plumbed commercial facilities. Playa Vista is the first planned development in the City to use recycled water for the irrigation of all of its landscaping and for residential outdoor use. This project began receiving recycled water in 2009. Recycled water is required for outdoor use under the development's mitigation requirements established during the environmental review process. Connections to the Playa Vista Development Phase 2 began in 2014 and will continue in the near future. Between 2009 and May 2015, four (4) additional projects were completed.

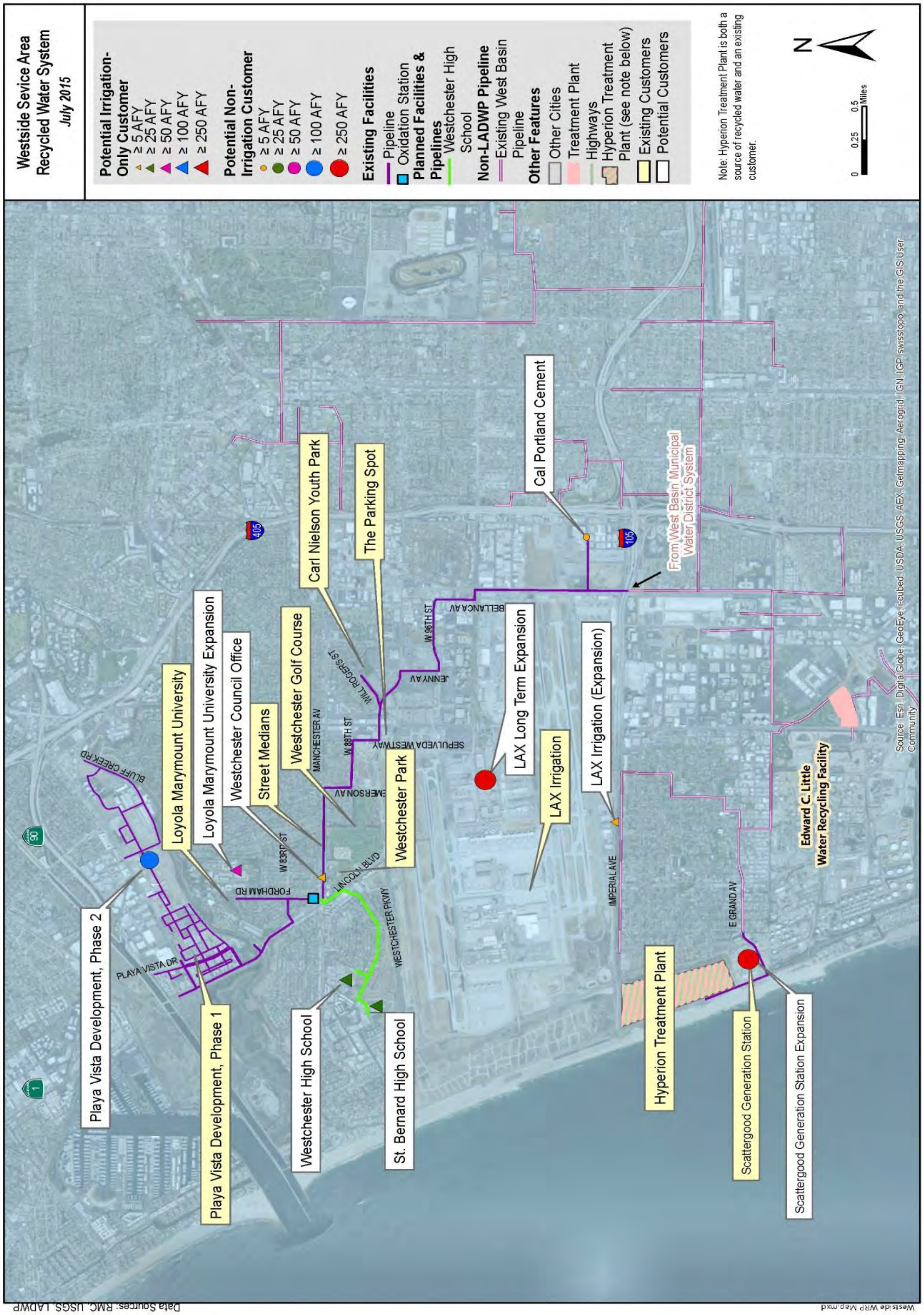
Exhibit 4L
Westside Recycled Water FY 2014/15 Annual Demand

Project	Existing Annual Demand (AFY)
Irrigation	
LADWP Scattergood Generating Station	0.4
Los Angeles International Airport Irrigation	165
Loyola Marymount University	146
Carl Neilsen Youth Park	16
Street Medians	46
The Parking Spot	1
Westchester Park	30
Playa Vista Development, Phase 1[1]	239
Playa Vista Development, Phase 2	13
Westchester Golf Course	185
Hyperion Water Reclamation Plant[1]	53
Subtotal Irrigation	894
Total Westside Water Recycling Projects	894

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

1. Irrigation and toilet flushing.

Exhibit 4M
Westside Recycled Water Service Area



4.3.5 Comparison of 2010 Projections Versus Actual Use

LADWP has made progress in increasing recycled water use in the interim period between completion of the 2010 and 2015 UWMPs. Between 2009 and May 2015, over 26 additional projects have come online. Municipal and industrial recycled water use between FY 2010/11 and FY 2014/15 increased from 7,894AFY to 10,421 AFY. The 2010 UWMP projected municipal and industrial recycled water use in FY 2014/15 to be approximately 20,000 AF; however, actual use was lower than projected, as shown in Exhibit 4N. Environmental use of recycled water fluctuates slightly year to year based on lake levels, but has historically averaged 26,600 AFY. For FY 2014/15 actual environmental use was 26,317 AF. Overall total recycled water used in FY 2014/15 was 36,738 AFY.

Although LADWP did not meet the 2010 UWMP recycled water projection for FY 2014/15, progress has been made, including the completion of over 26 additional projects. Other projects proposed for construction in the near future, including up to 30,000 AFY of groundwater replenishment, are described in Section 4.4, Recycled Water Planning Efforts. These projects are expected to increase recycled water use to 59,000 AFY by the end of FY 2024/25.

4.4 Recycled Water Planning Efforts

With the current drought and City initiatives to reduce imported potable reuse, recycled water planning efforts have rapidly accelerated. LADWP, in partnership with LASAN and BOE, completed a Recycled Water Master Planning documents (RWMP) in 2012 to provide guidance and identify future recycled water efforts. The RWMP was a multi-year effort initiated in 2009. A major purpose of the document was to develop plans for achieving and exceeding the recycled water targets for 2035 of 59,000 AFY established in the 2010 UWMP. The document serves as guidance for development of future recycled water projects. Two major strategies developed included:

- Development of a groundwater basin replenishment program using indirect potable water reuse; and
- Expansion of the existing non-potable reuse systems.

Exhibit 4N
2010 UWMP Recycled Water Projections for FY 2014/15 versus Actual Use

Programs	2014-15 Actual Use (AFY)	2014-15 Projected in 2010 UWMP (AFY)
Municipal and Industrial Uses[1]	5,989	20,000
Environmental Use[2]	26,317[3]	26,990
Seawater Intrusion Barrier (Dominguez Gap)[1]	4,432	3,000
Total	36,738	49,990

1. LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx. Does not include deliveries of 38,300 AFY to ELCWRF.
2. Historical water use averages 26,600 AFY and is ultimately discharged to the Los Angeles River.
3. LASAN, FY 2014-15 Recycled Water Table.

- Development of the RWMP involved extensive public input including establishment of a Recycled Water Advisory Group (RWAG) that continues to meet today. Furthermore, at the request of the City the National Water Research Institute established an Independent Advisory Panel to provide third party review of the City's Groundwater Replenishment (GWR) project as it progresses.

The RWMP recommended locations where the recycled water system could be effectively expanded. A cost benefit analysis was conducted to identify projects and potential customers based on location and projected use. A review of the wastewater treatment plants was performed to determine how much recycled water can be supplied. The RWMP reviewed available options for maximizing reuse through a combination of alternatives including expansion of non-potable irrigation/industrial uses and groundwater replenishment (indirect potable reuse).

In the interim period since completion of the RWMP, ED5 was issued by Mayor Garcetti in 2014 and the pLAn was completed in 2015, which established goals of reducing purchased imported potable water use by 50 percent by 2025 and increasing local water source to 50 percent by 2035. LADWP is working towards meeting this goal through multiple options, including an increase in recycled water use. The pLAn established the following goals as they relate to recycled water:

- Expand recycled water by an additional 6 mgd by 2017 at TIWRP;
- Convert 85% of public golf courses to recycled water;
- Develop a strategy to convert the City's lakes to recycled water and implement a pilot project; and
- Expand recycled water production, treatment, and distribution to incorporate indirect potable reuse and direct potable reuse.

While the RWMP continues to provide important guidance as LADWP moves forward to meet the goals of ED 5 and pLAn, the RWMP project planning timeframes and options have been surpassed with these new initiatives.

Recycled water projections in five year increments beginning in FY 2019/20 through 2039/40 (projection period) are presented in Exhibit 4O. These projections outline the recycled water use categories LADWP plans to increase to meet the goals established in ED5 and pLAn. LADWP recycled water use is projected to reach 59,000 AFY by FY 2024/25 by adding 19,000 AFY of planned municipal/industrial use and 30,000 AFY of indirect potable reuse (groundwater replenishment), and further increase to 75,400 AFY through the remainder of the projection period by adding another 16,000 AFY of potential customer growth. Environmental reuse is expected to remain constant at 26,740 AFY.

Exhibit 4O
Recycled Water Use Projections

Category	Project Use (AFY)				
	FY 19/20	FY 24/25	FY 29/30	FY 34/35	FY 39/40
Municipal and Industrial Uses[1]	19,800	29,000	39,000	42,200	45,400
Indirect Potable Reuse (Groundwater Replenishment)	0	30,000	30,000	30,000	30,000
Subtotal	19,800	59,000	69,000	72,200	75,400
Environmental Use[2]	26,740	26,740	26,740	26,740	26,740
Total	46,540	85,740	95,740	98,940	102,140

1. LADWP Recycled Water Group, UWMP 2015 Recycled Water Projections 2015.08.29.xlsx. Does not include projected deliveries to ELCWRF.
2. Historical water use has been 26,600 for environmental uses associated with DCTWRP. Actual yearly use will fluctuate based on conditions. 26,600 AFY is used for future planning purposes for environmental uses associated with DCTWRP plus 140 AFY for Machado Lake. Water associated with DCTWRP environmental uses is ultimately discharged to the Los Angeles River.

Exhibit 4P
Near-Term Estimated Demands by Recycled Water Service Area

Recycled Water Area	Estimated Additional Annual Demand (AFY)
Harbor Area	12,820
Metro Area	3,693
Valley Area	963
Westside Area	1,396
Total	18,872

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

Estimates of projected use and implementation timelines in the tables above, as well as the annual demands and service dates for individual customers in the following sections, may be affected by varying usage patterns of potential customers, timelines to reach agreements, potential financial constraints, and changing regulatory requirements.

4.4.1 Near-Term Projects through FY 2024/25

"Near-Term" projects are classified as projects that will result in new recycled water demands between July 1, 2014 and June 30, 2025 to assist in achieving total recycled water use of 59,000 AFY by FY2024/25. Near-Term projects are either in the planning, design, or construction stage. Near-Term projects target customers that have already been identified as potential recycled water users, exclusive of the GWR project. Estimated additional demands associated with the Near-Term projects are 18,872 AFY. Exhibit 4P summarizes Near-Term demands by recycled water service area.

Project Selection

Criteria for selecting Near-Term projects were established as part of the RWMP. Irrigation-only customers were focused on first as they are generally easier to convert to recycled water use than commercial or industrial users. As described below, recycled water project options were developed to meet the goal of maximizing recycled water use, while promoting cost efficiency, feasibility, and adaptability. Three primary steps were utilized to develop recycled water project options:

- Identification of preliminary project options to serve customers with non-potable demands in excess of 50 AFY or in high density demand clusters with non-potable demands in excess of 50 AFY per square mile.
- Define facilities including transmission pipeline (backbone alignments) and laterals based on hydraulic modeling and define cost estimates based on these facilities.
- Screen the list of preliminary project options by unit cost.

Recycled Water Supply Sources

Recycled water availability varies by service area. Additional supplies may be required to meet expected demands requiring a combination of existing facilities expansion, service connections to neighboring agencies outside the City, new facilities, and satellite treatment plants. LADWP expects to receive additional recycled water supplies available in the Valley and Harbor service areas via LVMWD's TWRF, City of Burbank Department of Public Works' BWRP, and WBMWD's Carson Facility. As part of the RWMP process, LADWP met with neighboring agencies in 2009 to explore potential opportunities for regional development of recycled water reuse facilities. These agencies are listed in Exhibit 4U, in section 4.4.5, Stakeholder Process and Agency Coordination.

Harbor Area

LADWP is currently expanding recycled water infrastructure in the Harbor Area to serve large industrial and irrigation customers, and provide environmental benefits at Machado Lake. Twelve projects are planned to increase recycled water usage by an additional 12,820 AFY by FY 2022/23. Approximately 140 AFY of recycled water is proposed for environmental uses at Machado Lake beginning in 2017 to stabilize lake levels. Lake levels are currently supplemented with potable water. An expansion of the AWTF at TIWRP is currently under construction to partially meet projected demands in the Harbor Area. Exhibit 4Q summarizes Near-Term projects, additional demands, estimated service dates, and the current status of projects in the Harbor Area.

LADWP and LASAN are currently exploring concepts to treat and deliver additional recycled water to the Harbor Area to meet projected demands. Potential sources of recycled water are HWRP, Carson Water Reclamation Facility, and the Joint Water Pollution Control Plant, shown in Exhibit 4A. Potential additional customers in the Harbor Area include Phillips 66, Tesoro, Harbor Cogen, Warren E/P, and Harbor College.

Exhibit 4Q
Harbor Area Near-Term Estimated Demands

Project Type	Estimated Annual Demand (AFY)	Estimated Service Date	Phase
Seawater Intrusion Barrier (Dominguez Gap) Expansion 1st Increase	1,000	2016	Permitting
Harbor Water Recycling Project AWTF Phase II Expansion	Provides treatment capacity expansion	2017	Construction
Seawater Intrusion Barrier (Dominguez Gap) Expansion 2nd Increase	1,500	2017	Design
Harbor Industrial Onsite Improvements	2,360	2017	Planning
Harbor Refineries Pipeline Project	1,000	2017	Construction
Machado Lake Pipeline Project	340	2017	Bid and Award
Roosevelt Memorial Park Water Recycling Project	90	2016	Construction
San Pedro Waterfront Port of LA	100	2022	Planning
Port of LA Wilmington Waterfront Water Recycling Project	140	2016	Complete
Harbor Recycled Water Tank	50	2022	Planning
West Basin Carson RW Pipeline or Alternative[1]	6,100	2023	Design
Machado Lake	140	2017	Bid and Award
Total	12,820		

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

1. Reach full capacity of 11,100 AFY by 2027

Metro Area

Seven water recycling projects and three customer connections are planned in the Metro Area to add annual demands of approximately 3,705 AFY. Almost all recycled water use is proposed for irrigation. LAGWRP will continue to meet all recycled water demands in the Metro Area. Exhibit 4R summarizes Near-Term demands for the Metro Area.

Exhibit 4R
Metro Area Near-Term Estimated Demands

Project Type	Estimated Annual Demand (AFY)	Estimated Service Date	Phase as of July 20, 2015
Griffith Park Area Expansions	8	2017	Construction
Chevy Chase Park	10	2015	Customer Connection
Bette Davis Park Water Recycling Project	35	2015	Construction
LACTMA Division 3 Bus Yard	30	2017	Customer Connection
Elysian Park Tank & Pump Station WRP	400	2019	Planning
Forest Lawn Memorial Park Expansion	500	2022	Planning
Downtown WRP	2,350	2021	Planning
Griffith Park South WRP	310	2017	Construction
North Atwater Park	40	2016	Customer Connection
Bond Park	10	2015	Construction
Total	3,693		

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

Hansen Dam Golf Course started irrigating with recycled water in 2015

Valley Area

In the Valley Area DCTWRP, in conjunction with recycled water potentially obtained from BWRP and the Las Virgenes Municipal Water District (LVMWD), will provide recycled water for 6 potential Near-Term projects and three customer connections. The projects and connections are expected to increase recycled water use by an additional 963 AFY by FY 2018/19. All Near-Term use will be for irrigation purposes. These users are all located within close proximity to the existing recycled water system. Exhibit 4S summarizes the potential Near-Term demands for the Valley Area.

LADWP has recently entered into an agreement with Burbank Water and Power to purchase recycled water from the BWRP. Water from this facility is proposed to be used primarily for irrigation.

LADWP is proposing to enter into multiple agreements with LVMWD to obtain recycled from TWRP. Currently, LADWP has identified a potential demand of 1,550 AFY of recycled water that could be served by TWRP. LADWP has completed an agreement with LVMWD for pre-design and environmental compliance for the Woodland Hills Water Recycling Project. An agreement for project design and purchase of recycled water from TWRP is in the early negotiation stage. LADWP will be working with LVMWD to evaluate other potential recycled water projects to use this recycled water.

Exhibit 4S
Valley Area Near-Term Estimated Demands

Project Type	Estimated Annual Demand (AFY)	Estimated Service Date	Phase as of July 20, 2015
Branford Park WRP	20	2016	Construction
Woodley Park/Cricket Fields (ongoing construction)	10	2015	Construction
Sepulveda Basin Sports Complex WRP	308	2017	Phase 1: Construction Phase 2: Planning
Woodland Hills WRP	300	2019	Planning
Delano Park WRP	10	2015	Customer Connection
Fulton Middle School WRP	10	2016	Customer Connection
North Hollywood WRP	285	2017	Construction
Woodbury University	20	2016	Customer Connection
Total	963		

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

Exhibit 4T
Westside Area Near-Term Estimated Demands

Project Type	Estimated Annual Demand (AFY)	Estimated Service Date	Phase
Cal Portland Cement	14	2016	Planning
Hyperion Water Reclamation Plant Phased Expansion	20	2016	Construction
Los Angeles International Airport Irrigation Expansion	18	2016	Design
Playa Vista Phase II (ongoing construction)	43	2017	Customer Connection
Los Angeles World Airports Cooling Towers WRP	1,250	2025	Planning
Westchester Municipal Building	1	2022	Customer Connection
Westchester HS WRP	50	2016	Design
Total	1,396		

Source: LADWP Recycled Water Group, UWMP 2015 Recycled Water Update rev2015.08.29.xlsx

Westside Area

LADWP will continue to acquire recycled water from WBMWD to serve additional Near-Term demands of approximately 1,396 AFY in the Westside Area. Near-Term demands include five projects and two customer connections. Most of the additional recycled water demands are attributed to industrial use at LAX for cooling towers. Exhibit 4T summarizes Near-Term demands for the Westside Area.

Loyola Marymount University, irrigates with recycled water

4.4.2 Groundwater Replenishment

As part of the Recycled Water Master Planning documents (RWMP), the City proposed a Groundwater Replenishment (GWR) Project, also referred to as indirect potable reuse, using highly purified advanced treated recycled water from DCTWRP for spreading in existing spreading basins in the San Fernando Valley area. An Advanced Water Purification Facility (AWPF) is proposed to be constructed to further treat tertiary effluent from DCTWRP to produce highly purified recycled water for recharge. The new AWPF is expected to include microfiltration (MF), reverse-osmosis (RO), and advanced oxidation to recharge up to 30,000 AFY of advanced treated water by 2023/24. Recharge will occur by allowing water to percolate at the existing Hansen Spreading Grounds and the Pacoima Spreading Grounds.

Infrastructure improvements required to implement the GWR Project include the aforementioned AWPF and pipelines to convey product water to the spreading basins. Conveyance pipelines to the Hansen Spreading Grounds are already in place and were constructed as a part of the previous recycled water initiatives for the East Valley Water Recycling Project. However, additional pipeline infrastructure is required to use the Pacoima Spreading Grounds for spreading.

Native stormwater recharge will continue to occur at the spreading grounds in conjunction with the project. Use of the spreading grounds could be potentially restricted for purified recycled water spreading during wet-weather events and spreading of raw imported water. Currently, LADWP and the Los Angeles County Department of Public Works use multiple spreading grounds located in the eastern portion of the San Fernando Basin to recharge the underlying San Fernando Basin with stormwater. A detailed discussion of the San Fernando Basin and existing recharge operations is provided in Chapter 6, Local Groundwater, and Chapter 7 Watershed Management.

Goals for the Advanced Water Purification Facility are:

1. Recharge up to 30,000 AFY by FY 2023/24;
2. Production capacity of 35 mgd;
3. No regulatory limitations on spreading amounts; and,
4. Product water shall comply with requirements from the RWQCB, SWRCB, and be suitable for indirect potable reuse.

Proposed technologies for water purification include microfiltration or ultrafiltration, reverse osmosis, advanced oxidation using ultraviolet light with hydrogen peroxide, and post-treatment for product water stabilization. As a by-product of advanced water treatment, brine is created and must be disposed.

LADWP is working closely with LASAN and regulatory agencies to expedite completion of the project by FY 2023/24. The project is currently in the planning stage. An Environmental Impact Report in compliance with California Environmental Quality Act requirements is being prepared with an anticipated completion date of 2016. This document will describe the alternatives under consideration and develop a recommended alternative for approval. Regulatory requirements for GWR are discussed in sub-section 4.1.2, GWR Regulatory Requirements.

Independent Advisory Panel

GWR projects typically require an independent third party with scientific and technical expertise to provide expert peer review of key aspects of the project. This review can further ensure the technical viability of the GWR project and facilitate the regulatory process. To accomplish this, LADWP awarded a contract to the National Water Research Institute (NWRI) to form an Independent Advisory Panel (IAP) to provide expert peer review of the technical, scientific, regulatory, and policy aspects of the proposed GWR project, pilot project testing, and other potential groundwater replenishment projects to maximize reuse as part of the City's RWMP. The IAP process has provided a consistent, thorough, and transparent review of proposed GWR projects and pilot testing during their critical formation phase, as well as during the long-term implementation phase. Today the IAP continues to provide input on the GWR project and the potential for direct potable reuse.

NWRI has vast experience in the organization and administration of the IAP processes for other agencies such as Orange County Water District's Groundwater Replenishment System. NWRI assists the IAP process by assembling the IAP members, developing a detailed scope and approach for the IAP's review, coordinating and facilitating meetings, and preparing IAP reports.

The "Independent Advisory Panel for the City of Los Angeles Groundwater Replenishment Project" consists of 12 members with scientific and/or professional expertise in issues related to the implementation of groundwater replenishment projects. The selection of members with different areas of expertise was based on the requirements of the California Department of Public Health Draft GWR Reuse Regulations dated August 2008, as well as the composition of panels used by the Orange County Water District and the City of San Diego for the implementation of similar groundwater replenishment projects.

NWRI convened the Independent Advisory Panel for the first time in October 2010 to receive introductory information about the recycled water program and groundwater replenishment project. The Panel is expected to be involved throughout the planning, permitting, design, environmental documentation, and implementation of the groundwater replenishment project.

Some of the activities addressed by the IAP have included, but are not limited to review of the following:

- General approach for Recycled Water Master Planning;
- Hydrogeology (in-basin groundwater blending);
- Treatment (barriers to replace the fifty-percent blend criteria);
- Reliability features of the Advanced Water Purification Facilities;
- Source Control Evaluation for GWR;
- Draft Engineering Report for GWR; and
- Response to technical concerns raised by regulators and the public.

4.4.3 Long-term Recycled Water Conceptual Planning Efforts

LADWP is exploring partnership efforts with other utilities to develop long-term alternatives to maximize recycled water use beyond the FY 2024/25 Near-term projects planning horizon. To maximize recycled water use LADWP is investigating the following options:

- **Las Virgenes Municipal Water District Partnership Full Expansion**
  Las Virgenes MWD produces an excess supply of recycled water in the winter time at TWRF. With seasonal storage in place, over 2,000 AFY of recycled water

could potentially be available for Los Angeles. Finding additional customers or expanding infrastructure, such as a new pipeline connecting to the existing recycled water system, could allow LADWP to use the additional supply.

- **City of Burbank Partnership Full Expansion**

  Burbank Water & Power produces an excess supply of recycled water. Up to 6,000 AFY is estimated to be available. Finding additional customers or expanding infrastructure, such as a new pipeline connecting to the existing recycled water system, could allow LADWP to use the additional supply.

- **Hyperion Full Expansion Plus West Basin Municipal Water District Partnership**

  HWRP has the potential to supply additional secondary effluent (or further treated effluent) to WBMWD. West Basin's existing pump station is being expanded from 40 mgd to 70 mgd, with a potential full expansion to 98 mgd. LADWP does not anticipate a significant number of additional customers and uses because HWRP is located near the City of LA boundary away from areas identified for future recycled water expansion. Even though the majority of increased recycled water supply is likely to be used by West Basin MWD and other agencies, LADWP may be able to connect some additional customers as part of the overall expansion.

4.4.4 Cost and Funding

The capital cost of expanding the recycled water system to achieve the goal of 59,000 AFY of recycled water through the construction of near term projects and the GWR project is estimated at $1 – 1.2 billion. Capital costs to construct the GWR project are estimated at approximately $450 million in 2015 dollars. The project annual operations and maintenance costs are estimated at $22 million per year in 2015 dollars.

Unit Cost

Non-potable reuse and GWR projects are diverse, and result in a wide range of costs to implement and sustain. Non-potable reuse projects present numerous challenges, including distance from treatment plant and the associated transmission pipeline construction costs. This is weighed against customer size and recycled water adaptability to a particular commercial site or process. The approximate range of cost for the near-term non-potable reuse projects is estimated to be from $600 to $1,500 per acre-foot. This approximation includes capital, operation, and maintenance costs. Unit costs for the GWR project, including capital, operation, and maintenance costs, are estimated to be $910/AF in 2015 dollars.

Funding

Capital costs for RWMP projects will be covered by the funding sources identified below, as well as other sources as they become available.

- Water Rates – LADWP water rates are the primary funding source for the recycled water program.

- Federal Funding – LADWP will pursue Federal funding as it becomes available. In the past LADWP has received funding for recycled water projects from the Federal Water Project Authorization and Adjustment Act of 1992, Public Law 102-575 (HR429), and the United States Bureau of Reclamation Title XVI Program.

- State Funding – LADWP will pursue State funding for recycled water projects through the SWRCB and DWR as it becomes available. Proposition 1, Chapter 9 contains $625 million for grants and loans for water recycling projects. This funding is being administered through the SWRCB's Water Recycling Funding Program, which also provides low-interest loans from the Clean Water State Revolving Fund. Proposition 1, Chapter 7 contains $98 million for Integrated Regional Water Management implementation projects in the Los Angeles subregion (includes Ventura), including recycled water projects. IRWM funding is administered by DWR.

- MWD Local Resources Program Incentive – The Local Resources Program provides funding for water recycling and groundwater recovery projects that prevent a new demand on MWD or displace an existing demand on MWD. Financial incentives vary based upon the incentive payment structures selected by the applicant. In 2014 MWD adopted three incentive structures with incentives ranging from $340 per AF to $475 per AF based upon the incentive terms. As of FY 2014/15, LADWP has 11 funded LRP agreements with MWD for recycled water projects, and another 4 which are in some phase of the application process.

4.4.5 Outreach and Agency Coordination

Outreach with key stakeholders and the public, and coordination with agencies is necessary for the success of the City's recycled water program. LADWP and LASAN initiated an extensive outreach process in 2009 with the formation of the Recycled Water Advisory Group (RWAG).

Stakeholder Process

Through the combined outreach efforts of the LADWP and LASAN, the City continues to promote the advantages and safety of recycled water use. Outreach strategies include briefing key influential stakeholders and elected officials as well as presentations to Neighborhood Councils and community groups. Water recycling staff participates in multiple community events and responds to public inquiries regarding the City's goals and water supply challenges.

In addition, LADWP staff continues to reach out to K-12 students and faculty to educate them about the urban water cycle, the recycled water program, and various water treatment technologies.

At the center of the City's outreach efforts is continued dialog with stakeholders through the RWAG. The RWAG is a group of approximately 70 stakeholder organizations with varied perspectives representing specific ethnic groups, water interests, community groups, neighborhood councils, environmental groups, and business affiliations. The RWAG was formed in 2009 by the LADWP and LASAN to actively engage with the public regarding the negative perception of recycled water through two way communication. Since the group's launch, RWAG members have participated in a series of half-day workshops, tours, and other informational sessions which have familiarized them with the details of the water recycling process. The RWAG provided guidance in the development of the City of LA Recycled Water Master Planning documents. RWAG members have also formed working groups such as the Consensus Statement Working Group and the Public Outreach Working Group to tackle focused objectives.

Two main roles of the RWAG were:

1) To provide input on recycled water options from technical, environmental, financial, and social viewpoints.

2) Consider key project issues and discuss implementation challenges and acceptability.

The RWAG continues to share their opinions and concerns regarding the City's recycled water program during the planning and implementation of the Groundwater Replenishment project. The City also continues to outreach to the general public through elected official briefings and presentations to Neighborhood Councils and community groups.

Agency Coordination

To maximize recycled water use and to move forward with recycled water efforts, LADWP has closely coordinated and continues to coordinate with agencies at the local and state levels. Coordination is necessary to ensure adequate funding, identification of end-users, adequate availability of supplies, permitting and regulatory approvals, and regional cooperation. If Federal funding opportunities become available, LADWP will also coordinate with the applicable Federal agencies. Exhibit 4U provides a summary list of agencies that LADWP either coordinated with or is currently coordinating with to maximize recycled water use.

Financial Incentives

LADWP also coordinates recycled water end use with potential customers by assisting with facility retrofits and public education. Recycled water is provided to customers at a cost less than potable water. LADWP has implemented a new incentive program on July 11, 2012 designed to assist with onsite retrofits to convert customers to the use of recycled water.

4.4.6 Recycled Water Quality

All recycled water provided by LADWP meets, at minimum, Title 22 standards. Title 22, Chapter 4, of the California Code of Regulations establishes water quality standards and treatment reliability criteria for water recycling to ensure public safety as discussed in Section 4.1. Title 22 standards are achieved with tertiary treatment and disinfection.

Advanced wastewater treatment is currently provided for the Dominguez Gap Seawater Barrier at the TIWRP by the AWTF. The AWTF has advanced treatment that includes microfiltration and reverse osmosis, which removes many of the impurities remaining after tertiary treatment and disinfection. This level of treatment is proposed to be implemented for the planned groundwater replenishment project being developed. DCTWRP effluent used to recharge the San Fernando Basin via spreading basins is expected to undergo the additional treatment of advanced oxidation. Exhibit 4C, located in Section 4.2, summarizes the level of treatment provided by each of the City's water reclamation plants.

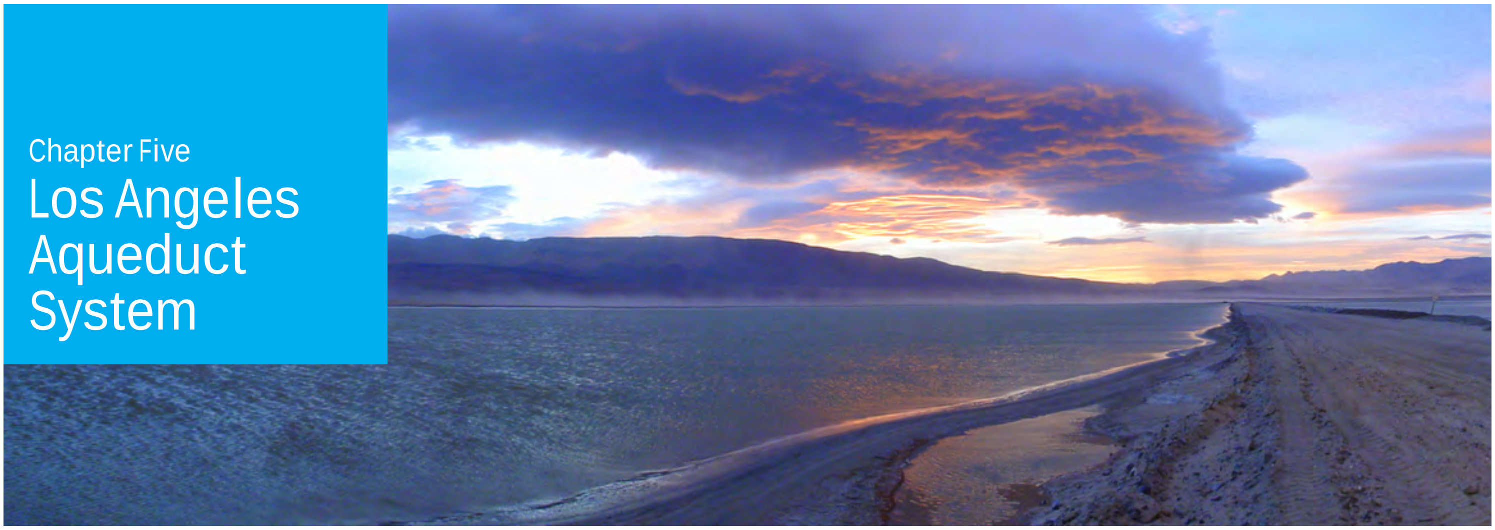
Exhibit 4U
Recycled Water Agency Coordination

Burbank Water and Power[1]	Los Angeles County Department of Public Works[1]
Central Basin Municipal Water District[1]	Metropolitan Water District of Southern California[1]
Glendale Water and Power[1]	Pasadena Water and Power[1]
Los Angeles County Sanitation Districts[1]	Water Replenishment District of Southern California[1]
Long Beach Water Department[1]	West Basin Municipal Water District[1]
Las Virgenes Municipal Water District[1]	Los Angeles Regional Water Quality Control Board
State Water Resources Control Board	Los Angeles County Department of Public Health
California Department of Public Health	City of Los Angeles Department of Public Works, Bureau of Sanitation

1. Met with agencies individually to discuss potential regional recycled water use.

Chapter Five

Los Angeles Aqueduct System

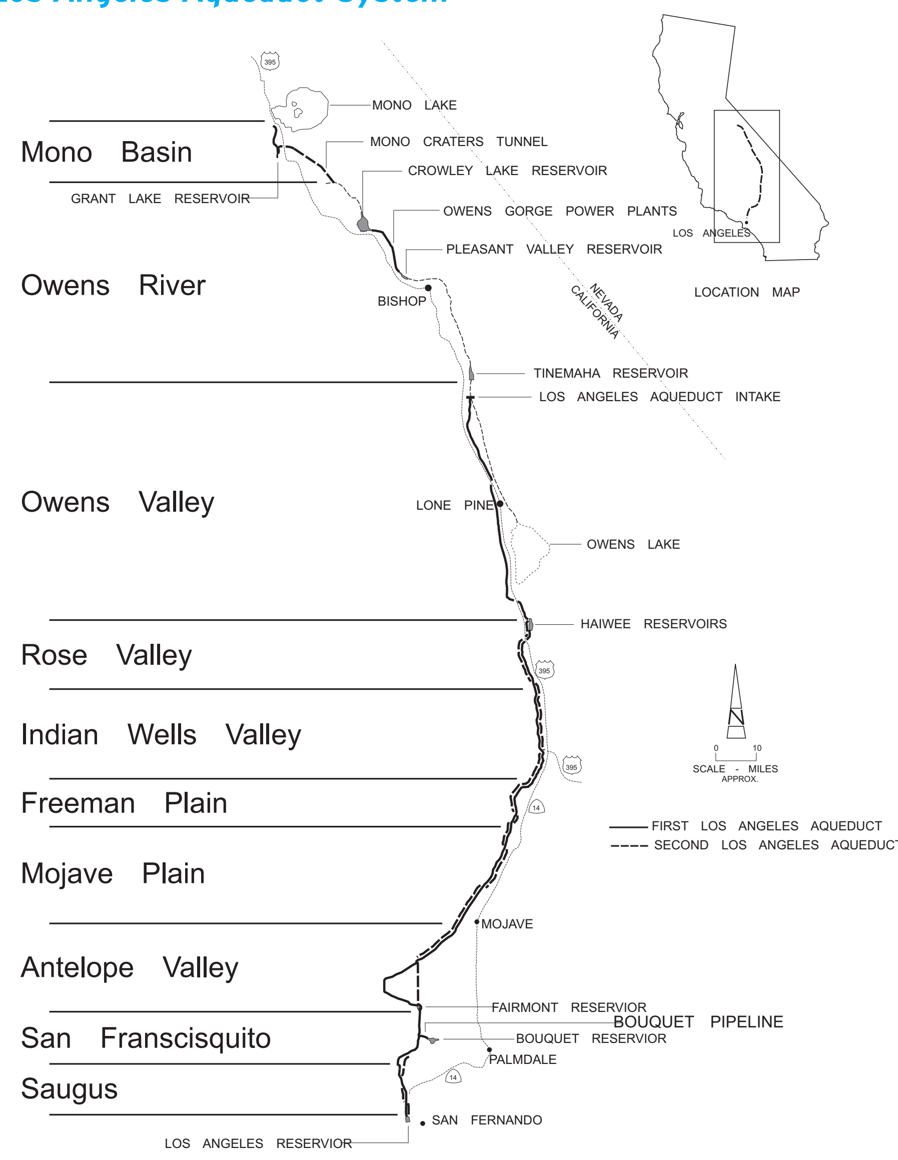


Stormy Sunrise on Owen's Lake

5.0 Overview

Local water supplies have been an integral part of the City's history. The City's population and economy was initially supported through a combination of local surface flows primarily from the Los Angeles River, and local groundwater pumping primarily from the San Fernando Basin. When it became apparent that the local groundwater supply and local surface flows were insufficient to meet the future water needs of the City, the citizens of Los Angeles under the leadership of William Mulholland approved by a 10 to 1 margin a $23 million bond measure to construct the First Los Angeles Aqueduct in 1913. This investment was equal to 12 percent of the entire City's assessed valuation at that time. Then in 1940, an additional $40 million was spent to extend the first aqueduct 40 miles north from the Owens River to streams that were tributaries to Mono Lake, see Exhibit 5A.

Exhibit 5A
Los Angeles Aqueduct System



Pine Tree Sag Pipe Looking South

To meet the additional water needs of its population, the City decided to construct a second barrel of the Los Angeles Aqueduct in 1963, later to become known as the Second Los Angeles Aqueduct. Construction of the Second Los Angeles Aqueduct was completed in 1970. The second aqueduct increased the City's capacity to deliver water from the Mono Basin and the Owens Valley to Los Angeles from 485 cubic feet per second (cfs) to 775 cfs.

The value of the City's historical investment in the Los Angeles Aqueduct (LAA) System is substantial. For nearly a century, the City has benefited from the delivery of high-quality, cost-effective water supplies from the Eastern Sierra Nevada.

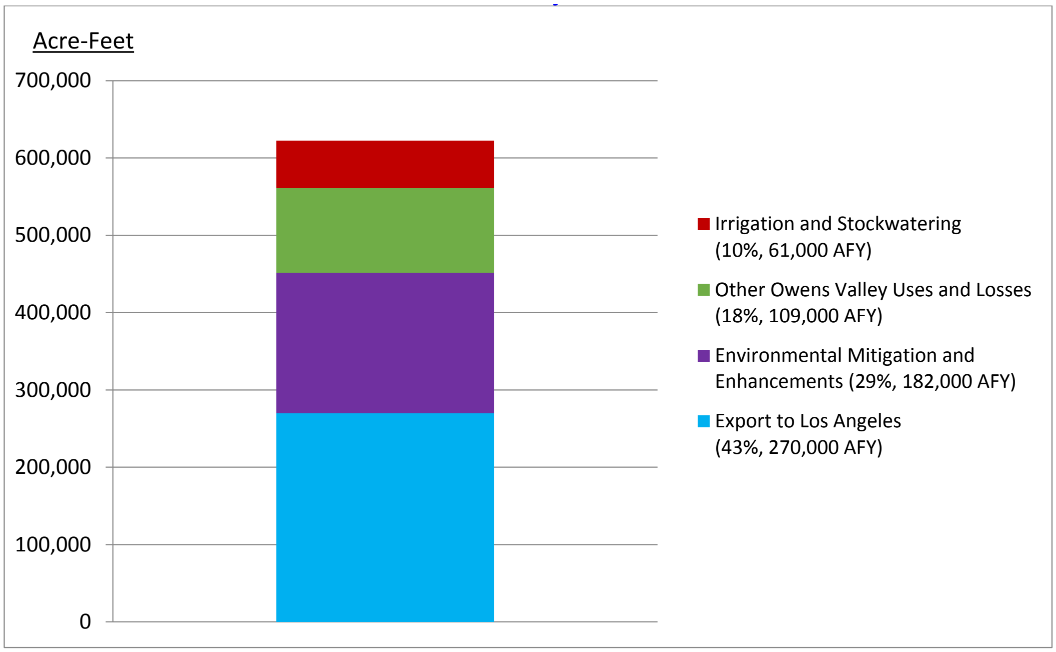
Over time, environmental considerations have required that the City reallocate approximately one-half of the LAA water supply to in-valley uses and environmental mitigation and enhancement projects. Between 1992 and 2015, the City has used approximately 182,000 acre-feet per year (AFY) of water to supply environmental mitigation and enhancement projects in the Owens Valley and Mono Basin. That is in addition to about 61,000 AFY supplied for irrigation and stockwater and 109,000 AFY for other in-valley uses, including uses on Native American Reservations and private lands, recharge, and evaporation and conveyance losses.

In 1991, the County of Inyo and the LADWP entered into a court-ordered agreement, the "Long Term Water Agreement," which established an overall goal for managing groundwater resources within Inyo County. The intent is to avoid certain described decreases and changes in vegetation, and to cause no significant effect on the environment which cannot be acceptably mitigated, while providing a reliable supply of water for export to Los Angeles and for use in Inyo County. In 1994, the State Water Resources Control Board (SWRCB) entered Decision 1631 which amended City water right licenses 10191 and 10192 to establish fishery protection flows for streams tributary to Mono Lake, and to protect public trust resources at Mono Lake and in the Mono Basin. LADWP's water rights licenses in the Mono Basin are under revision pursuant to a 2013 Settlement Agreement reached between LADWP, the Mono Lake Committee, California Trout and the California Department of Fish and Wildlife. LADWP's proposed license amendments include modification of the Grant Reservoir Spillgate to accommodate a new flow regime that will facilitate higher peak flows and more accurately manage lower wintertime base flows in order to complete fishery and habitat restoration on Rush Creek.

Prior to operation under the Long Term Water Agreement, average in-valley water uses and losses totaled 216,000 AFY. In contrast, these uses and losses increased to 278,000 AFY following implementation of the Long Term Water Agreement. Prior to Decision 1631, water exports from Mono Basin into the LAA averaged 90,000 AFY compared to recent average exports of 16,000 AF from the Mono Basin. Limiting water deliveries to the City from the LAA has directly led to increased dependence on imported water supplies from MWD. LADWP's purchase of supplemental water from MWD in FY 2013/14 was at an all-time high.

As indicated in Exhibit 5B, LAA deliveries comprise 43 percent of the total runoff in the Eastern Sierra Nevada in an average year, from Runoff Year (RY) 1992/93 to RY 2014/15. RY is measured from April 1st to March 31st of the following year. The majority of rainfall in the Eastern Sierra Nevada stays in the Mono Basin, Owens River, and Owens Valley serving ecosystem and other uses.

Exhibit 5B
Mono Basin and Owens Valley Water Use Allocations[1]



1. The average post-Water Agreement year begins RY 1992/93 and ends RY 2014/15

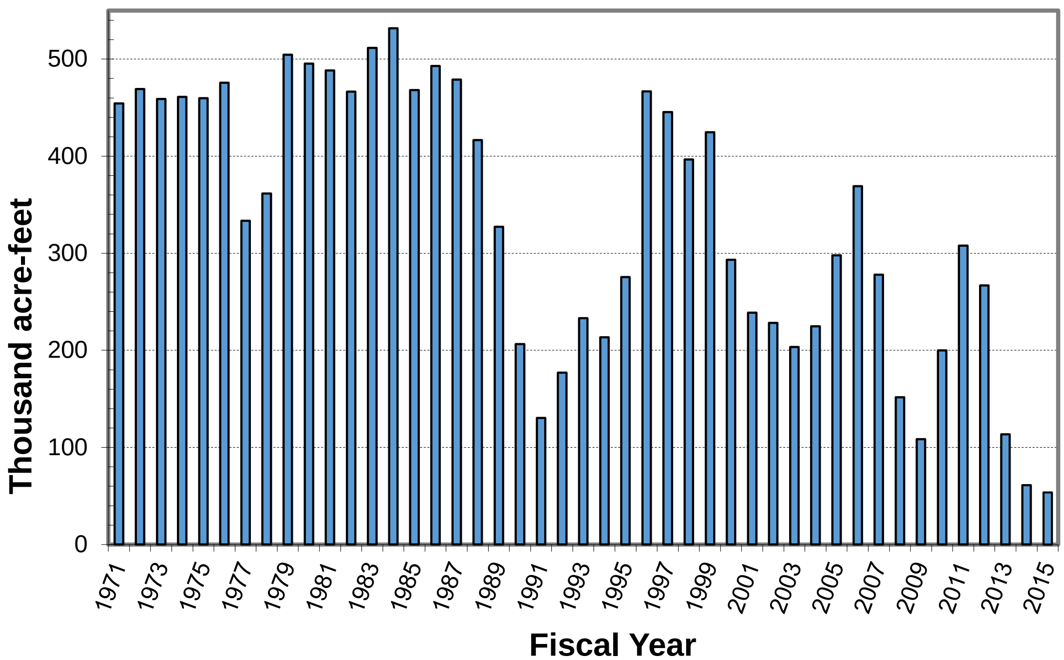
5.1 Historical Deliveries

Annual LAA deliveries are dependent on snowfall in the Eastern Sierra Nevada. Years with abundant snowpack result in larger water deliveries from the LAA, and typically reduced purchases of supplemental water from Metropolitan Water District (MWD). Conversely, low LAA deliveries in dry years increase the demand for supplemental water from MWD.

The impact to LAA water supplies due to varying hydrology in the Mono Basin and Owens Valley is amplified by the requirements to release water for environmental enhancement efforts in the Eastern Sierra Nevada. Since 1989, when City water exports were significantly reduced to comply with State Water Board orders to enhance the Mono Basin's ecosystem, LAA deliveries from the Mono Basin and Owens Valley ranged from 53,500 AF in FY 2014/15 to 466,600 AF in FY 1995/96. Average LAA deliveries since FY 1989/90 have been approximately 244,700 AFY, which is on average 40 percent of the City's total water needs.

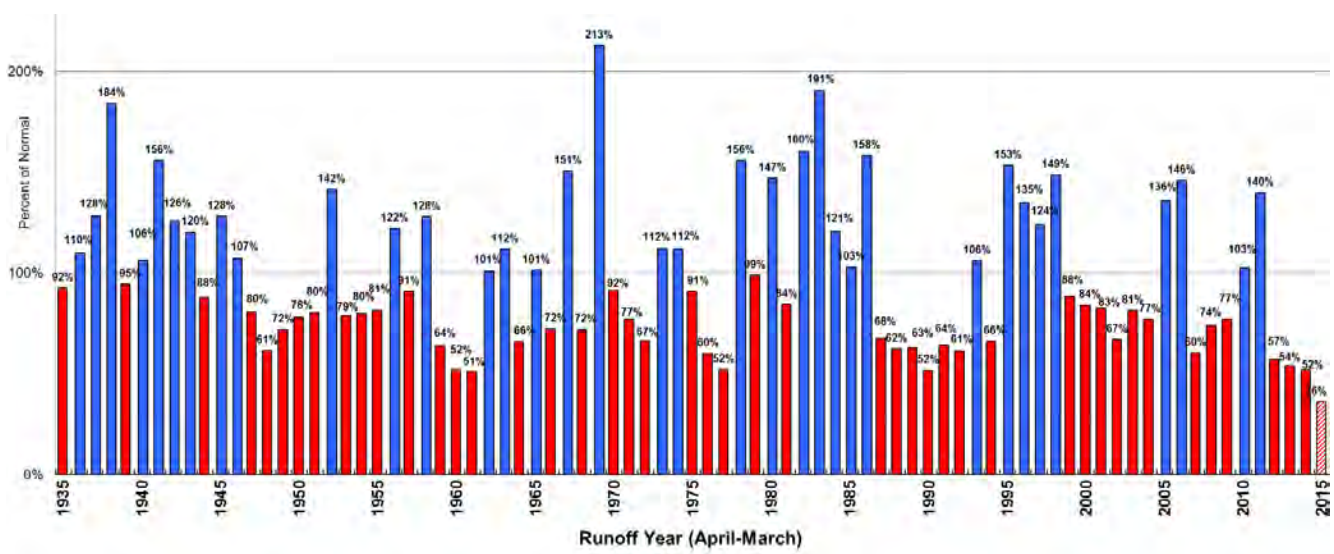
The cyclical nature of hydrology is exhibited best by LAA deliveries over the last fifteen years. This general period was characterized by a series of wet years, followed by a series of dry years that have extended into the current drought period. From FY 2010/11 through 2014/15, LAA deliveries supplied an average of 29 percent of the City's water needs. The reliability impact of hydrologic cycles on LAA supplies is evident throughout historical deliveries. A broader look at how deliveries from the LAA have fluctuated from year to year is shown in Exhibit 5C. In the 1970s and 1980s, majority of the aqueduct deliveries were above 400,000 AFY. They began to slide and dropped below 150,000 AFY by FY 1990/91 due to a severe drought. Deliveries recovered above 400,000 AFY in FY 1995/96 but started declining after the implementation of new environmental allocations. Deliveries in the two short wet periods around FY 2005/06 and FY 2010/11 have never rebounded back to above 400,000 AFY. Beginning in 2012, a multiple-year drought impacted the entire California State and LAA deliveries reached a new record low of 53,500 AF during FY 2014/15.

Exhibit 5C
Historical Los Angeles Aqueduct Deliveries



A long term perspective of the general cycle of wet and dry years for the Owens Valley is evident in Exhibit 5D, particularly since the late 1960s. As illustrated, reliance solely on one water supply source is not practical. Therefore, the City relies on the LAA in combination with the Colorado River Aqueduct and the State Water Project as the City's primary imported water sources. These imported sources combined with local groundwater, recycled water, and conservation make up the City's total water supply portfolio. This portfolio of water resources is fundamental to LADWP's ability to deliver a reliable water supply to meet the needs of nearly 4 million residents of Los Angeles.

Exhibit 5D
Owens Valley Runoff Percent of Normal



5.2 Mono Basin and Owens Valley Supplies

Surface runoff from snowmelt in the Eastern Sierra Nevada Mountains is the primary source of supply for the LAA. The LAA extends approximately 340 miles from the Mono Basin to Los Angeles. Water is conveyed the entire distance by gravity alone. LADWP regulates deliveries to the Los Angeles Aqueduct Filtration Plant through storage control at nine reservoirs. Six reservoirs are used for storage: Grant Lake, Long Valley, Tinemaha, North Haiwee, South Haiwee, and Bouquet Reservoir. The remaining three reservoirs are used to regulate flow for hydroelectric power plant generation, which include Pleasant Valley, Fairmont, and Drinkwater. The total combined reservoir storage capacity of the system is 300,246 AF. Hydroelectric power is generated at 12 power plants along the LAA. Combined maximum capability of the power generation facilities is 215 mega-watts.

The LAA is fed by runoff from the eastern slope of the Sierra Nevada Mountains. Runoff from the eastern slope reaches its maximum in the late spring and summer, after most of the year's precipitation has already occurred. The snowpack in the Eastern Sierra Nevada provides natural storage for the LAA system. This snowpack storage is necessary in light of the minimal regulatory storage capacity along the LAA system.

Water Rights

The City's water rights in the Eastern Sierra Nevada are comprised of riparian rights, pre-1914 appropriations, and post-1914 appropriations held on various streams in the Mono Basin and Owens Valley. Riparian rights are for stream flow used on land adjacent to the stream. Appropriations by the City based on post-1914 water rights are made pursuant to licenses issued by the SWRCB. The majority of the City's water rights are pre-1914 water rights established prior to enactment of the State Water Commission Act. The most significant basis for export of surface water from the Eastern Sierra Nevada is an appropriation claim in 1905 to divert up to 50,000 miner's inches (1,250 cfs) from the Owens River at a location approximately 15 miles north of the town of Independence into the LAA for transport to Los Angeles. The City files supplemental statements (for riparian and pre-1914 water rights) and licensee reports (for post-1914 water rights) of water diversion and use with the SWRCB for its diversions during each calendar year.

The City's water right licenses in the Mono Basin were amended by the SWRCB in 1994 through the Mono Lake Basin Water Right Decision 1631. Recently, water exported from the Mono Basin has been limited to 16,000 AFY based on a court order to raise the target elevation of Mono Lake and restore four streams that flow into Mono Lake. For RY 2015/16, the water exported from Mono Basin will be limited to 4,500 AF, as the Mono Lake water level dropped below the Water Right Decision 1631 trigger elevation of 6,380 feet.

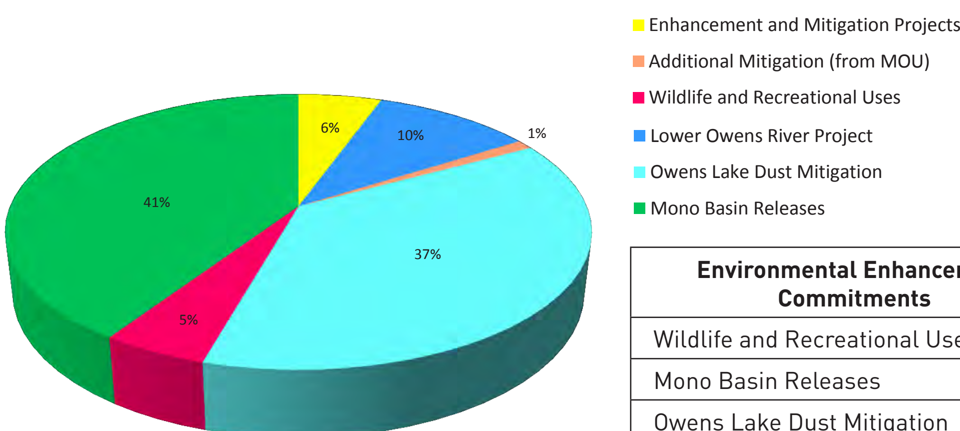
In 2013, LADWP, California Department of Fish and Wildlife, California Trout, and Mono Lake Committee entered into the Settlement Agreement Regarding Continuing Implementation of Water Rights Orders 98-05 and 98-07 (Settlement Agreement). Pursuant to the Settlement Agreement, further amendments by the SWRCB to the City's water right licenses are pending.

The primary groundwater right through which Los Angeles has developed groundwater resources in the Owens Valley is based on ownership of a majority of the land (approximately 314,000 acres) and associated water rights in the Owens Valley. LADWP manages groundwater resources in Inyo County according to a 1991 agreement between Inyo County and LADWP. In 1991, the County of Inyo and the LADWP entered a court ordered agreement, the "Long Term Water Agreement," which established an overall goal for managing groundwater resources within Inyo County. The intent of this agreement is to avoid certain described decreases and changes in vegetation, and to cause no significant effect on the environment which cannot be acceptably mitigated, while providing a reliable supply of water for exports to Los Angeles and for use in Inyo County.

5.3 Environmental Enhancement and Mitigation

Over time an increasingly larger portion of the LAA water supply has been reallocated to the environment. As a result, the City's average supply for environmental enhancement in the Owens Valley and Mono Basin has amounted to 182,000 AFY. To attempt to compensate for the loss of traditional LAA water supplies, LADWP has funded stormwater capture, conservation, and water recycling programs in Los Angeles to augment locally-developed supplies. Exhibit 5E illustrates the breakdown of LAA water supply by category. The environmental enhancement and mitigation projects that have been implemented as part of the City's commitment to meet the environmental water needs of the Owens Valley are also shown as part of Exhibit 5E. Among the environmental projects, LADWP is diverting 9,000 AFY for wildlife and recreational uses, 74,000 AFY for Mono Basin releases, 68,000 AFY for Owens Lake Dust Mitigation, 19,000 AFY for the Lower Owens River Project (LORP), 10,000 AFY of water from the LAA for Owens Valley enhancement and mitigation projects, and 2,000 AFY for additional mitigation for the Memorandum of Understanding (MOU). The Enhancement and mitigation projects were identified and described in the 1991 Environmental Impact Report on Water from the Owens Valley to supply the Second Los Angeles Aqueduct and noted subsequently in the Mitigation Monitoring Program. The 1997 MOU between LADWP, Inyo County, California Department of Fish and Game (CDFG), California State Lands Commission (SLC), Sierra Club, Owens Valley Committee (OVC), and Carla Scheidlinger outlines the requirement for environmental commitments in addition to those identified in the 1991 Environmental Impact Report concerning LADWP's groundwater pumping and related activities.

Exhibit 5E
Mono Basin and Owens Valley Environmental Enhancement Commitments[1]



Environmental Enhancement Commitments	AFY
Wildlife and Recreational Uses	9,000
Mono Basin Releases	74,000
Owens Lake Dust Mitigation	68,000
Lower Owens River Project	19,000
Enhancement and Mitigation Projects	10,000
Additional Mitigation (from MOU)	2,000
Sub Total	182,000

1. The average post-Water Agreement year begins RY 1992/93 and ends RY 2014/15

Mono Basin

Exhibit 5F provides the maximum export levels from the Mono Basin under specified conditions as defined in the SWRCB Decision D1631 that was issued on September 28, 1994. Since the long-term average of Mono Basin exports before 1994 was approximately 90,000 AFY, the net reduction in water exports in the Mono Basin was estimated at 74,000 AFY of water mainly from Grant Lake Reservoir, Lee Vining Creek, Walker Creek, Parker Creek, and Rush Creek when Mono Lake elevation was still above 6,391 feet. As of April 2015, Mono Lake elevation reached 6,379 feet. This means that LADWP's Mono Lake exports will decrease to 4,500 AF for RY 2015/16 as opposed to 16,000 AF for RY 2014/15.

Extensive restoration and monitoring programs in the Mono Basin have improved the streams, riparian, fishery, and waterfowl habitats. In 2013, LADWP, California Department of Fish and Wildlife (CDFW), California Trout, and Mono Lake Committee (the Parties) entered into the Settlement Agreement Regarding Continuing Implementation of Water Rights Orders 98-05 and 98-07 (Settlement Agreement). The Settlement Agreement called for implementation of new flow regimes for the Mono Lake tributaries which included discharges of up to 750 cfs into Lower Rush Creek from Grant Lake Reservoir.

Exhibit 5G summarizes the Settlement Agreements Stream Ecosystem Flow (SEF) requirements for Lower Rush Creek. SEF requirements vary in relation to seven hydrologic conditions ranging from dry to extreme wet as identified by forecasted runoff for Mono Basin.

Exhibit 5F
Mono Lake Elevation and Exports

Mono Lake Elevation (feet)		Exports (AFY)
Transition	<6,377	0
	6,377 - 6,380	4,500
	6,380 - 6,391	16,000
	>6,391	export all runoff less minimum stream flow requirements and stream restoration flows
Post - Transition	<6,388	0
	6,388 - 6,391	10,000
	>6,391	export all runoff less minimum stream flow requirements and stream restoration flows

Exhibit 5G
Rush Creek Stream Ecosystem Flows

Flow Release Schedule	Flow Requirement
Year Type - Extreme Wet	
Starting between June 23 and July 19 with the 5-day peak between June 29 and July 29	220 cfs increasing to 750 cfs, 750 cfs for 5 days, 750 cfs decreasing to 220 cfs
Year Type - Wet	
Starting between June 20 and July 7 with the 5-day peak between June 27 and July 19	170 cfs increasing to 650 cfs, 650 cfs for 5 days, 650 cfs decreasing to 170 cfs
Year Type - Wet Normal	
Starting between June 19 and July 1 with the 3-day peak between June 26 and July 10	145 cfs increasing to 550 cfs, 550 cfs for 3 days, 550 cfs decreasing to 145 cfs
Year Type - Normal	
Starting between June 17 and June 25 with the 3-day peak between June 23 and July 3	120 cfs increasing to 380 cfs, 380 cfs for 3 days, 380 cfs decreasing to 120 cfs
Year Type - Dry-Normal II	
Starting between June 2 and June 15 with the 3-day peak between June 6 and June 21	80 cfs increasing to 200 cfs, 200 cfs for 3 days, 200 cfs decreasing to 80 cfs
Year Type - Dry-Normal I	
Between May 15 and July 3	80 cfs
Year Type - Dry	
Between May 18 and July 6	70 cfs

Note: Flow requirements and release schedule can be found in Tables 1A through 1F on pages 6 - 11 of the Settlement Agreement (SWRCB, 2013).

Lower Owens River Project

Beginning December 2006, the LORP, depicted in Exhibit 5H, releases water from the LAA to create a warm water fishery along a 62-mile section of the Owens River. Water is released near the LAA intake facility and a pump back station is located downstream to return flows to the LAA or to Owens Lake for dust control measures. In accordance with the Memorandum of Understanding between LADWP, Sierra Club, Owens Valley Committee, California Department of Fish and Wildlife, California State Land Commission and Inyo County and the approved Environmental Impact Report, annual monitoring reports are to be prepared to measure project success. The first LORP Annual Monitoring Report was prepared in 2008.

The Memorandum of Understanding prescribes requirements for LORP flows. Both base flows and seasonal habitat peak flows are required for the LORP. A flow schedule is provided in Exhibit 5I. Seasonal habitat peak flows vary between 40 cfs (zero additional flows beyond the base flow requirements) to 200 cfs. For below average RY, seasonal habitat flows may be incrementally lowered from the average RY requirements of 200 cfs to 40 cfs (base flow) in proportion to the forecasted runoff flows in the watershed. Base flows are constant at 40 cfs regardless of forecasted runoff flows. It is estimated that the long-term use and transit losses from the project will be approximately 19,000 AFY.

Exhibit 5H
Lower Owens River Project Area

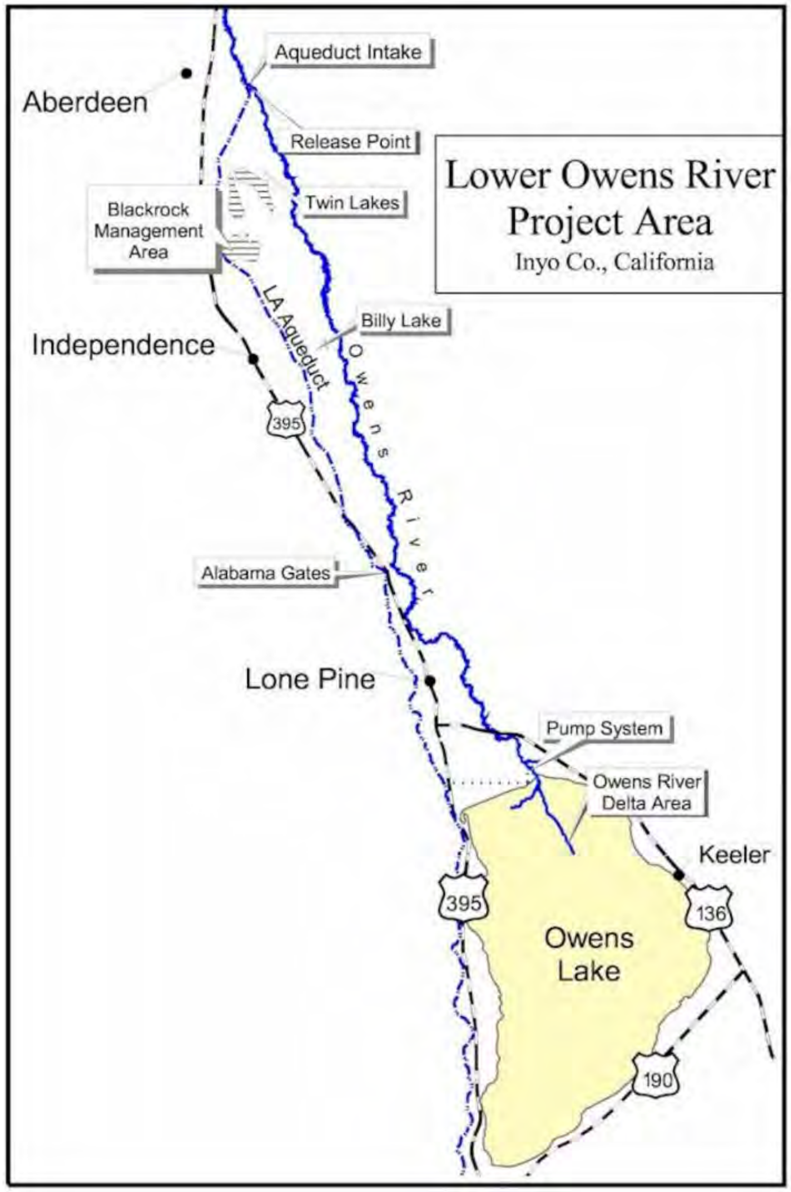


Exhibit 5I
Lower Owens River Base and Peak Seasonal Habitat Flow Requirements

Hydrologic Condition Forecasted[1]	Base Flow	Peak Seasonal
(Percent of Average Runoff)	(cfs)	Habitat Flow[2] (cfs)
50 percent or less	40	Base flow only
70 percent	40	100
100 percent or greater	40	200

1. Runoff forecast determined by LADWP's Runoff Forecast Model for Owens River Basin based on April 1st snow survey.
2. Peak season habitat flows are proportionately ramped up from 40 cfs to 200 cfs based on the percent of average runoff forecasted greater than 50 percent and less than 100 percent.

5.4 Owens Lake Dust Mitigation Program and Master Project

Historically, the Owens River was the main source of water for Owens Lake. Diversion of water from the river, first by farmers in the Owens Valley and then by the City, contributed to the lake being reduced to a small brine pool. Regulators concluded that the exposed lakebed became a major source of windblown dust, resulting in the United States Environmental Protection Agency (USEPA) classifying the southern Owens Valley as a serious non-attainment area for particulates (dust) also known as PM10 emissions in 1991. The PM standard includes Particulate Matter with a diameter of 10 micrometers or less (0.0004 inches or one-seventh the width of a human hair). USEPA's health-based national air quality standard for PM10 is below 50 microgram per cubic meter for an annual mean and below 150 microgram per cubic meter for daily concentration.

As a result of PM10 emissions exceeding regulations, the USEPA required California to prepare a State Implementation Plan (SIP) to bring the region into compliance with Federal air quality standards by 2006. In July 1998, LADWP entered into a Memorandum of Agreement with the Great Basin Unified Air Pollution Control District (GBUAPCD) that: 1) delineated the dust producing areas on the lakebed that needed to be controlled; 2) specified what measures must be used to control the dust; and 3) outlined a timetable for implementation of the control measures. The Memorandum of Agreement was incorporated into a formal air quality control SIP by the GBUAPCD. The plan was approved by the USEPA in October 1999. The regulators approved only three methods of dust control: two of which required the use of water. The California State Lands Commission staff believes that the third method, gravel cover, may not promote Public Trust Doctrine values.

LADWP's water use for dust mitigation purposes at Owens Lake has gradually increased over the years. Exhibit 5J summarizes yearly water use for the Owens Lake Dust Mitigation Program.

Exhibit 5J Yearly Water Use on Owens Lake

Runoff Year	Total AF
2001/02	7,712
2002/03	22,983
2003/04	27,049
2004/05	28,981
2005/06	31,643
2006/07	42,542
2007/08	66,580
2008/09	61,326
2009/10	66,940
2010/11	75,267
2011/12	74,031
2012/13	75,341
2013/14	67,900
2014/15	53,700
2015/16[1]	61,000

1. RY 2015/16 is projected.

Since 2001, LADWP has diverted water from the LAA for the Owens Lake Dust Mitigation Program. A combination of shallow flooding, managed vegetation, and gravel cover are used as Best Available Control Measures for mitigating dust emissions from approximately 48.6 square miles of Owens Lake playa. Exhibit 5K provides a description of the Best Available Control Measures.

Exhibit 5K
Dust Control Mitigation Best Available Control Measures

Dust Control Measures		Description
Shallow Flooding	Sheet Flooding (Lateral)	Releases water from arrays of low-flow water outlets spaced at intervals of between 60 and 100 feet along pipelines laid along lake bed contours. Pipelines are spaced between 500 and 800 feet apart. This arrayed configuration of water delivery creates large, very shallow sheets of braided water channels. Water depths in sheet flooded areas are typically at most a few inches deep. The lower edge of sheet flooded areas has containment berms to capture and pond excess flows. The water slowly flows across the typically very flat lake bed surfaces downhill to tail-water ponds where pumps recirculate the water back to the outlets. To maximize project water use efficiency, flows to sheet flow areas are regulated at the outlets so that only sufficient water is released to keep the soil wet. Any water that does reach the lower end of the control area is collected and recirculated back through the water delivery system.
	Shallow Flooding (Pond)	Water containment berms that allow ponds to be formed that submerge the emissive lake bed areas. These ponds are up to four feet deep. The containment berms are typically rock-faced to protect them from delivery to the pond area until the pond reaches a size and depth sufficient to submerge the required amount of emissive water. Water delivery then ceases until evaporation reduces the pond size to a set minimum.
	Tillage with Best Available Control Measure Backup (TwB2)	TwB2 consists of soil tilling and/or wetting within all or portion of Shallow Flooding Best Available Control Measure where sufficient shallow flood infrastructure and available water supply exists.
	Brine Shallow Flooding	Brackish water containment berms that allow ponds to be formed that submerge the emissive lake bed areas. These ponds are up to four feet deep. The containment berms are typically rock-faced to protect them from delivery to the pond area until the pond reaches a size and depth sufficient to submerge the required amount of emissive water. Brackish water delivery then ceases until evaporation reduces the pond size to a set minimum.
Managed Vegetation		Control measure consists of creating a farm-like environment from barren playa. The saline soil must first be reclaimed with the application of relatively fresh water and then planted with salt-tolerant plants that are native to the Owens Lake basin. Thereafter, soil fertility and moisture inputs must be managed to encourage rapid plant development and maintenance. Existing Managed Vegetation areas are irrigated with buried drip irrigation tubing and a complex network of buried drains to capture excess water for reuse on the Managed Vegetation area or in Shallow Flooding areas. Managed Vegetation is sustainable at Owens Lake only if salt from the naturally occurring shallow groundwater is prevented from rising back into the rooting zone.
Gravel Blanket		Two to four-inch layer of coarse gravel laid on the surface of the Owens Lake playa will prevent emissions by preventing the formation of efflorescent evaporate salt crusts, because the large pore spaces between the gravel particles disrupt the capillary movement of saline water to the surface where it can evaporate and deposit salts. The gravel also creates a surface that has a high threshold wind velocity so that direct movement of the large gravel particles is prevented and the finer particles of the underlying lake bed soils are protected. Gravel Blankets are effective on essentially any type of soil surface.

LADWP has achieved the regulatory requirements of the Phase 7A Project by the required deadline of December 31, 2015. With completion of the Phase 7A Project's dust mitigation components, LADWP has mitigated approximately 45 square miles of dust emissions from Owens Lake playa. Exhibit 5L provides a summary of the phases and their completion dates.

Exhibit 5L
Owens Dust Mitigation Program

Phase	Date Competed
Phase 1 North	December 2001
Phase 1 South	July 2002
Phase 2	April 2003
Phase 3	September 2004
Phase 4	November 2005
Phase 5	December 2006
Phase 7	April 2010
Phase 8	October 2012

Exhibit 5M provides a summary of the GBUAPCD's SIPs and square miles of dust mitigation completed under the SIP.

Exhibit 5M
Owens Dust Mitigation Completed

SIP	Total Area Mitigated (Square Miles)
1998	16.5
2003	13.3
2008	14.7

LADWP reached a historic agreement with the GBUAPCD on November 14, 2014. The agreement was entered as a Stipulated Judgment approved by the Sacramento County Superior Court on December 30, 2014. The agreement for the first time established an upper limit of 53.4 square miles that the City could potentially be ordered to mitigate dust emissions from Owens Lake playa by the GBUAPCD. Without the agreement, the City could have been potentially responsible for mitigating dust emissions for up to approximately 88 square miles of Owens Lake playa, if other regulators concurred. The agreement further allows LADWP to implement new waterless dust control measure on Owens Lake playa. The agreement also contains a commitment by the GBUAPCD to collaboratively work with LADWP to develop other water efficient and non-water dust control methods for use on Owens Lake. The GBUAPCD has also agreed to support LADWP in securing the necessary approvals, right-of-ways, leases, and permits for installation of approved water efficient and waterless dust control measures from regulatory and oversight agencies such as the California State Lands Commission and CDFW. As part of this historic agreement, LADWP has agreed to mitigate dust emissions for an additional 3.62 square miles of Owens Lake playa as was originally ordered by the GBUAPCD in 2011 and 2012 (Phase 9/10 Project). The mitigation of dust emissions for the additional 3.62 square miles of Owens Lake playa is to be completed by December 31, 2017 at an estimated cost of $200 million. The Phase 9/10 Project is anticipated to result in further water conservation at Owens Lake through increasing use of water efficient and waterless dust mitigation measures. Upon completion of the Phase 9/10 Project, LADWP will mitigate approximately 48.62 square miles of dust emissions in the Owens Lake playa. Hence, the GBUAPCD's potential future dust mitigation orders to LADWP cannot exceed an additional 4.8 square miles.

LADWP is also working collaboratively with the local Native American tribes, Lone Pine Chamber of Commerce, Inyo County, GBUAPCD, CDFW, California State Lands Commission, U.S. Bureau of Land Management, U.S. Forest Service, California Native Plant Society, Eastern Sierra Audubon Society, Sierra Nevada Conservancy, Rio Tinto Minerals, and other stakeholders to develop and implement the Master Project. The Master Project's goal is to continue to meet the ambient air quality standards while maintaining wildlife habitat values on Owens Lake and conserving water.

The Master Project is anticipated to be fully implemented by 2024. The estimated cost is between $600 million to $1 billion. Depending on the Master Project's overall habitat requirements and values, LADWP anticipates conserving and further reducing water usage for dust mitigation purposes on Owens Lake to between 40,000 and 50,000 AFY.

Cascades on the Los Angeles Aqueduct

5.5 Water Quality

As land owners of much of the Mono Basin and Owens River watersheds, LADWP has placed strict limits on the extent of development impacting the City-owned watersheds. Snowmelt from the Eastern Sierra Nevada is a high quality water source containing very low concentrations of total organic carbon (TOC), bromide, and other constituents that can form disinfectant byproducts during the water treatment process. LADWP conducts routine monitoring of all of its water supplies for over 170 constituents and contaminants. One hundred of theses constituents and contaminants have enforceable standards.

The LAA supply is the main source of natural arsenic in LADWP's water supply. The Owens River flows through volcanic formations and receives input from geothermal springs throughout the Owens Valley, but predominately from Hot Creek in Long Valley. Geothermal springs in these areas have arsenic concentrations of around 200 parts per billion (ppb). Concentrations are dramatically reduced as water in the area mixes with snow melt and other pristine water sources. Historic untreated LAA water arsenic concentrations have ranged from 10 to 74 ppb. During the last 5 years of routine compliance monitoring from 2010 to 2014, the highest arsenic concentration after treatment at Cottonwood Treatment Plant and the Los Angeles Aqueduct Filtration Plant was 6 ppb, while the average arsenic concentration within LADWP's water distribution system was 3.2 ppb, both well below the current Federal and State drinking water standard of 10 ppb set by USEPA in 2000. In anticipation of more stringent arsenic regulations in the future, LADWP is taking a proactive approach in addressing this issue by investigating and planning enhanced coagulation treatment.

LADWP completed an evaluation and preliminary design report for enhanced coagulation at the Los Angeles Aqueduct Filtration Plant (LAAFP) in December 2006 as a means of addressing future water quality regulations faced by LADWP, including arsenic. However, the need to meet the Stage 2 Disinfectants/ Disinfection Byproducts Rule (S2DBPR) by 2012, delayed work on the final design to complete other major projects. An enhanced coagulation facility using the process as outlined in the report is planned as part of the treatment process at the Los Angeles Aqueduct Filtration Plant by 2032.

To comply with the 2012 deadline for the S2DBPR, the water quality improvement effort focused on the conversion from chlorine to chloramine as a secondary disinfectant. LADWP obtained a 2-year extension to the 2012 compliance date citing major capital improvement projects needed to comply. This transition, which was completed in May 2014, allowed LADWP to maintain the same high level of disinfection in its water distribution system, while minimizing the formation of the disinfection byproducts (DBPs), including Total Trihalomethane, Halogenic Acetic Acid, and bromate. This conversion also required a change in the primary disinfectant used at the LAAFP. Ozone which for many years provided primary disinfection could not be used with the increasing reliance on SWP supply. Bromate, a disinfection byproduct of ozone, forms in the presence of the high bromide found in SWP supplies, especially during dry years when sea water intrusion is most pronounced. In response, LADWP built the second largest state-of-the-art ultra-violet (UV) disinfection treatment facility in the nation. The UV treatment and conversion to chloramines has reduced DBP levels in the water distribution system by nearly 50 percent. The use of chloramines will provide additional operational flexibility by allowing the blending of purchased MWD water (which contains chloramines) into the LADWP distribution system without the problems associated with creating a chlorine/chloramines interface when blending the two supplies.

5.6 Projected Deliveries

Near-term water deliveries are forecasted for the LAA using two models, the Runoff Forecast Model and the Los Angeles Aqueduct Simulation Model (LAASM). These two models, used jointly, accurately predict the amount of water available from the LAA.

The Runoff Forecast Model is used to predict total Owens Valley and Mono Basin stream runoff. The model's estimating equations were developed using historical rainfall, snowfall, and streamflow data. Model inputs consist of 6 months of antecedent rainfall and streamflow data, as well as the final snowpack levels on April 1st. The model's output is the forecasted runoff for the Owens Valley and Mono Basin during the twelve month period following April 1st, assuming that median rainfall occurs during those twelve months.

Runoff flows from the Owens Valley to the City of Los Angeles are modeled by the LAASM. LAASM uses the output of the Forecast Model as input, along with estimates of various uses within the Owens Valley. LAASM uses estimating equations based on historical data to forecast various losses, including evaporation and infiltration, as well as other inflows such as unmetered springs. The final output from LAASM is the volume of LAA water projected to be delivered to the City of Los Angeles.

Taking the foreseeable factors discussed earlier in this chapter into consideration, the average annual long-term LAA delivery over the next 25 years, using the 50-year average hydrology from FY 1961/62 to 2010/11, is expected to be approximately 278,000 AFY and gradually decline to 267,000 AFY due to climate change impact. However, with the anticipated completion of the Master Project by 2024, the projected LAA delivery will increase to 286,000 AFY due to water conserved at Owens Lake. Deliveries for a series of dry years, assuming a repeat of FY 2012/13 through 2014/15 hydrology, are expected to range from approximately 33,700 AFY to 111,400 AFY during FY 2015/16 through FY 2017/18. A single dry year minimum of 32,400 AFY is expected with a repeat of FY 2014/15 hydrology. An annual reduction factor due to climate change impact is applied for both multiple dry years and single dry years. Detailed projections of LAA deliveries by year are provided in Chapter 11, Water Service Reliability Assessment.

5.7 LAA Delivery Cost

The costs associated with the LAA water supply are primarily operation and maintenance costs. Therefore, the unit cost of importing water through the LAA to the City varies with the quantity of water delivered, which is highly dependent on hydrologic conditions. During dry years, the amount of water delivered to the City decreases, which results in an increase to the unit cost. Over the years, Eastern Sierra Nevada environmental enhancement project costs have also contributed to rising overall LAA delivery unit costs. The Owens Lake Dust Mitigation Program and Lower Owens River Project are two examples. Exhibit 5N summarizes the historical unit cost of treated water from the LAA. The peaks occurred when LAA deliveries significantly decreased during FY 1990/91, 2002/03, 2008/09, and 2014/15 with the LAA delivering 130,300 AF at $499/AF, 203,400 AF at $419/AF, 108,500 AF at $1,003/AF, and 53,500 AF at $2,723 respectively.

Exhibit 5N
Historical Unit Cost of LAA Treated Water

Exhibit 5O shows the unit cost of LAA treated water from FY 2010/11 to 2014/15. The 5-year average was $1,481/AF. The increase in cost for FY 2014/15 was due to LAA deliveries being the lowest on record.

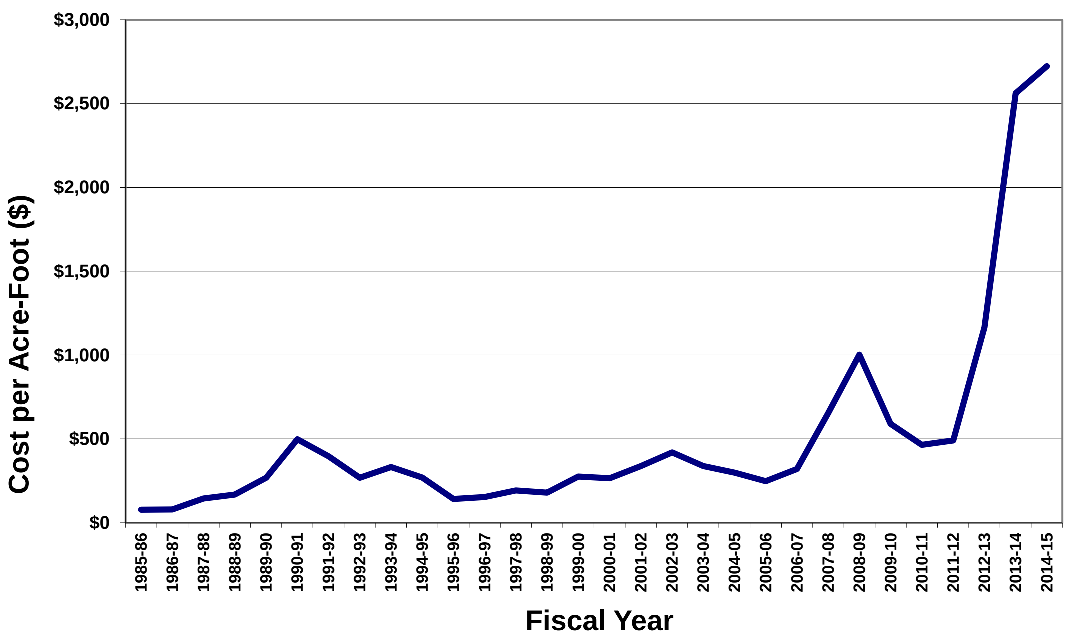


Exhibit 5O
Annual Unit Cost

	Fiscal Year				
	2010/11	2011/12	2012/13	2013/14	2014/15
Unit Cost per AF	$464	$491	$1,165	$2,562	$2,723

Chapter Six

Local Groundwater

Mission Wellfield Water Tank

6.0 Overview

A key resource that the City has relied upon as a major component of its local water supply portfolio is local groundwater. Over the last five years local groundwater has provided approximately 12 percent of the total water supply for Los Angeles, and since 1970 has provided up to 23 percent of total supply during extended dry periods when imported supplies become less reliable. California is experiencing a multi-year dry period that began in 2012 and continued through 2015. The State's surface water resources have been diminishing during this period and the California Department of Water Resources (DWR) has responded by reducing water allocations to the State Water Project (SWP). Similar hydrologic conditions affecting the Los Angeles Aqueduct (LAA) system's source waters, contained in the Eastern Sierra snowpack, have led to historic low deliveries of Owens Valley supply. Governor Jerry Brown declared a statewide drought emergency on January 17, 2014 and signed into state law the Sustainable Groundwater Management Act (SGMA) on September 16, 2014. The Metropolitan Water District (MWD) enacted its Water Supply Allocation Plan effective July 1, 2015, thereby limiting its delivery of imported water to Southern California member agencies. As a result, local groundwater resources have become increasingly important to California communities, including Los Angeles.

Several sources of local groundwater within Los Angeles are accessible to the City. The Upper Los Angeles River Area (ULARA) watershed is the principal groundwater resource where the City produces local groundwater from the San Fernando and Sylmar Basins. The City also produces local groundwater from Central Basin and is entitled to produce water from the neighboring West Coast Basin. The Hollywood and Santa Monica Basins are local resources where the City may potentially develop future drinking water supplies in partnership with neighboring municipalities. Combined, these basins can potentially supply the City with more than 110,000 AFY of groundwater. However, various challenges have restricted the City's use of these local resources.

Industrial contamination issues are the principle reason for restricted use of local groundwater pumping by the City. Much of LADWP's pumping capacity has been impaired by contaminants, primarily volatile organic compounds (VOCs). In the San Fernando Basin (SFB), more than 80 of LADWP's 115 water supply wells have been removed from service, or restricted in use. In neighboring Sylmar Basin, contamination has caused two of three LADWP water supply wells to be removed from service. Two of ten LADWP water supply wells in the Central Basin have been impaired, taken off line, and demolished as a result of groundwater contamination issues. Water quality problems associated with hydrocarbon pollutants caused LADWP to discontinue utilizing its West Coast Basin facilities in 1980. Furthermore, declining groundwater levels and overdraft conditions have become additional concerns for

Los Angeles basins where decades of expanding urbanization, increasing impervious hardscape, and channelization of stormwater runoff have diverted natural replenishment away from local aquifers. Aging wellfields and distribution system infrastructure has also presented challenges to the development and use of the City's local groundwater resources.

Combined, these challenges have caused the City to renew its focus on sustainable management of its local groundwater basins. Responding to groundwater contamination issues has been a high priority of the City, particularly in the SFB. Recently completed studies have provided analysis of groundwater quality and characterization of the extent of contaminants affecting the City's largest well fields in the basin. Expanded basin remediation systems are under development to remove contamination from the local groundwater basin for the betterment of the environment and to restore the beneficial uses of this important basin. The expanded remediation facilities are anticipated to be operational by 2021. Efforts in the Sylmar and Central Basins have been focused on rehabilitation of LADWP's well fields. Water supply wells impaired by contamination are being replaced using modern construction standards to restore lost pumping capacity and improve water quality.

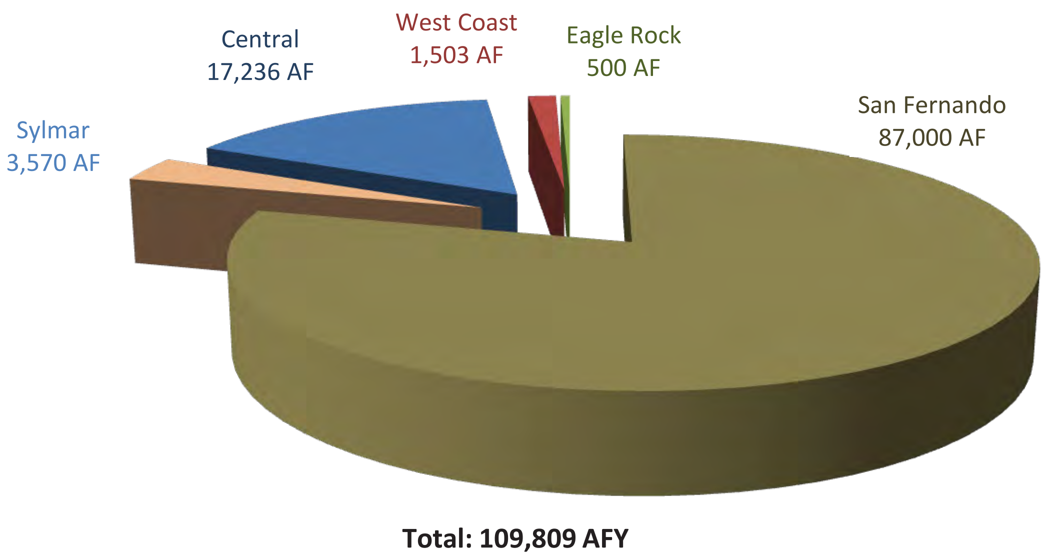
LADWP continues to invest in stormwater recharge projects to restore local groundwater basin levels by enhancing and enlarging existing stormwater capture facilities, as discussed in Chapter 7: Watershed Management and Stormwater Capture. Investments in advanced treatment systems in SFB to produce purified recycled water for groundwater replenishment and indirect potable reuse are discussed in Chapter 4: Water Recycling. These investments will help augment the City's groundwater and ensure basin water levels remain sustainable for many decades into the future. With the recent conclusion of water rights litigation in December 2015, the Superior Court of the State of California has affirmed the City's entitlements to groundwater in Antelope Valley Groundwater Basin. Although native groundwater may only be used locally within the basin, the City is entitled to use the Antelope Valley Groundwater Basin as an underground reservoir to store imported supplies for future export to Los Angeles during emergencies or dry periods.

Manhattan Wellfield

6.1 Groundwater Rights

The City owns water rights in the San Fernando, Sylmar, Eagle Rock, Central, and West Coast Basins. All of these basins are adjudicated by judicial decrees of the Superior Court of the State of California (each Judgment is provided in Appendix F). The City's combined water rights in these basins are approximately 109,809 AFY, of which approximately 87,000 AFY are located in the SFB, 500 AFY in the Eagle Rock Basin, and 3,570 AFY in Sylmar Basin. Central Basin water rights were recently increased from 15,000 AFY to 17,236 AFY as a result of three purchase transactions completed during 2014 and 2016. Water rights in the West Coast Basin are 1,503 AFY, which the City may produce from the Central Basin per the Third Amended Central Basin Judgment. Exhibit 6A graphically depicts the City's annual local groundwater entitlements by basin.

Exhibit 6A
Annual Local Groundwater Entitlement



The ULARA Groundwater Basin Adjudication

The ULARA watershed, in its entirety, is addressed in DWR Bulletin 118 as basin number 4-12. ULARA watershed encompasses four primary groundwater basins: San Fernando, Sylmar, Verdugo, and Eagle Rock Basins. The City's groundwater entitlements in these basins were established by judicial decree of the Superior Court of the State of California for the County of Los Angeles in Case No. 650079, *The City of Los Angeles, Plaintiff, vs. Cities of San Fernando, et. al., Defendants,* dated January 26, 1979 (ULARA Judgment) and the subsequent Sylmar Basin Stipulations (Sylmar Stipulation). Appendix F contains the ULARA Judgment and Sylmar Stipulation.

Groundwater Basin Management and Sustainability

The ULARA Judgment requires safe yield operations for each of the basins to ensure groundwater extractions over the long-term do not create a condition of overdraft in any one of these basins. Basin management in ULARA is achieved by collective efforts of a court-appointed Watermaster and ULARA Administrative Committee of representatives from five public water supply agencies overlying the ULARA Basins. The five public agencies include representatives from the City of Burbank, City of Glendale, City of Los Angeles, City of San Fernando, and Crescenta Valley Water District.

Reports furnished by the ULARA Administrative Committee members enable the Watermaster to publish annual reports. The annual reports monitor and account for actual and projected groundwater extractions, water imports and exports to and from each basin, natural and artificial groundwater recharge, generation and reuse of recycled water, changes in groundwater elevations and storage, and groundwater quality. ULARA Administrative Committee members have made significant contributions towards ensuring sustainable management of ULARA basins. These efforts include operation of groundwater remediation systems, use of an extensive network of groundwater monitoring wells, routine reporting on groundwater elevation and water quality, management and mitigation of urban runoff water quality, and development of enhanced stormwater recharge and groundwater replenishment.

Federal and State regulatory agencies are also involved with managing water quality and are requiring responsible parties to assist with expedited cleanup of groundwater contamination at sites within the ULARA watershed. These regulatory agencies include the Los Angeles Regional Water Quality Control Board (LARWQCB), State Water Resources Control Board—Division of Drinking Water (DDW), California Department of Toxic Substance Control (DTSC), and the United States Environmental Protection Agency (USEPA). The Watermaster and ULARA Administrative Committee members routinely meet and coordinate efforts with these agencies. As required by the 2009 Statewide Recycled Water Policy, the Watermaster and ULARA Administrative Committee members are preparing a Salt and Nutrient Management Plan for each basin within the ULARA watershed. This plan will quantify the effects and possible mitigation of salt loading activities on groundwater, in order to protect groundwater quality from long-term degradation.

Historical Groundwater Production

On average over the past five years, about 89 percent (59,621 AFY) of the City's local groundwater supply was produced from ULARA groundwater basins, while the Central Basin provided 11 percent (7,514 AFY). Exhibit 6B summarizes the City's local groundwater production by basin over the last five years.

LADWP utilizes conjunctive use strategies to optimize available surface water and groundwater to balance supplies with demand. Through conjunctive use, the timing of groundwater pumping can be used to meet varying demands. During previous successive dry-year periods, LADWP would pump groundwater at greater-than-average rates for the first few years of the drought, followed by lower pumping rates in subsequent years to facilitate groundwater basin replenishment. This strategic pumping would serve to meet dry year needs while also preventing an overdraft condition within the basin.

Since 2007, groundwater contamination issues in the SFB have greatly limited LADWP's ability to strategically increase groundwater pumping. As a result, LADWP has been limited in its ability to effectively use conjunctive use strategies for SFB groundwater operations. As basin remediation is expanded, the beneficial use of the SFB to store and supply groundwater conjunctively can begin to be restored. Eventually, LADWP will regain its ability to conjunctively use the basin to ensure water supply reliability while at the same time protecting the basin against overdraft conditions.

With the 2012 onset of the recent drought and resulting statewide water shortages, the need for groundwater supplies has never been greater. MWD encouraged all its member agencies to reduce their reliance on imported water supplies from the drought impacted SWP. LADWP

Exhibit 6B
Local Groundwater Basin Supply
Fiscal Year (July through June in AF)

Groundwater Basin	2010/11	2011/12	2012/13	2013/14	2014/15	Average	Percentage
San Fernando	44,029	50,244	50,550	68,784	80,097	58,741	88
Sylmar	225	1,330	1,952	891	0	880	1
Central	5,099	9,486	6,310	9,727	6,948	7,514	11
Total	49,353	61,060	58,812	79,402	87,045	67,135	100

responded by proactively increasing groundwater pumping from SFB to reduce LADWP's deliveries from the SWP. In an effort to respond to the statewide emergency, by maximizing this water source, LADWP cautiously increased pumping rates in the SFB recognizing that this strategy may need to be limited if contaminant concentrations at each operating wellhead increased. Water quality conditions have been closely monitored and LADWP will curtail pumping as necessary to ensure continued compliance with safe drinking water standards. As compared with previous non-drought years, LADWP successfully increased its pumping during FY 2013/14 and FY 2014/15 as shown in Exhibit 6B.

Groundwater Development and Augmentation Plan

As Los Angeles Mayor and City leaders call for locally sustainable water supplies, LADWP is taking a comprehensive approach towards development of the City's local groundwater assets. Concurrent with the pursuit of immediately beneficial groundwater projects, the Groundwater Development and Augmentation Plan (GDAP) is the next step towards developing the use, storage, and augmentation of local groundwater supplies. GDAP will help LADWP identify projects, programs, and strategies that secure, enhance, and diversify water supply to the region. GDAP will result in a prioritized program of capital improvement projects that LADWP can develop and pursue in cooperation with its regional partners.

6.2 San Fernando Basin

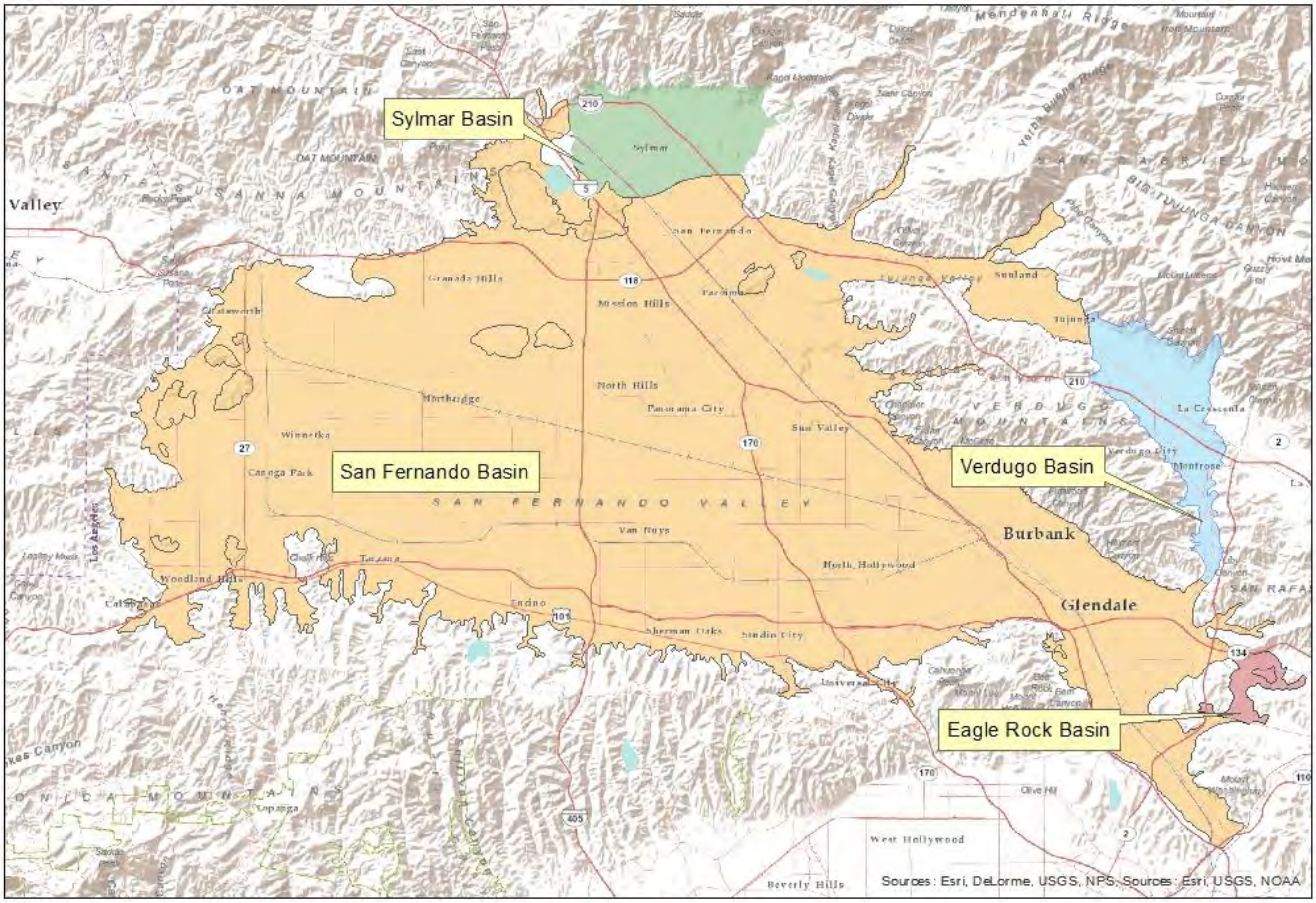
The primary source of local groundwater for the City is the SFB, which has provided as much as 92 percent of the City's groundwater supply during the recent five-year period, ranging from 44,029 AFY to 80,097 AFY. The SFB is the largest of four groundwater basins in ULARA, spanning 112,000 acres. This basin is bounded on the east by the Verdugo Mountains; on the north by the Little Tujunga Syncline and the San Gabriel and Santa Susana Mountains; on west by the Simi Hills; and on the south by the Santa Monica Mountains. Exhibit 6C provides a map depicting the four groundwater basins of ULARA.

LADWP's well fields were generally installed over a 65-year period spanning from 1924 to 1991.LADWP has ten major well fields within the SFB comprising a total of 115 wells, which if fully operational have a maximum pumping capacity of 540 cubic feet per second (cfs). The actual pumping capacity is significantly less due to the large number of wells that have become inoperable or restricted mostly due to contamination.

Tujunga, Rinaldi-Toluca, and North Hollywood Wellfields are LADWP's largest and primary well fields providing a maximum combined pumping capacity of nearly 268 cfs. The Tujunga and Rinaldi-Toluca Wellfields provide nearly 70 percent (213 cfs) of the City's maximum active pumping capacity in SFB. Erwin, Verdugo, and Whitnall provide flexibility and additional capacity of 29 cfs. Pollock Wellfield is located along the Los Angeles River Narrows and provides nearly 6 cfs of capacity to produce groundwater that would otherwise outflow from the SFB. The North Hollywood Operable Unit (NHOU) Wellfield is a USEPA Superfund facility that provides approximately 2 cfs remediation capacity with treated groundwater being discharged into the LADWP water distribution system. Collectively these eight well fields have a maximum active capacity to pump nearly 305 cfs of SFB groundwater.

Two remaining well fields, Crystal Springs and Headworks Wellfields, have historically provided an additional 65 cfs of pumping capacity but are no longer in service. Planning efforts are underway to revitalize and restore operations at Headworks Wellfield. The most recent well fields are Rinaldi-Toluca established in 1988 and Tujunga established in 1991.

Exhibit 6C
San Fernando Basin



Groundwater Rights

In accordance with the ULARA Judgment, the City has the exclusive right to utilize the surface waters tributary to the Los Angeles River (LA River) and all native groundwater within the SFB, which represents the Pueblo Water Right of the City of Los Angeles. The City also has the right to recapture Import Return Water, groundwater derived from percolation attributable to delivered imported water. This Import Return Water is calculated each year by the ULARA Watermaster based on 20.8 percent of water LADWP delivered to customers overlying the basin, including delivery of recycled water. Native safe yield has been determined as 43,660 AFY and Import Return Water averages approximately 43,000 AFY, therefore the City's estimated water right in SFB is 87,000 AFY. The ULARA Judgment allows groundwater to be stored within the basin when the City pumps less than its annual water right, and stored water credits may be pumped in future years to supplement the City's water supply. The direct spreading of both imported surface water and recycled water by the City increases the water rights by an equal amount.

In September 2007, the Cities of Los Angeles, Glendale and Burbank entered into a ten-year Interim Agreement for the Preservation of the San Fernando Basin Water Supply (Interim Agreement). The Interim Agreement is intended to address reductions in stored groundwater within the basin and accumulation of stored water credits. The Interim Agreement acknowledged the need for projects to enhance stormwater recharge capacity, limited pumping of stored water credits, began the accounting for groundwater losses from the basin, and it also envisioned a future basin safe yield study.

In response to the Interim Agreement, LADWP has worked in collaboration with Los Angeles County Flood Control District (LACFCD), other local agencies, and non-local governmental organizations to develop and sponsor various projects that will significantly enhance stormwater recharge capacity in the basin. Additionally, as described in the Interim Agreement, the ULARA Watermaster has placed limits on the pumping and usage of stored water credits. The ULARA Watermaster determines the proportion of credits that can be made available during each water year (Available Credits) and restricts the remaining balance (Reserve Credits). As of October 1, 2013, the City has accrued stored water credits amounting to 537,453 AF, of which 175,806 AF was made available for use and 361,648 AF was placed on reserve.

As groundwater levels increase within the basin due to natural infiltration, stormwater capture, etc., more Reserve Credits will become available for use. This ensures stored water can be pumped in a sustainable manner that will not result in a condition of critical overdraft for the basin. A basin safe yield study was prepared in 2009 but not finalized. At that time, the ULARA Watermaster determined that SFB was not in a condition of overdraft and that current operations did not pose an imminent threat to water supplies. This affords basin pumpers time to complete stormwater recharge enhancement projects while also compiling data necessary for a future re-evaluation of safe yield.

Groundwater Development

Los Angeles River Narrows Underflow Study: Groundwater in the SFB naturally flows across the basin in a general southeasterly direction towards the Los Angeles River Narrows where the LA River bends to a southward alignment as it flows towards river gaging station Gage F-57C-R. Gage F-57-C-R is owned and operated by LA County Flood Control District. Groundwater becomes shallow in this area, tending to rise into an unlined reach of the LA River where it emerges as flow within the river channel. Subsurface groundwater also flows southward from this same locality leaving the SFB. This groundwater outflow is accounted for annually in the basin water budget provided with each ULARA Watermaster Report.

These annual losses are estimated using a methodology developed in the Report of Referee in 1962 utilizing readings from Gage F-57C-R and other nearby river gages. Average annual losses from 1971 through 2012 due to rising groundwater was estimated at 3,257 AFY; average annual losses due to subsurface outflow was estimated at 400 AFY. From 1915 until 1983, LADWP reduced basin outflows by diverting LA River surface water into Headworks Spreading Grounds and extracting the replenished groundwater from nearby Headworks Wellfield, until operations ceased due to discovery of contaminated groundwater at the wellheads. The Headworks Spreading Grounds has since been decommissioned and LADWP has repurposed the site for a recently constructed water storage reservoir. Pollock Wellfield, located upgradient of Gage F-57C-R, remains in operation and LADWP continues to produce groundwater intercepting much of the potential outflow losses.

During the 1990s to 2000s, a number of events resulted in the need to re-examine the outflow situation:

1. Pollock Wellfield was taken out of service for a decade until the 1999 installation of a groundwater treatment plant,

2. Headworks Wellfield and Spreading Grounds were removed from service,

3. Local stream gages were abandoned or became dysfunctional, and

4. Gage F-57C-R readings were deemed unreliable due to maintenance and construction issues.

To improve the understanding of basin outflows and accurately quantify the flux of water through the basin boundary, LADWP began working with ULARA Watermaster to evaluate various river gages and identify the need for repair or replacement of any problematic gaging station. These continuing efforts also involve coordination with LACFCD, owner of the gauging stations. LADWP is now securing an expert consultant who will prepare a hydraulic and hydrogeologic computer model to simulate groundwater flows through this region of the narrows. The results and findings will be integrated into an improved methodology for basin outflow estimations and the overall basin water budget calculation. Proposals for additional measurement systems and strategies to contain or reduce basin losses will also be considered.

Saugus Formation Exploration and Test Wells at Van Norman Complex: Two exploratory test wells have been constructed at LADWP's Van Norman Complex to investigate hydrogeology, water quality, and potential yield for groundwater production from this region of the Saugus Formation. The test wells have been sited near the Los Angeles Aqueduct Filtration Plant intake channel to accommodate test pump discharges and avoid the cost of conveyance discharge lines. The first exploratory well VN-EW-1 was completed to 1,660 feet below ground surface and exploratory well VN-EW-2 was completed to 1,680 feet below ground surface. Initial laboratory tests indicate water produced from both test wells are of acceptable water quality, complying with all safe drinking water standards. Groundwater from confined aquifer units was found to be in an artesian condition with natural flow as much as 150 gallons per minute (gpm); pumping tests will evaluate long term drawdown and sustainable yield to produce groundwater from this aquifer.

Groundwater Quality

During 1980s testing of water supply wells in SFB, trace levels of the contaminants trichloroethylene (TCE), perchloroethylene (PCE), and other VOCs were discovered. The presence of these contaminants is due to past improper chemical handling and disposal practices of industries in the San Fernando Valley. Additionally, the 1990s saw the emergence of hexavalent chromium (chromium VI or Cr(VI)) and perchlorate detected in various wells within the SFB. Nitrate concentrations have also been detected in an increasing trend since the 1990s. The source of nitrate originates from agricultural activities across the San Fernando Valley. Most recently, 1,4-dioxane has been an emerging chemical of concern with an increasing trend.

Industrial contaminants have severely impaired the majority of LADWP's 115 wells in the SFB. Of these, 57 wells have been removed from service, lowering LADWP's pumping capacity by an estimated 236 cfs. Of the remaining 58 wells, various contaminants have been recorded in 45 wells at concentrations exceeding the Maximum Contaminant Level (MCL) established by State and Federal regulatory agencies. Among these contaminants of concern are VOCs (TCE, PCE, and carbon tetrachloride), nitrates, and perchlorate. Marginal levels of contamination have been detected in the remaining 13 wells, mostly due to VOCs. Hexavalent chromium has also been detected in some of LADWP's wells. However, LADWP remediates groundwater and blends with other sources to remove or lower contaminants to concentrations below MCL to ensure groundwater delivered to customers complies with State and Federal safe drinking water standards.

LADWP's established its two largest well fields, Rinaldi-Toluca and Tujunga, in areas that were at one time believed to have been located away from known contamination areas. Since that time, these important well fields have also been significantly impacted by contamination sources that are yet to be fully investigated. As discussed in following sections, LADWP has developed various programs to accelerate basin remediation – including the comprehensive Groundwater System Improvement Study and monitoring well installation program, interim wellhead treatment facilities, and collaborative efforts with State and Federal regulatory agencies to investigate sources of contamination and identify potentially responsible parties.

Agency Cooperation of SFB Remediation

LADWP actively coordinates with the California Water Resources Control Board, DDW, LARWQCB, DTSC, and USEPA to pursue protective and remedial measures for the SFB. DDW, LARWQCB, and DTSC are the three regulatory agencies with enforcement responsibilities within the SFB. The LARWQCB and the DTSC issue enforcement directives for pollutant sites and guide the development of cleanup work plans and the cleanup of polluted groundwater sites. DDW oversees the quality of potable water from groundwater sources. USEPA administers the Superfund Program in SFB.

In 1987, LADWP entered into a Cooperative Agreement with the USEPA to conduct the "Remedial Investigation of Groundwater Contamination in the San Fernando Valley." Under this agreement, LADWP received funds from the USEPA's Superfund Program to carry out: (1) construction, operation, and maintenance of the NHOU consisting of a groundwater treatment facility and a system of eight production wells (construction completed in 1989), and (2) completion of the Remedial Investigation to characterize the SFB and the nature and extent of its groundwater contamination. The Remedial Investigation included: (a) 88 shallow and clustered monitoring wells to monitor contamination plumes of TCE, PCE, and nitrates in the SFB installed in 1992, (b) the development of a groundwater flow model (Flow Model) and the preparation of the Remedial Investigation report that was completed for the USEPA in 1992, and (c) on-going monitoring for TCE, PCE, nitrates, and emerging contaminants.

The Flow Model is a three-dimensional computer simulated model of the SFB based on the MODFLOW model program code that was developed by the United States Geological Survey. It consists of four layers that represent the various depth zones of the SFB. Geologic and hydrogeologic data for the basin, generated through field investigations, were analyzed to develop the physical site characterization of the basin for the MODFLOW Flow Model. The Flow Model produced simulated groundwater levels, gradients, and their fluctuations as a function of time. Based on field monitoring and Flow Model simulations, groundwater production strategies are reviewed and adjusted monthly to balance the City's water supply need with SFB management.

San Fernando Basin Groundwater Remediation Programs

In coordination with other agencies, LADWP has completed or is planning various projects to maintain the SFB as a reliable local water supply for the City. The following summarizes the various remediation programs LADWP is pursuing in the SFB.

Groundwater System Improvement Study (GSIS)

LADWP completed the 6-year, $11.5-million study in February 2015 that provides the basis for a comprehensive remediation and cleanup program to address groundwater contamination in the SFB.

One of the fundamental goals of the GSIS was to fill data gaps and provide a framework to collect data and assess overall groundwater quality in eastern SFB. The GSIS was executed as an iterative and dynamic study, whereby data gaps were identified, addressed, and then re-assessed.

The two primary data gaps identified during initial evaluation of available data included:

- Comprehensive water quality data to identify the chemicals of concern (COCs), including emerging and future contaminants, as identified by the DDW, as well as their distribution in groundwater in the eastern SFB
- Geophysical and hydrogeologic characteristics of the eastern SFB, specifically in areas of North Hollywood, Rinaldi-Toluca, and Tujunga Wellfields, required to update and refine the Hydrogeologic Conceptual Site Model (HCSM)

LADWP developed a monitoring well installation, sampling, and analysis program to fill these data gaps. The monitoring well installation, performed between 2013 and 2014, included the collection of the following data to assist with the development of the HCSM:

- Lithologic data collected through logging of soils by an onsite geologist and geophysical logging of the borehole. This information, along with data from adjacent wells, was also used to determine the appropriate screen intervals for the multi-level monitoring wells.
- Soil properties (e.g., soil bulk density, porosity and hydraulic conductivity) through geotechnical testing of select soil samples.
- Water quality samples collected at discrete depths in situ during advancement of the borehole and from the nested well casings after well completion.

Water quality data was collected from existing monitoring wells and production wells (a total of 67 wells sampled in 2012/2013) and 26 newly-installed multi-level nested monitoring wells (a total of 75 screen locations) were sampled during 2014. These sampling events included a comprehensive list of more than 400 chemicals that were analyzed.

Combining the data from the above mentioned monitoring events with water quality data from the historic record, a total of 93 chemicals were detected in the groundwater above a regulatory threshold at least once since water quality monitoring began in 1980. Only a portion of these chemicals pose a long-term risk to human health or the environment and require attention during the evaluation and design of remedial alternatives in the Draft Feasibility Study. To prioritize these COCs, each of the 93 chemicals was evaluated with respect to occurrence in the SFB and LADWP production wells, toxicity, and relation to regulatory thresholds and treatment requirements.

Using these criteria, a total of 12 COCs were identified as "high priority," which consist of the following:

- Organic Chemicals
  - TCE
  - PCE
  - Cis-1,2-Dichloroethene (cis-1,2-DCE)
  - 1,1-Dichloroethene (1,1-DCE)
  - 1,2-Dichloroethane (1,2-DCA)
  - Carbon tetrachloride
  - 1,2,3-Trichloropropane (1,2,3-TCP)
  - 1,4-Dioxane
  - NDMA
- Inorganic Chemicals
  - Cr(VI)
  - Perchlorate
  - Nitrate

The remaining chemicals were reported at least once above established regulatory limits but are considered lower priority. In fact, when treatment is considered, many will be addressed through treatment technologies for the high-priority COCs.

The Remedial Investigation Report summarizes investigative results from the GSIS as well as other data sources and updates the current conceptual understanding of the SFB. The report is an update to the 1992 Remedial Investigation Report for the San Fernando Valley because many of the findings from that report form the basis of the current HCSM model. The Remedial Investigation Update Report presents LADWP's latest understanding of the groundwater basin physical characteristics, nature and extent of contamination, fate and transport characteristics, and the contaminants' risk to human health and the environment.

With the completion of the Remedial Investigation Update and Draft Feasibility Study, LADWP will be able to proceed with the necessary environmental reviews, design, permitting, construction, and startup of the groundwater remediation facilities to effectively contain, clean, and remove contaminants from SFB.

Groundwater Remediation Facilities

North Hollywood Operable Unit: In 1989, the NHOU was placed into service with a design remediation capacity of 2,000 gpm (3,230 AFY); however actual capacity averages less than 1,300 AFY. This facility includes an aeration tower which forces air streams vertically through the tower against the downward flow of water to strip and remove VOCs from contaminated groundwater. The air stream ladened with VOCs continues along its path through a vapor-phase granular activated carbon (GAC) to remove VOCs from the air emissions before release to the atmosphere.

The NHOU was designed, constructed, and operated under supervision by USEPA pursuant to their consent decree with the Responsible Parties. This fifteen-year consent decree expired on December 31, 2004, however, the VOC contaminants have not been completely remediated from the targeted region of the basin. USEPA continues working with Responsible Parties and LADWP to implement the Second Interim Remedy (2IR) which has a targeted treatment capacity of 4,923 AFY. The 2IR will improve hydraulic containment of contaminant plumes, thereby protecting LADWP's nearby production wells, and add treatment technology capable of treating contaminants, such as Cr(VI) and 1,4-dioxane, that cannot be removed by the existing NHOU aeration tower.

USEPA amended its Record of Decision on January 10, 2014 adding re-injection of treated groundwater effluent as an equally preferred option for the 2IR. LADWP proposed an alternative Cooperative Containment Concept; if successfully negotiated among the parties, this concept will more than double the target treatment capacity to 10,500 AFY. Agreement on this concept will allow Responsible Parties to discharge treated groundwater into LADWP's drinking water system instead of re-injecting water back into the ground. Parties expect to conclude negotiations on the Cooperative Containment Concept and begin construction as early as 2018.

Pollock Wells Treatment Plant: Pollock Wells Treatment Plant was constructed with LADWP funds and placed into service in 1999. The plant treats groundwater pumped from two extraction wells using four liquid-phase GAC vessels at a total design flow of 3,000 gpm. The Pollock Wells Treatment Plant was designed to treat for TCE and PCE and restore a critical well field used to contain and reduce the loss of groundwater flowing out of SFB through Los Angeles River Narrows.

Temporary Tujunga Wellfield Treatment Study Project: Implemented May 2010, LADWP and MWD constructed the Temporary Tujunga Wellfield Treatment Study Project to install wellhead treatment on two of the 12 Tujunga water supply wells and test the effectiveness of coconut-based media for removing VOCs from groundwater. This project remediates contaminated groundwater using ten liquid-phase GAC vessels for each wellhead. To date, coconut-based GAC has proven to operate effectively. This facility provides remediation at a rate of up to 8,000 gpm (12,000 AFY). The capital cost of approximately $7.5 million was fully funded by LADWP and construction was completed in November 2009.

Groundwater Interconnection with City of Burbank Water and Power: LADWP and City of Burbank Water and Power (BWP) have partnered on a project to optimize use of the Burbank Operable Unit (BOU), a SFB groundwater remediation facility implemented in 1996. Currently, BOU operates near design capacity during hotter months of the year when water demands are high. During cooler months, the BOU must operate below design capacity due to low water demand. This project will enable BOU to operate at optimal flow rates for longer periods of each year to remediate and remove more contaminants from the groundwater basin. BWP will convey the additional treated groundwater into LADWP's system via a new interconnecting pipeline. BWP expects this project will enable remediation of as much as an additional 3,000 AFY of groundwater and remove an extra 1,500 pounds of contaminants annually from SFB. This project will also restore use of more local groundwater to the City of Los Angeles.

Expanded San Fernando Basin Remediation Strategies

Pursuant to recommendations provided by the Groundwater System Improvement Study, LADWP plans to implement comprehensive basin remediation at its three primary well fields in SFB: Tujunga, Rinaldi-Toluca and North Hollywood Wellfields. Concurrent with this strategy, LADWP has initiated studies to characterize groundwater in the southeast region of SFB surrounding Headworks, Pollock, Erwin, Whitnall, and Verdugo Wellfields. Results of this characterization study will provide the basis for implementation of additional basin remediation facilities.

LADWP will continue to investigate the utilization of various advanced and/or emerging groundwater treatment technologies for removal of contaminants such as VOCs, Cr(VI), 1,4-dioxane, nitrate, and perchlorate.

6.3 Sylmar and Eagle Rock Basins

The Sylmar Basin has provided as much as 3 percent of the City's local groundwater during the recent five-year period, providing as much as 1,952 AF during FY 2012/13, see exhibit 6B. The Sylmar Basin is located in the northern part of ULARA and spans 5,600 acres. This basin is bounded on the north and east by the San Gabriel Mountains; on the west by a topographic divide in the valley fill between the Mission Hills and the San Gabriel Mountains; and on the south by the Little Tujunga syncline, which separates it from the SFB.

LADWP's Mission Wellfield had a total of 7 wells constructed; two of which were constructed before 1961 and five of which were constructed between 1961 and 1977. Of these, only two remain operable; however one of these two wells have been removed from service due to groundwater contamination issues and may be demolished. The Mission Wells Improvement Project will install three replacement water supply wells and associated infrastructure. Phase I installation of a new water storage tank was completed in 2009. Phase II installation of the wells and treatment facilities is ongoing. Two off-site monitoring wells have also been installed to evaluate water quality near the well field. The three replacement wells are scheduled to be in service by 2016, thereby restoring LADWP's pumping capacity and ability to produce the City's annual water rights and stored water credits in the Sylmar Basin.

The Eagle Rock Basin is the smallest of the four basins and located in the southeast corner of ULARA spanning only 800 acres. Eagle Rock Basin is bounded by the San Rafael Hills on the north and west, by the Repetto Hills on the east and south, and a small alluvial area to the southeast consisting of a topographic divide. The safe yield of Eagle Rock Basin is derived from imported water delivered by LADWP, and there is no measurable native safe yield. LADWP has the right to produce the entire safe yield from the basin, but has not established groundwater production facilities in this basin. Currently, one private party pumps groundwater from Eagle Rock Basin and compensates the City for such pumping in accordance with the ULARA Judgment.

Groundwater Rights

Water rights in Sylmar Basin were originally established by the 1979 ULARA Judgment which recognized prior overlying rights of two private land owners and appropriative rights of the cities of San Fernando and Los Angeles. This Judgment also recognized the cities' rights to store water within the basin and recapture Import Return Water, calculated as 35.7 percent of imported water delivered. On August 26, 1983, the ULARA Watermaster reported to the Los Angeles Superior Court that Sylmar Basin was in a condition of overdraft. In response, the Los Angeles Superior Court signed the 1984 Stipulated Agreement limiting total pumping to 6,210 AFY, divided equally between the two cities. In 1996, ULARA Watermaster recommended and ULARA Administrative Committee approved increasing the safe yield to 6,510 AFY for a ten-year period. In 2006, ULARA Watermaster re-evaluated the safe yield and recommended a subsequent increase to 6,810 AFY, which the Los Angeles Superior Court approved subject to various conditions. Conditions included requiring the two cities to install groundwater monitoring wells to assist in determining basin outflows used to evaluate basin storage capacity. In 2012, ULARA Watermaster completed an updated re-assessment of safe yield which resulted in a temporary and conditional increase in safe yield to 7,140 AFY, allowing each City the right to produce 3,570 AFY. Court approved this new stipulated Agreement which will expire upon conclusion of the 2015-16 water year.

Stored water credits accumulated in the basin are determined by the Watermaster pursuant to ULARA Judgment and subsequent stipulations. As of October 1, 2013, the City has accrued 9,014 AF of stored water credits in the Sylmar Basin.

Water Quality

Groundwater quality issues in the Sylmar Basin related to TCE contamination has impaired one of the two remaining production wells at LADWP's Mission Wellfield. TCE has also been detected in trace amounts in the second well. LADWP has removed the impaired well from service to ensure groundwater produced from the well field surpasses State and Federal safe drinking water standards. Recently installed replacement wells have shown the presence of hexavalent chromium, or Cr(VI), detected at trace levels, and TCE above the MCL in one of the three wells. LADWP anticipates that well field blending will be sufficient to ensure Cr(VI) concentrations remain below the State MCL of 10 parts per billion (ppb). Evaluations are underway to determine the need for remediation systems to fully address TCE contamination at this well field.

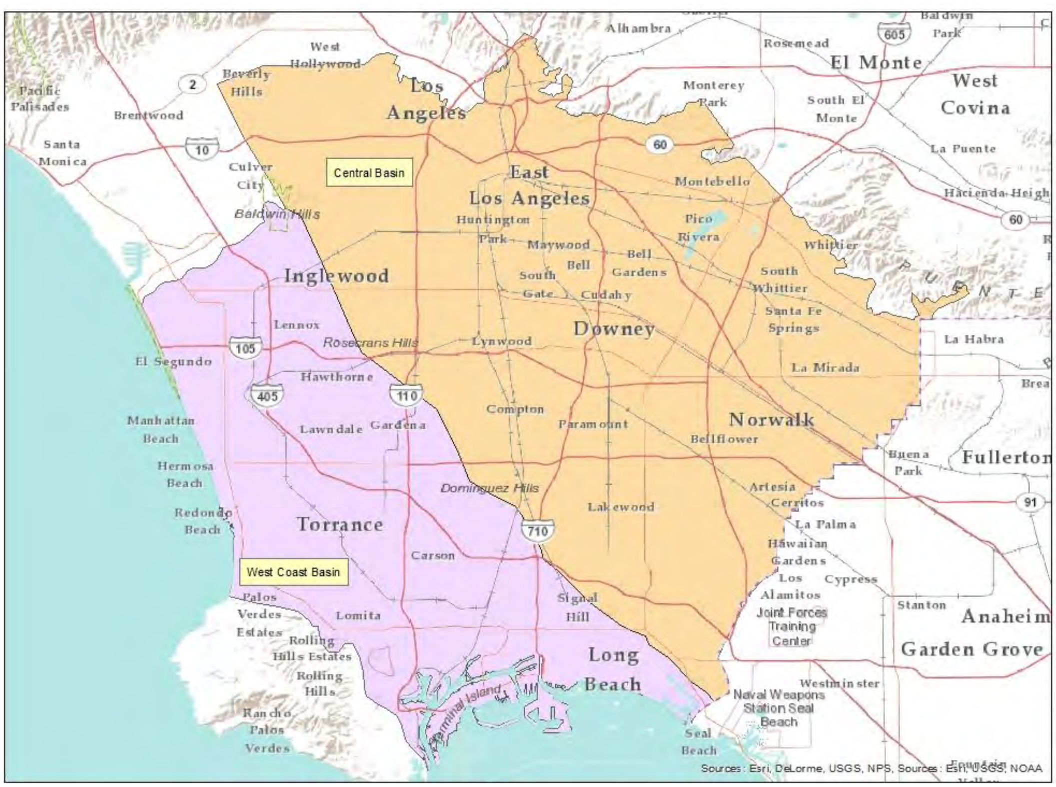
6.4 Central Basin

Over the recent five-year period, the Central Basin has provided as much as 15 percent of the City's local groundwater supply ranging from 5,099 AF to 9,727 AF through two well fields, see exhibit 6B. Known as sub-basin number 4-11.04 in DWR Bulletin 118, the Central Basin Watermaster service area overlies about 227 square miles of the Central Basin in the southeastern part of the Los Angeles Coastal Plain in Los Angeles County as depicted in Exhibit 6D. The Central Basin Watermaster service area is bounded by the Newport-Inglewood Uplift on the southwest, the Los Angeles-Orange County line on the southeast, and an irregular line that approximately follows Stocker Street, Martin Luther King Boulevard, Alameda Street, Olympic Boulevard, the boundary between the City of Los Angeles and unincorporated East Los Angeles, and the foot of the Merced and Puente Hills on the north. Twenty-three incorporated cities and several unincorporated areas are within the Central Basin Watermaster service area.

Groundwater within the basin provides a large portion of the water supply needed by overlying residents and industries. Central Basin Watermaster Service Report for FY 2013/14 indicates 131 parties with rights to groundwater in the Central Basin.

LADWP produces Central Basin groundwater from the Manhattan and 99th Street Wellfields. Six production wells were installed at the Manhattan Wellfield between 1928 and 1974, and two active wells remain with a production capacity of 7.0 cfs. Production wells were installed at the 99th Street facility between 1974 and 2002 and the remaining four active wells have a production capacity of 6.1 cfs. The 99th Street wells are newer and have relatively little mechanical or other problems. The Manhattan wells are approaching the end of their useful life and have experienced water quality issues and mechanical deterioration which has limited their capacity. To restore pumping capacity in Central Basin, LADWP is implementing the Manhattan Wells Improvement Project, discussed in detail on the succeeding section.

Exhibit 6D
Central Basin



Groundwater Rights

Beginning over 50 years ago, groundwater overdraft and declining water levels in Central Basin threatened the area's groundwater supply and caused seawater intrusion in the southern part of Central Basin. However, timely legal action and adjudication of the water rights halted the overdraft and prevented further damage to Central Basin. Today, groundwater use in Central Basin is restricted to Allowed Pumping Allocations set by Superior Court Judgment and is monitored by a court-appointed Watermaster. The Central Basin Judgment was amended in December 2013 and major changes include new provisions to allow parties to augment and store groundwater, and to appoint a new Watermaster Panel. The Watermaster consists of three separate arms with different functions. The first arm is the Administrative Body, to administer the Watermaster accounting and reporting functions. This role is performed by the Water Replenishment District of Southern California (WRD). The second arm is the Central Basin Water Rights Panel (CBWRP), which enforces issues related to pumping rights defined in the adjudication. The CBWRP is made up of seven water rights holders who are selected through election. The third arm is the Storage Panel, which is comprised of the CBWRP and the WRD Board of Directors. Annually, the Watermaster prepares a Watermaster Service Report indicating groundwater extractions, replenishment operations, imported water use, recycled water use, finances of Watermaster services, administration of the water exchange pool, and significant water-related events in the Central Basin.

The City's entitlement in the Central Basin of 15,000 AFY was established by judgment of the Superior Court of the State of California for the County of Los Angeles through the Central Basin Judgment (Case No. 786,656 – third amended judgment). The City purchased additional pumping rights in 2014 and 2016 in three separate transactions, bringing the total annual pumping right in the Central Basin to 17,236 AF. The City has also utilized the new storage provisions allowed under the third amended judgment, and has accrued 6,020 AF of stored water in the Central Basin (Central Basin Watermaster Service Report, FY 2014/15). In addition to its annual entitlement, the Central Basin Judgment allows for carryover of unused water rights, up to a maximum of 40 percent of the purveyor's pumping allocation for FY 2014/15. This carryover percentage will increase annually by 10 percent until reaching its final level of 60 percent. The Central Basin Judgment also allows for over extraction of an additional 20 percent under emergency situations that would be debited against the purveyor's following year entitlement. The City can use its carryover storage right for operational flexibility and conjunctive use. Combined with previously accrued emergency storage, the City's groundwater in storage is 11,270 AF into FY 2015/16.

Water Quality

Although the Manhattan and 99th Street Wellfields in the Central Basin are located approximately 4 miles apart, there is a significant variation in water quality between the facilities. Two of the six Manhattan wells have been impaired by contamination exceeding the MCL of 5 ppb for TCE. Wellfield blending was not sufficient to allow continued operation of these impaired wells which showed TCE concentrations as high as 20 ppb, requiring that these wells be removed from service. The two remaining wells have also shown TCE detected at trace levels below the MCL. The impaired wells, along with two other mechanically deteriorated wells, have been demolished. Four replacement production wells have been installed at Manhattan Wellfield and test results have demonstrated that improved water quality can be produced from these wells. LADWP will continue to manage and operate the wellfields in such a way that ensures groundwater quality complies with State and Federal safe drinking water standards.

Groundwater produced from 99th Street Wellfield does not currently show detection of any industrial contaminants above the MCLs; however, two naturally occurring constituents, manganese and iron, exceed secondary MCLs, requiring treatment to comply with safe drinking water standards. These two constituents do not pose a risk to human health, but at existing concentrations they do affect the aesthetic qualities of the groundwater such as taste, color, and odor. LADWP's application of zinc orthophosphate, via corrosion control treatment, acts as a sequestering agent. Additionally, sodium hypochlorite oxidizes manganese, and both of these treatments provide effective water quality control for manganese and iron. Hydrogen sulfide is also present, but with chlorination, it does not pose an imminent threat to the reliability of this well supply.

Manhattan Wellfield Improvement Project: The Manhattan Wellfield Improvement Project (MWIP) was initiated to restore the pumping capacity of the Manhattan Wellfield and to produce the City's annual entitlement to groundwater in the Central Basin plus accumulated groundwater storage credits. The project will reduce the City's reliance on imported water purchased from MWD and thereby reducing LADWP's cost of procuring water by approximately $2 million per year.

Wells and infrastructure at Manhattan Wellfield date to the 1920s. A number of wells have been decommissioned largely due to age and corrosion resulting in casing failures and sand intrusion as well as contaminant plumes impacting the local water quality. The MWIP proposes to rehabilitate and/or construct up to two groundwater monitoring wells and up to eight groundwater production wells and related facility infrastructure, including well collector and discharge lines, electrical upgrades and SCADA controls.

As of April 2015, the MWIP has been accelerated in order to obtain $3M in Proposition 84 Integrated Regional Water Management State Grant funding. Construction of the first new monitoring well started in July 2014 and MH-MW-01 was completed at the end of February 2015. Construction of the replacement production wells began in October 2014. Piping designs have been approved and on-site improvements began in late December 2014. Electrical designs are undergoing review. Delivery of well pumps is expected by summer 2016 when production well and piping construction is completed. Per the Grant Funding Agreement, the well field is to be on-line by late 2016.

Wellfield No. 3 Feasibility Study and Site Investigations: It is anticipated that additional water rights will be purchased or leased, and stored groundwater will continue to accumulate. While planned improvements at the Manhattan Wellfield will significantly increase production, additional capacity will be needed to utilize the City's entire annual water rights including stored groundwater.

LADWP is evaluating the feasibility of establishing additional extraction facilities in the Central Basin. The study assesses existing and forecasted groundwater supplies, potential environmental impacts of a new well field construction and operation, potential sites for well field development, and economic cost/benefit analysis. Additionally, LADWP has plans to construct two monitoring wells in the Central Basin to further evaluate hydrogeology, groundwater quality, and well performance. Early study results anticipate a 5,000 AFY design production capacity, with a 15,000 AFY expansion option.

6.5 West Coast Basin

Due to localized groundwater contamination issues and deterioration of water quality, LADWP discontinued operating its Lomita Wellfield and has been unable to pump its entitlement from the West Coast Basin since 1980. Referred to as sub-basin number 4-11.03 by DWR Bulletin 118, the West Coast Basin underlies 160 square miles in the southwestern part of the Los Angeles

Coastal Plain in Los Angeles County. The West Coast Basin is bounded on the west by Santa Monica Bay, on the north by Ballona Escarpment, on the east by the Newport-Inglewood Uplift, and on the south by San Pedro Bay and the Palos Verdes Hills. Twenty incorporated cities and several unincorporated areas overlie the West Coast Basin (West Coast Basin Watermaster Service Report, FY 2013/14).

Groundwater Rights

In 1945, when intrusion of seawater caused by declining water levels threatened the quality of the groundwater supply, legal action was taken to halt the overdraft and prevent further damage to the West Coast Basin. In 1955, the Superior Court of Los Angeles County appointed DWR as the Watermaster to administer an Interim Agreement. In 1961, the Court retained DWR as the Watermaster of the Final West Coast Basin Judgment (Case No. 506,806 – amended judgment). Similar to the Central Coast Basin, an annual Watermaster Service Report is prepared. The West Coast Basin Judgment affirmed the City's right to produce 1,503 AFY of groundwater from this basin.

In 2014, the West Coast Basin Judgment was amended in a manner similar to the Central Basin Judgment. The new Watermaster for the West Coast Basin also consists of the Administrative Body (handled by WRD, as in the Central Basin), West Coast Basin Water Rights Panel, and Storage Panel. Parties will also be able to store specified quantities of water in the West Coast Basin, and certain parties (including the City) are able to pump unused West Coast Basin rights out of the Central Basin, per the Central Basin Judgment.

Water Quality

Groundwater quality problems in the West Coast Basin were previously related to high levels of total dissolved solids (TDS), hydrocarbons, and chlorides. LADWP halted operations in the basin in September of 1980 with closure of the Lomita Wellfield, and intends to study the feasibility and cost of restoring groundwater pumping.

6.6 Antelope Valley Groundwater Basin

The City has entitlements to pump 3,975 AF of native groundwater from Antelope Valley Groundwater Basin (AVGB) and to store water it imports into the basin for future export. Utilization of the basin to meet city water demand will be limited to supplies imported and stored in the AVGB. Native safe yield entitlements may only be used locally within the basin. However, water imported and stored in the AVGB can be exported for use in the City. Known by DWR Bulletin 118 as sub-basin number 6-44, the AVGB underlies 1,580 square miles of an extensive alluvial valley in the western Mojave Desert. The elevation of the valley floor ranges from 2,300 to 3,500 feet above sea level. The basin is bounded on the northwest by the Garlock fault zone at the base of the Tehachapi Mountains and on the southwest by the San Andreas fault zone at the base of the San Gabriel Mountains. The basin is bounded on the east by ridges, buttes, and low hills that form a surface and groundwater drainage divide and on the north by Fremont Valley Groundwater Basin at a groundwater divide approximated by a southeastward-trending line from the mouth of Oak Creek through Middle Butte to exposed bedrock near Gem Hill, and by the Rand Mountains farther east.

Total groundwater storage capacity in AVGB is reported to be between 68 million acre-feet (MAF) (Planert and Williams 1995) and 70 MAF (DWR 1975). For the shallow section of the basin between 20 and 220 feet below ground surface, the storage capacity is reported to be 5.4 MAF (Bader 1969). However, the AVGB has a documented history of declining groundwater levels resulting in land subsidence and adverse effects to overlying land caused by excessive groundwater pumping. Much of the AVGB supported extensive agricultural production in the early part of the twentieth century followed by a shift towards rapid urbanization during the latter part of the century. The shift brought about renewed demand for groundwater, which resulted in a dramatic decrease in groundwater levels.

Groundwater Rights

Declining groundwater levels and concerns about the availability of groundwater became more pronounced as public water suppliers increased pumping for municipal supply. Litigation over Antelope Valley groundwater rights began in October 1999 with certain private land owners filing complaints and public water suppliers responding with cross-complaints. In August 2005, the various actions were consolidated into the Antelope Valley Groundwater Cases which continued under the Santa Clara County Superior Court supervised by the Honorable Jack Komar. Overlying landowners collectively have the paramount right to native groundwater and public water suppliers have claimed prescriptive rights against the landowners. The City of Los Angeles has standing in this litigation as one of the overlying landowners in the basin.

During the 1960s and 1970s, the City, by and through Los Angeles World Airports (LAWA), acquired approximately 27 square miles of land in Antelope Valley for the purpose of developing an international airport in Palmdale. LAWA has leased their properties to tenants using the land for agricultural production, which has been supported by groundwater pumping and use of treated effluent supplied by Los Angeles County Sanitation District No. 20.

After more than a decade of litigation, four trial phases, and various attempts to comprehensively adjudicate the water rights, litigation concluded on December 23, 2015 with Judge Komar signing the Antelope Valley Groundwater Adjudication settlement. The Court determined the native safe yield as 82,300 AFY and total safe yield inclusive of import return flows as 110,000 AFY. The United States government asserted a paramount federal reserved right to 11,000 AFY for Edwards Air Force Base. The Court found the basin to be in overdraft since at least 1951 and has estimated current pumping at between 130,000 and 150,000 AFY. The City's entitlement to pump 3,975 AFY may only be used on LAWA land in the Antelope Valley. Settlement provisions also allow parties to carryover and store unused annual entitlements in AVGB, and ability to transfer entitlements (purchase/sell) between parties in the Antelope Valley. The City's right to store imported water in AVGB allows for later recovery and export to the City, subject to any irretrievable losses that may be determined by the Watermaster.

The City's annual entitlement to native groundwater may be useful for LAWA's future development of an international airport in Palmdale since the native groundwater may be used only on overlying land. The right to store imported water is of broader interest to LADWP. This would allow LADWP to import water from various sources such as the Eastern Sierra for example, temporarily store these supplies within the AVGB, and recover the water for export to Los Angeles at times when it is necessary to manage seasonal peak demand or augment supplies during dry periods, emergencies, or natural disaster. The LAA and State-owned California Aqueduct are facilities which may be used to convey imported supplies into AVGB for storage. Additional facilities, such as percolation basins or injection wells, are necessary to physically place water into storage. Pumping facilities are also needed to recover stored water from AVGB for conveyance to the City. Agencies who own storage and extraction facilities may become potential partners to facilitate the City's use of underground storage in AVGB.

Water Quality

AVGB groundwater quality typically contains calcium bicarbonate where the basin approaches the surrounding mountains, and sodium bicarbonate or sodium sulfate near the central part of the basin (Duell 1987). In the eastern part of the basin, the upper aquifer contains sodium-calcium bicarbonate, while the lower aquifer contains sodium bicarbonate (Bader 1969). TDS averages 300 milligrams per liter (mg/L), ranging from 200 to 800 mg/L (KJC 1995). High levels of boron and nitrates have also been observed in the basin (KJC 1995). Based on water quality data reported to the State, concentrations detected in certain wells have exceeded the MCL for inorganics, radiological constituents, nitrates, and/or VOCs/SVOCs.

6.7 Sustainable Groundwater Management Act (SGMA)

Amidst a multiple year drought, California is challenged with several statewide water shortage issues, including over pumping which results in land subsidence and dry well issues. In response to the current drought, Governor Jerry Brown and the State Legislature enacted the SGMA which took effect on January 1, 2015. With SGMA, the State focused upon equipping and empowering local agencies with tools needed to manage local groundwater basins in a sustainable manner. Actions necessary to achieve sustainability will vary with each basin, but SGMA generally requires local agencies to form Groundwater Sustainability Agencies (GSAs), develop and implement Groundwater Sustainability Plans (GSPs), and monitor and report status of groundwater conditions within each basin. By enacting the new law the State seeks to mitigate and prevent the occurrence of adverse effects caused by unreasonable use of groundwater, such as groundwater storage depletion, land subsidence, seawater intrusion, water quality degradation, critical overdraft basin conditions, and surface water depletions.

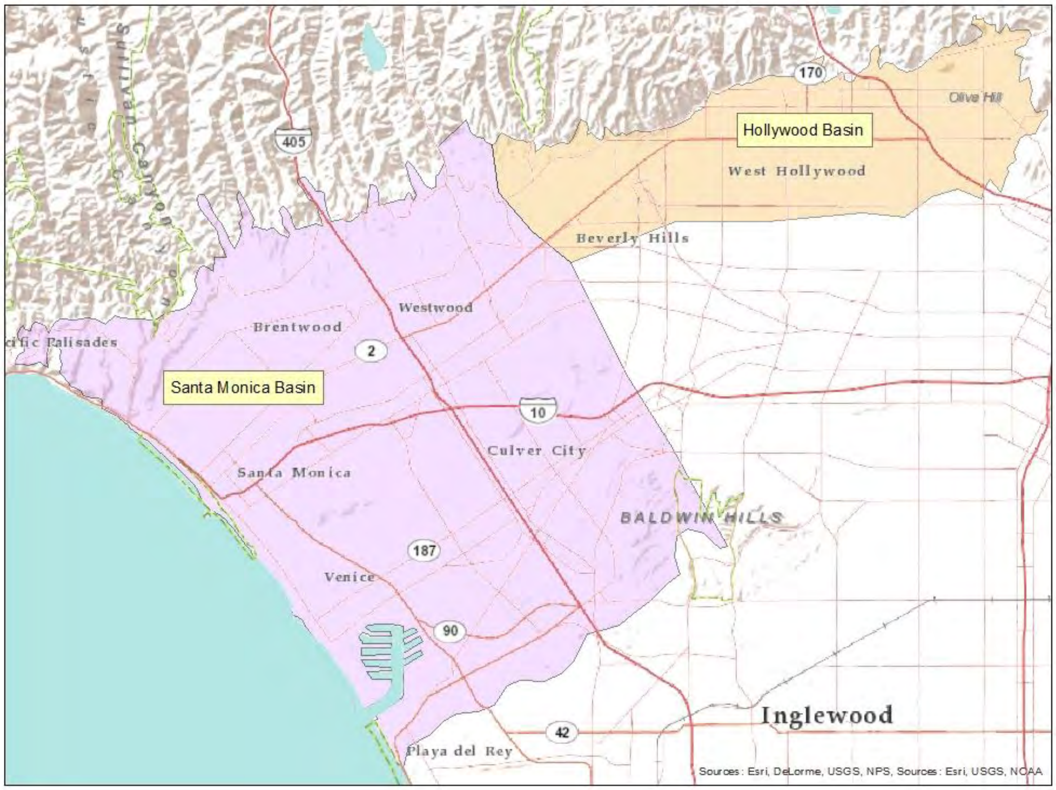
The State has made funding and technical assistance available to ensure local agencies can implement SGMA successfully. Agencies who fail to comply will risk having their basin(s) being placed on probationary status which authorizes the State to step in and implement SGMA on their behalf. Advancing guidelines for the SGMA, DWR is developing its Strategic Plan for a Sustainable Groundwater Management (SGM) Program. DWR's SGM Program will implement the new and expanded responsibilities identified in SGMA. Some of these expanded responsibilities include: (1) developing regulations to revise groundwater basin boundaries, (2) adopting regulations for evaluating and implementing GSPs and coordination agreements, (3) identifying basins subject to critical conditions of overdraft, (4) identifying water available for groundwater replenishment, and (5) publishing best management practices for the sustainable management of groundwater.

Throughout the development of SGMA, there was broad public consensus that adjudicated basins are well managed, subject to Court jurisdiction, and should not be the primary focus for SGMA. Therefore, the new law only requires managers of adjudicated basin to file a copy of the adjudication with DWR and the annual reports which document basin conditions. Los Angeles overlies both adjudicated and unadjudicated basins; therefore LADWP will work with its regional partners towards implementing SGMA for the unadjudicated basins that are located within the City's boundaries.

6.8 Unadjudicated Basins

The Central and West Los Angeles areas of the City overlie the Hollywood Basin, Santa Monica Basin, and the northerly area of Central Basin located outside

Exhibit 6E
Hollywood and Santa Monica Basins



of the adjudicated basin boundary. The unadjudicated Hollywood and Santa Monica Basins are depicted in Exhibit 6E. Although the potential for utilizing these basins for groundwater supply may present certain challenges related to water quantity and quality, the call by City leaders to increase use of local resources has prompted a renewed view towards all of the City's groundwater assets including potential supplies from these basins. Therefore, LADWP anticipates developing groundwater resources in a manner that is locally sustainable and in cooperation with its regional partners in each of the basins.

With the passing of the SGMA, cities with overlying land in unadjudicated basins are mandated to sustainably manage their respective basins, particularly those considered by the State to be of medium or high priority. While Hollywood Basin is considered to be a low priority basin, Santa Monica Basin is considered a medium priority basin. Per regulatory guidelines, a Groundwater Sustainability Agency must be established by June 30, 2017, and a GSP must be established by January 31, 2020. This also applies to the unadjudicated northern area of Central Basin, a high priority basin. LADWP plans to move forward in collaborating with municipalities and agencies overlying these basins to comply with the SGMA.

6.9 Water Quality Goals and Management

The groundwater management efforts that LADWP has undertaken resulted in all groundwater delivered to LADWP customers meeting or exceeding all DDW water quality regulations. As part of its regulatory compliance efforts, LADWP works with the DDW to perform water quality testing on production and monitoring wells.

Groundwater Monitoring

Every well that is pumped to supply water to the City is actively monitored by LADWP as required by DDW. LADWP's groundwater monitoring program is comprised of several distinct components. These components include the monitoring of metals (Hexavalent Chromium and lead), coliform bacteria, inorganics, VOCs, unregulated compounds such as vanadium, boron, and disinfection by-products. The frequency and level of monitoring (i.e., annually, quarterly, or monthly) depends on the level of contamination found in each well. Monitoring for all contaminants is performed in close proximity to where the water is being pumped from the wells, typically the blend point. If water quality problems are detected, the well source is immediately isolated and retested. LADWP conducts extensive field and laboratory tests throughout the year for hundreds of different contaminants to ensure that they are well within the safe levels before serving water to customers.

Operating Goals

LADWP has established operating goals for TCE, PCE, nitrates, perchlorate, and total chromium that are more stringent than the MCLs permitted by Federal or State regulations. These stricter operational goals provide an additional safety margin from these contaminants for City customers. Exhibit 6F summarizes these water quality goals and compares them with the State-regulated requirements, which are generally more stringent than Federal requirements.

TCE and PCE compounds are commonly used in industries requiring metal degreasing such as automotive, aerospace, and fabrication. PCE was commonly used in dry cleaning and automotive repair industries.

Nitrate is a concern because of its acute effect on infants, who are most sensitive to nitrate's effect of reducing the uptake of oxygen to the blood. The current standard for nitrate is 45 parts per million (ppm). A single exceedance of the nitrate standard is classified as an acute violation requiring immediate public notification. Treatment for nitrates may eventually become necessary for affected City groundwater supplies.

In October 2007, an MCL was adopted for perchlorate of 6 ppb. Perchlorate is an inorganic compound that is commonly used in the manufacture of rocket fuels, munitions, and fireworks.

Exhibit 6F
Operating Limits of Regulated Compounds

Compound	State of California Limit	LADWP Operational Goals (ppb)	LADWP Added Factor of Safety
Trichloroethylene (TCE)	5 ppb	3 ppb	40%
Perchloroethylene (PCE)	5 ppb	3 ppb	40%
Nitrate (N03)	45 ppm	30 ppm	33%
Perchlorate (CI04)	6 ppb	4 ppb	33%
Hexavalent Chromium (Cr(VI))	10 ppb	6 ppb	40%
Total Chromium	50 ppb	30 ppb	40%

99th Street Wellfield

Managing Emerging Contaminants of Concern

LADWP addresses emerging contaminants on many levels: 1) by encouraging the development of standardized testing to enable early detection and supporting the regulatory framework by providing early occurrence data, 2) by advocating good science and a balanced approach to risk assessment, 3) by seeking to gain a risk perspective with other existing contaminants to manage the emerging contaminants in the absence of regulations, 4) by supporting early interpretation of emerging contaminants in collaboration with research and regulatory agencies, and 5) by supporting the research to develop cost-effective treatment for the removal and management of these emerging contaminants.

The response to Cr(VI) is an example of how LADWP addresses an emerging contaminant. Prior to 2014 Cr(VI) did not have an enforceable drinking water standard. However, Cr(VI) was included in the State total chromium standard of 50 ppb. Chromium is a heavy metal that has been used in industry for various purposes including electroplating, leather tanning, and textile manufacturing, as well as controlling biofilm formation in cooling towers. LADWP began low level monitoring of Cr(VI) long before monitoring was required by regulators. LADWP supported new health-effects research needed to support risk assessment and advocated a balanced approach to risk management. LADWP funded research to develop new treatment technologies to reduce Cr(VI) detection levels. In April 2014, an MCL for Cr(VI) of 10 ppb was established by the State and became effective on July 1, 2014.

An increasing number of LADWP's North Hollywood wells have contamination of 1,4-dioxane above the 1 ppb Notification Level set by the USEPA. Several of LADWP's North Hollywood wells were removed from service due to the increasingly compromised water quality and critical need for plume management. Presently, there are no treatment systems installed on these wells and thus LADWP is losing their use of these wells for the foreseeable future. To make up this loss, LADWP will have to replace this water with imported water purchased from MWD.

Most recent among emerging contaminants are pharmaceutically active compounds and personal care products that are emerging in rivers, lakes, and waterways from urbanized areas. Concerns exist regarding the occurrence and effects of endocrine disrupters, hormone-shifting compounds, and pharmaceuticals. Technology now allows the detection of compounds down to the parts per trillion levels, thus some of these previously invisible compounds are now being detected in water supplies. The risk assessment sector is having difficulty keeping pace with rapid advances in analytical detection technology. The question of what health risks these contaminants pose at low levels needs more investigation. LADWP will continue to proactively address emerging contaminants through early monitoring and utilization of a balanced approach to risk management.

LADWP will be incorporating appropriate treatment processes into future groundwater treatment facilities. LADWP has and will continue to solicit input from stakeholders to properly plan and develop processes for removal and treatment of emerging contaminants. LADWP's Recycled Water Advisory Group is an example of ongoing efforts to solicit input.

6.10 Groundwater Pumping Cost

Exhibit 6G graphically illustrates LADWP's annual unit-cost to produce local groundwater for the City over the previous 21 years. Costs include operating and maintaining water well pumps, conveyance piping, disinfection treatment systems, electrical services, associated repairs, annualized depreciation of fixed infrastructure, and related financing and overhead costs. Payments of groundwater replenishment fees to an outside agency are also included. Other related costs were recently recognized and are now being incorporated into this analysis beginning with Fiscal Year 2010-11; these

Exhibit 6G
Historical Cost of Groundwater Pumping

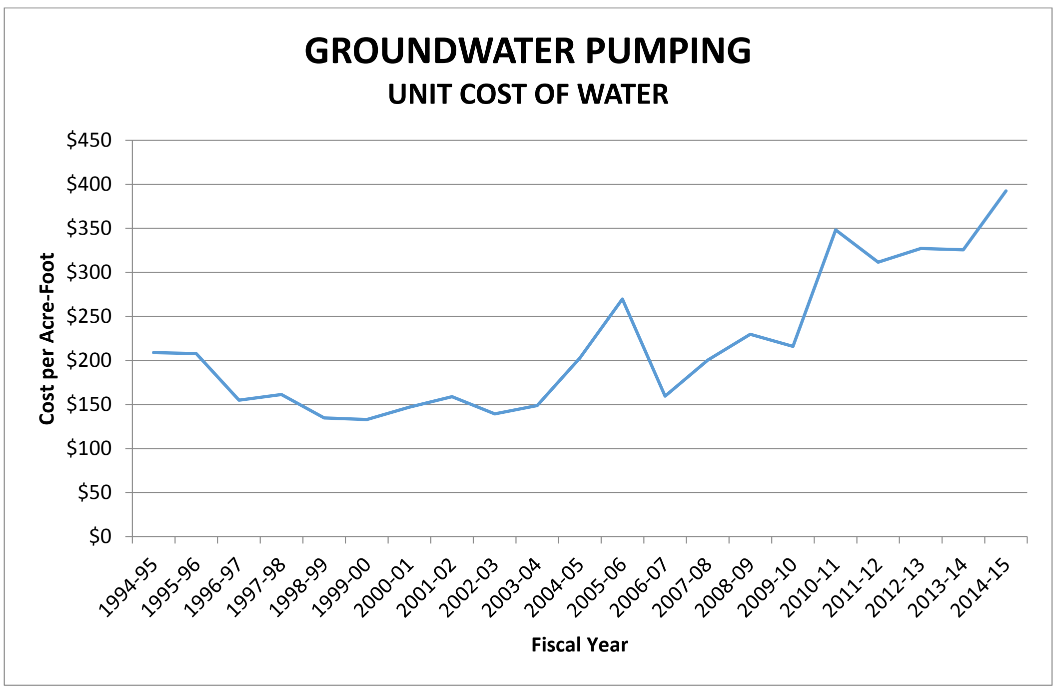


Exhibit 6H
Annual Unit Cost ($/AF)

Fiscal Year	2010/11	2011/12	2012/13	2013/14	2014/15
Unit Cost	$348	$312	$327	$326	$392

related costs include pressurization of groundwater to service pressure, payment of fees to the Court-appointed Watermasters, and groundwater planning and management services. Exhibit 6H tabulates annual unit costs for the recent five year period, and the five-year average is $341 per acre-foot.

6.11 Groundwater Production Forecast

Exhibit 6I presents LADWP's forecast for groundwater production from each basin through fiscal year ending June 30, 2040. The projection accounts for projects that restore capacity of LADWP's existing well fields and the implementation of expanded basin remediation in San Fernando Basin. Although excluded from the figures provided, LADWP anticipates pumping additional volumes in conjunction with enhanced groundwater recharge and replenishment using stormwater and purified recycled water as presented in Chapter 7: Watershed Management and in Chapter 4: Water Recycling. Please see the respective chapters for water supply forecasts associated with these related activities.

LADWP utilizes various strategies to respond to dry period conditions when surface water supplies become diminished. Historically, LADWP has operated its groundwater resources conjunctively with surface water supplies by reducing pumping during wet periods when more surface water can be used for municipal supply and increasing pumping during dry periods to compensate for reduced availability of surface water supplies. This strategy allows for greater replenishment to the local groundwater basins during wet and normal periods, and prevents conditions of severe overdraft when groundwater pumping is increased during dry periods.

The various water rights judgments also enable conjunctive use strategies through provisions allowing water rights holders to pump less than their annual entitlements and accumulate groundwater into storage. Parties may then produce this stored groundwater in subsequent years, such as during dry periods for example. Certain provisions of the water rights judgments also allow temporary increases in pumping while requiring equivalent reductions in pumping in subsequent years. This provides flexibility for parties who may have no accumulated groundwater in storage. LADWP utilizes these judgment provisions and has accumulated stored groundwater within each of its operating basins to provide supplemental water during dry periods, natural disasters, and emergencies.

Exhibit 6I
Groundwater Production 2014/15 to 2039/40 for all Weather Conditions

Basin	2014/15 (Actual)	2019/20	2024/25	2029/30	2034/35	2039/40
	AFY					
San Fernando[1]	80,097	90,000	88,000	84,000	92,000	92,000
Sylmar[2]	0	4,170	4,170	4,170	4,170	3,570
Central[2]	6,948	18,500	18,500	18,500	18,500	18,500
Total	87,045	112,670	110,670	106,670	114,670	114,070

1. SFB remediation facilities are expected to be in operation in FY 2021/22. Use of groundwater storage credits allows for increased pumping above safe yield.

2. Use of groundwater storage credits in Sylmar Basin and Central Basin allows for temporary increase in pumping above safe yield until stored water credits have been expended.

Chapter Seven
Watershed Management

Hansen Spreading Grounds

7.0 Overview

Stormwater runoff from urban areas is an underutilized local water resource. Within the City of Los Angeles, the majority of stormwater runoff is directed to storm drains and ultimately channeled into the ocean. This unused stormwater carries many pollutants that are harmful to marine life and public health. In addition, local groundwater aquifers that should be replenished by stormwater are receiving less recharge than in the past due to increased urbanization. Urbanization has increased the City's hardscape, which has resulted in less infiltration of stormwater and a decline in groundwater elevations.

In response, LADWP's Watershed Management Group was created in January 2008 to develop and manage the water system's involvement in emerging issues associated with local and regional stormwater capture. The Watershed Management Group coordinates activities with other agencies, departments, stakeholders and community groups for the purpose of planning and developing projects and initiatives to improve stormwater management within the City. The Group's primary goal is to increase stormwater capture by expanding centralized stormwater capture facilities and promoting distributed stormwater infiltration and reuse systems. Achieving this goal will help the City achieve its long-term strategy of enhancing local water supply through stormwater capture, in coordination with Mayor Eric Garcetti's Executive Directive No. 5 and the City of Los Angeles Sustainable City pLAn. While working to increase stormwater capture for improved long-term groundwater reliability, other watershed benefits can also be achieved including increased water conservation, improved water quality, open space enhancements, wildlife habitat, flood control, and social/ economic benefits.

LADWP's Stormwater Capture Master Plan (SCMP), which was completed in August 2015, comprehensively evaluated stormwater capture potential within the City. This 2015 Urban Water Management Plan (UWMP) utilized the SCMP as the basis for quantifying stormwater that could be captured for local water supply benefits. Stormwater capture can be achieved by increasing infiltration into groundwater basins (i.e., groundwater recharge) and by onsite capture and reuse of stormwater for landscape irrigation (i.e., direct use). Conservatively, additional stormwater capture projects will increase groundwater recharge by 66,000 AFY and direct use by 2,000 AFY, using both centralized and distributed projects and programs. A conservative estimate of total stormwater capture potential in 2035 is 132,000 AFY, which includes both existing and additional new stormwater capture. Under a more aggressive approach total stormwater capture potential in 2035 could be up to 178, 00 AFY.

As mentioned above, urbanization encroached onto historical waterway floodplains resulting in channelization of these waterways, which once recharged the San Fernando Basin (SFB) groundwater aquifers with large volumes of stormwater runoff. As these floodplains were undergoing rapid development, LADWP and the Los Angeles County Flood Control District (LACFCD) reserved several parcels of land for use as stormwater spreading facilities. These facilities are adjacent to some of the largest tributaries of the Los Angeles River, and the Pacoima and Tujunga Washes.

During average and below average years, these spreading facilities are very effective at capturing a large portion of the stormwater flowing down the tributaries. However, storm flows during wet and extremely wet years exceeds the capacity of these facilities. Weather patterns in Los Angeles are highly variable, with periods of both dry years and wet years. Some climate studies predict that these patterns may become more extreme in the future. The SCMP identified future centralized projects to capture an additional 35,000 AFY to 51,000 AFY by 2035, based on a conservative or aggressive approach, respectively.

Furthermore, a significant portion of the watershed is not located adjacent to large tributaries, and therefore cannot be served by existing spreading facilities. These areas are the urbanized low-lying flatlands where stormwater runoff typically accumulates. Therefore, the SCMP identified a strategy to develop and implement distributed stormwater infiltration solutions. These distributed solutions include widespread, smaller projects at the neighborhood scale and landscape changes at the individual parcel scale. The SCMP identified future distributed infiltration and direct use projects, programs and policies to capture an additional 33,000 AFY to 63,000 AFY by 2035, based on conservative or aggressive approach, respectively.

With ever-increasing attention being placed on stormwater capture, other challenging conditions beyond imperviousness and changing climate patterns have been identified. These challenges include aging spreading facilities, landfills adjacent to spreading facilities, floodplain encroachment, substructure impacts, and other man-made conditions that limit the ability to capture stormwater for later use. Solutions exist for many of these challenges. For example, the aging delivery systems at the spreading facilities can be retrofitted with new gates and telemetry. Other conditions, such as the presence of large sanitary landfills adjacent to spreading facilities, are more difficult to rectify.

With increasing pressure on traditional water resources, LADWP is undertaking a significant effort to augment its local water supply portfolio with increased stormwater capture. This effort aligns with LADWP's mission of providing safe, reliable, and environmentally sensitive water supply for the City of Los Angeles.

7.1 Importance of Watershed Management to Groundwater Supplies

Managing native stormwater is a necessary step towards maintaining a healthy groundwater basin. Urbanization and its associated increase in impervious surfaces has altered the natural ability of stormwater to replenish local groundwater aquifers. Stormwater systems in the City were designed primarily for flood control to convey stormwater runoff to the Pacific Ocean as quickly as possible, thereby minimizing the potential for flooding while maximizing the land area available for development. Within LADWP's service area, the SFB is the most receptive to regional stormwater capture and recharge through spreading basins because of its predominantly sandy soils. However, stormwater that once percolated into groundwater is now being channeled across impervious surfaces and through concrete-lined channels to areas outside the San Fernando Valley. Several other groundwater basins within LADWP's service area may provide varying levels of opportunities for development of stormwater capture. These basins include: Central Basin, West Coast, Hollywood Basin, Santa Monica Basin, Main San Gabriel, Sylmar, Verdugo, and Eagle Rock. The Central and West Coast basins have clear legally adjudicated mechanisms in place that would allow for storage and recovery of additional stormwater in a manner beneficial to the City's local water supply goals.

An essential task of watershed management is to retain as much stormwater runoff as possible for groundwater recharge, which is the process of increasing an aquifer's water content through percolation of surface water. Groundwater recharge occurs in the SFB primarily through the infiltration of natural rainfall, captured local stormwater, and/or imported irrigation water. LADWP has not utilized imported water for spreading and recharge since 1998. Groundwater recharge supports the health of LADWP's SFB groundwater supplies by addressing the long-term reduction in stored groundwater within the SFB, protecting the safe yield of the groundwater basin, and ensuring the SFB's long-term water supply reliability.

During storm events, large volumes of stormwater are captured with existing centralized facilities for spreading purposes. Centralized stormwater capture facilities (i.e., spreading grounds, dams, reservoirs) are engineered features located in specific locations that capture large runoff flows when available, and subsequently deliver this runoff to spreading basins where it is infiltrated into underlying groundwater aquifers. These facilities on average have captured and infiltrated 27,000 AFY, with a historic high of 96,899 AFY. LADWP coordinates these activities with the LACFCD to effectively recharge the SFB through the spreading of native stormwater. Flood control facilities are the primary means to divert native runoff into the spreading ground facilities listed on Exhibit 7A and mapped on Exhibit 7B. LACFCD oversees operations at the Branford, Hansen, Lopez, and Pacoima Spreading Grounds. The Tujunga Spreading Grounds are operated by LACFCD in partnership with LADWP.

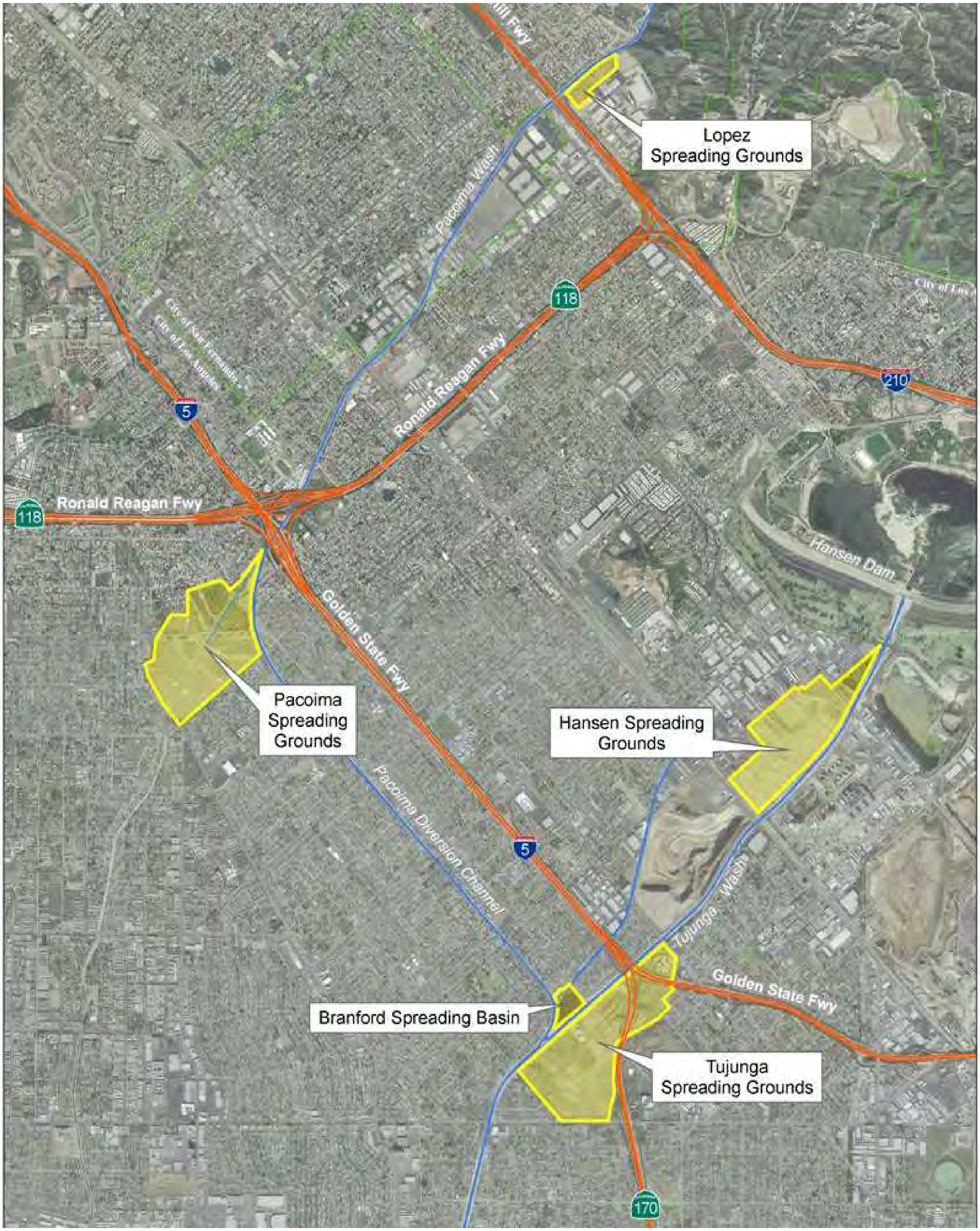
Exhibit 7A
SFB Spreading Grounds Operations Data

		Annual Spreading (AF)	
Facility	**Location**	**Average[1]**	**Historic High[2]**
Branford	Mission Hills, CA	552	2,142
Hansen	Sun Valley, CA	13,647	35,192
Lopez	Lake View Terrace, CA	587	3,922
Pacoima	Pacoima, CA	6,851	24,164
Tujunga	Sun Valley, CA	5,034	31,479
	Total	26,671	96,899

1. Historic average through December 2015

2. Historic high at each facility was determined independently

Exhibit 7B
Spreading Ground Facility Locations



7.2 Additional Benefits of Watershed Management

Watershed management provides additional important benefits to the City, including increased water conservation, improved water quality, open space enhancements, wildlife habitat, flood control, and social/economic benefits.

7.2.1 Water Quality

Water quality in local streams, rivers and the Pacific Ocean is improved by reducing pollutants reaching downstream waterways. Stormwater runoff is a conveyance mechanism that transports pollutants from the watershed into various waterways, and ultimately the Pacific Ocean. Pollutants include, but are not limited to, bacteria, oils, grease, trash, and heavy metals. The City must comply with adopted Total Maximum Daily Loads (TMDLs) for pollutants. TMDLs set maximum limits for specific pollutants that can be discharged to a water body without causing the water body to become impaired or limiting certain uses, such as water body contact during recreation.

In 2009, the Los Angeles City Council adopted the Water Quality Compliance Master Plan for Urban Runoff. This 20-year plan provides a strategy for cleaning stormwater and runoff to protect the City's waterways and the Pacific Ocean. Capturing stormwater runoff for groundwater recharge removes a portion of the pollutant conveyance mechanism, which in turn reduces downstream pollution and thereby assists the City with water quality compliance and improving the overall health of its waterways.

The 1987 amendment to the Clean Water Act, required that the U.S. Environmental Protection Agency (USEPA) issue National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater permits for discharges from large Municipal Separate Storm Sewer Systems (or MS4s), which are systems serving a population of 250,000 or more. An NPDES Permit allows stormwater discharges into surface waters such as rivers, lakes, creeks, or the ocean. The Los Angeles Regional Water Quality Control Board (LARWQCB) issues NPDES Permits in the Los Angeles area, wherein the permit requires a decrease in pollutants to the maximum extent practicable in stormwater and urban runoff. NPDES MS4 Permit Order No. R4-2012-0175 was adopted on November 8, 2012 by the LARWQCB and became effective on December 28, 2012. The purpose of the Permit is to ensure the MS4s within Los Angeles County are not causing or contributing to exceedances of water quality objectives, which are set to protect the beneficial uses in the receiving waters in the Los Angeles region.

The Permit allows permittees to customize their stormwater programs through the development and implementation of a Watershed Management Program (WMP) or an Enhanced Watershed Management Program (EWMP) to achieve compliance with receiving water limitations (RWL) and water quality-based effluent limits (WQBELs). The EWMP compliance path is designed to enable permittees to collaborate within specific Watershed Management areas in order to implement multi-benefit regional projects that, where feasible, retain all non-stormwater runoff and all stormwater runoff from the 85th percentile, 24-hour storm event. EWMPs were prepared/approved for the City, by watershed, as part of LASAN's compliance with MS4 Permit in June 2015.

7.2.2 Water Conservation

Water conservation is achieved by enhancing the capture and management of localized runoff for uses that reduce potable demands. Distributed stormwater capture is the primary stormwater capture mechanism that provides water conservation. Distributed stormwater capture includes stormwater Best Management Practices (BMPs) that utilize vegetation, soils, and natural processes to manage stormwater runoff close to the source and capture localized dry and wet weather runoff. Distributed projects are smaller-scale projects that can provide water supply benefit at the neighborhood and even residential level, and can be placed throughout the City on any landscape, including parks, public and private development, public infrastructure and rights of way, and entire residential blocks. Distributed direct use projects aim to conserve water by capturing stormwater for uses that reduce potable water demand. Examples of distributed direct use projects that reduce potable demands include rain gardens, cisterns, and rain barrels.

7.2.3 Open Space Enhancement

Open space enhancement can be an added benefit of some stormwater capture/groundwater recharge projects, which at times provide additional open space areas that may include passive recreation, educational opportunities, and habitat restoration. Most projects involve increasing vegetation and recreational amenities to create opportunities for wildlife habitat and a recreational/educational resource for the local community. Additionally, open space enhancements assist the City in improving the overall quality of life for residents and provide substantial aesthetic improvements to the urban landscape.

7.2.4 Wildlife Habitat

Wildlife habitat can be improved or augmented through stormwater capture projects that include restoration of native vegetation. For example, projects that include open space enhancements may also provide habitat for aquatic life, birds and insects while helping to replenish groundwater supplies and improve water quality. Additionally, removal of invasive species increases native vegetation that provides food and habitat for wildlife.

7.2.5 Flood Control

Flood control benefits are achieved when demand on the conveyance capacity of the storm drain system is reduced. Groundwater recharge projects reduce potential flooding by diverting a portion of storm flows into recharge areas, thereby decreasing the demand on the overall capacity of the storm drain system.

7.2.6 Social/Economic

Social and economic benefits can be provided by stormwater capture projects. Specific benefits include: passive recreation, neighborhood revitalization, public health improvement, educational opportunities, and job creation.

7.3 Stormwater Capture Master Plan

The Stormwater Capture Master Plan, completed in 2015, investigated potential strategies for advancement of stormwater and watershed management throughout the City. Stormwater capture projections presented in this UWMP are based on the SCMP. The SCMP is a document that outlines LADWP's strategies over the next 20 years to: (1) implement stormwater policies, programs and projects in the City, and (2) contribute to the development of more reliable and sustainable local water supplies, which ultimately reduce the City's purchase of imported water.

7.3.1 Goals and Benefits

The SCMP includes an evaluation of existing stormwater capture facilities and projects, quantifies the maximum stormwater capture potential, develops feasible stormwater capture alternatives (i.e., projects, programs, policies etc.), and proposes potential strategies to increase stormwater capture. The SCMP also evaluates the multi-beneficial aspects of increasing stormwater capture, including potential open space alternatives, improved downstream water quality, and peak flow attenuation in downstream channels, creeks, and streams such as the Los Angeles River.

The goals of the SCMP include:

- Quantification of the stormwater capture potential, including both long-term (2099) as well as a 20-year implementation timeline;
- Identification of new projects, programs, and policies to increase stormwater capture for water supply;
- Prioritization of opportunities based on water supply criteria;
- Development of costs and benefits for proposed projects, programs, and policies;
- Definition of timing and key milestones at 5-year intervals/implementation rates (2020, 2025, 2030, and 2035); and
- Identification of potential funding strategies that could be used for program and project implementation.

7.3.2 Key Stakeholders

Project partners and supporters included:

- City of Los Angeles Department of Public Works
- City of Los Angeles Department of Water and Power
- Community-based organizations/ stakeholders (e.g. TreePeople, Inc., Council for Watershed Health, The River Project)
- County of Los Angeles Department of Public Works
- Los Angeles County Flood Control District
- Metropolitan Water District of Southern California
- U.S. Army Corps of Engineers

The SCMP's target audiences were grouped into four categories:

(1) The internal audience, which consisted of local and state elected officials, regulators, and entities involved in research or implementation programs related to stormwater capture. Groups included City, County, State, and Federal departments, such as the Mayor and City Councilmembers, USEPA Region 9 Administrators, LARWQCB members, and the SWRCB.

(2) The Technical Advisory Team, which consisted of internal LADWP and City staff, as well as representatives from other government agencies with planning-level interests and overlap with LADWP's master planning process.

(3) Key regional stakeholders, which included critical opinion leaders and leaders of environmental, neighborhood, civic, and community organizations.

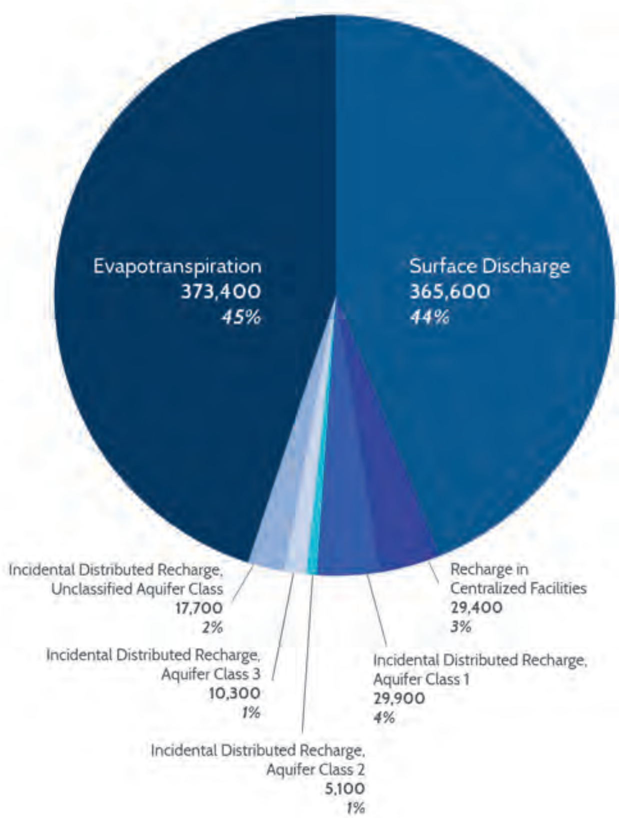
(4) The general public, which included the citywide audience, constituents of key stakeholders, and the media.

7.3.3 Existing Capture

The SCMP used two watershed models to estimate the existing stormwater capture occurring in the City, both in centralized facilities (e.g. spreading grounds) and as incidental distributed capture on pervious surfaces. The primary model was Los Angeles County's Load Simulation Program (LSPC) model because it is constructed with all of the major centralized facilities in place, calibrated to simulate runoff for the SCMP study area, and can simulate the routing, drainage networks, storage in dams, and infiltration in spreading grounds. The second model used to corroborate the LSPC results was the Ground Water Augmentation Model (GWAM) because it models evapotranspiration and recharge more robustly than LSPC, though it does not have the ability to simulate the flow routing.

As shown in Exhibit 7C, results indicate that an average annual volume of 831,400 AF of water enters the City (volumes are based on the average annual volume for the period of record from 1988 to 2011) as precipitation, irrigation, or runoff from upstream areas and leaves either as evapotranspiration, capture in centralized facilities, incidental capture on pervious surfaces, or as runoff downstream. Approximately 11% or 92,000 AF of the total incoming water currently goes to recharge aquifers, which is split between 29,000 AF of centralized stormwater capture and 63,000 AF of incidental distributed stormwater capture. However, only 35,000 AF of the incidental distributed stormwater capture is recharged into water supply aquifers. Combined, the total existing amount recharged into water supply aquifers is 64,000 AF. The San Fernando Valley is where most of the incidental distributed recharge is occurring and where all of the existing centralized facilities are located.

Exhibit 7C
Watershed Model Results



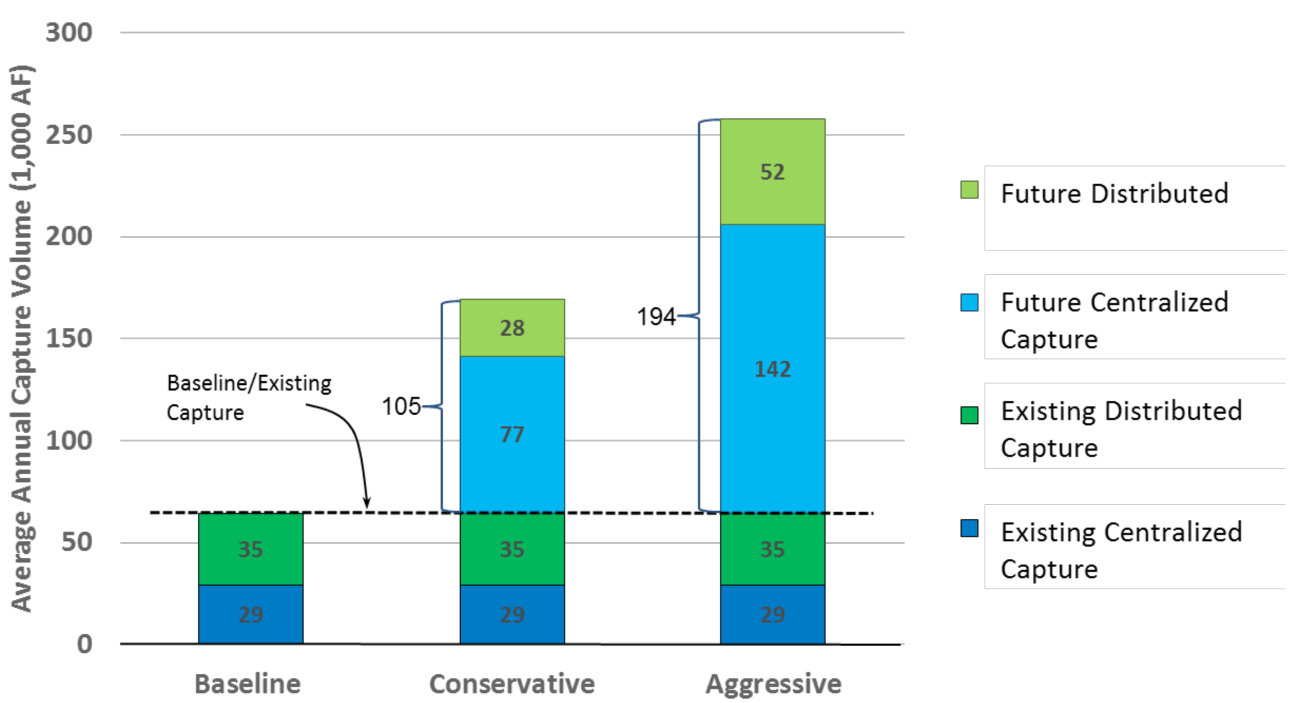
7.3.4 Potential Capture

The SCMP analyzed potential capture to determine how much of the inflow to the City could realistically be captured in centralized facilities (e.g. spreading grounds), distributed facilities/infiltration BMPs (e.g. rain gardens), incidental distributed capture/recharge on pervious land, and direct use storage facilities (e.g. cisterns). This analysis defined the Conservative and Aggressive implementation scenarios, and modeled those scenarios to determine how much capture is attainable. The two scenarios create an "envelope" of the range of potential future outcomes and reflect broader conditions outside the direct control of LADWP that could impede or accelerate stormwater capture.

Man-made obstacles that could potentially be addressed in the future were mapped for the entire City area, including contaminant plumes, superfund sites, dewatering permits, production wells influenced by untreated stormwater, and heavy industrial land uses. Under the Conservative Scenario these obstacles were assumed to remain, and those areas considered off-limits. Under the Aggressive Scenario, it was assumed that these obstacles were removed so that these constraints did not impact opportunity. For the purposes of the UWMP, the Conservative Scenario numbers are utilized.

The long-term (2099) stormwater capture potential is 179,000 AFY and 258,000 AFY under the Conservative and Aggressive scenarios, respectively. This capture potential is shown on Exhibit 7D and represents a long-term (2099) capture volume of approximately double and triple the existing volume.

Exhibit 7D
Existing and Long-Term (2099) Potential Stormwater Capture



The SCMP provides an implementation strategy for stormwater capture over the next 20 years, at 5-year increments, using centralized and distributed capture. Under the SCMP implementation strategy, LADWP could increase its stormwater capture by nearly 68,000 to 114,000 AF per year by 2035 for a total capture amount of 132,000 AF (Conservative) and 178,000 AF (Aggressive). Of the 68,000 AF increase in stormwater capture, under the Conservative Scenario:

- 35,000 AF will come from centralized stormwater capture for recharge.
- 31,000 AF will come from distributed stormwater capture for recharge.
- 2,000 AF will come from distributed stormwater capture for direct use.

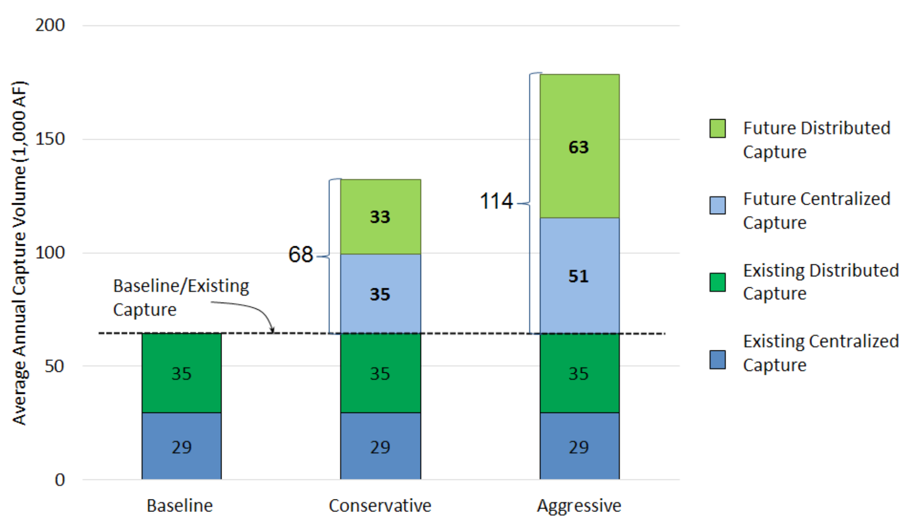
As in the existing condition, most of the increase in recharge will take place in the San Fernando Valley under both scenarios. Capture volumes are summarized in the Exhibits 7E and 7F for the 20-year implementation timeline ending in 2035.

Exhibit 7E
Potential Distributed and Centralized Stormwater Capture in 2035

Type of Stormwater Capture			Conservative Scenario (AF)	Aggressive Scenario (AF)
Existing/ Baseline Capture	Baseline Recharge	Centralized Capture	29,000	29,000
		Incidental Distributed Capture	35,000	35,000
		Subtotal Existing/Baseline Capture	64,000	64,000
Future Capture	Recharge Potential	Centralized Facilities	35,000	51,000
		Distributed Facilities	31,000	56,000
		Subtotal Recharge	66,000	107,000
	Direct Use Potential	Distributed Direct Use	2,000	7,000
	Total Future Capture		68,000	114,000
Total Existing/Baseline + Future Capture			132,000	178,000

Source: LADWP, Stormwater Capture Master Plan, 2015.

Exhibit 7F
Distributed and Centralized Capture - 2035



7.3.5 Implementation

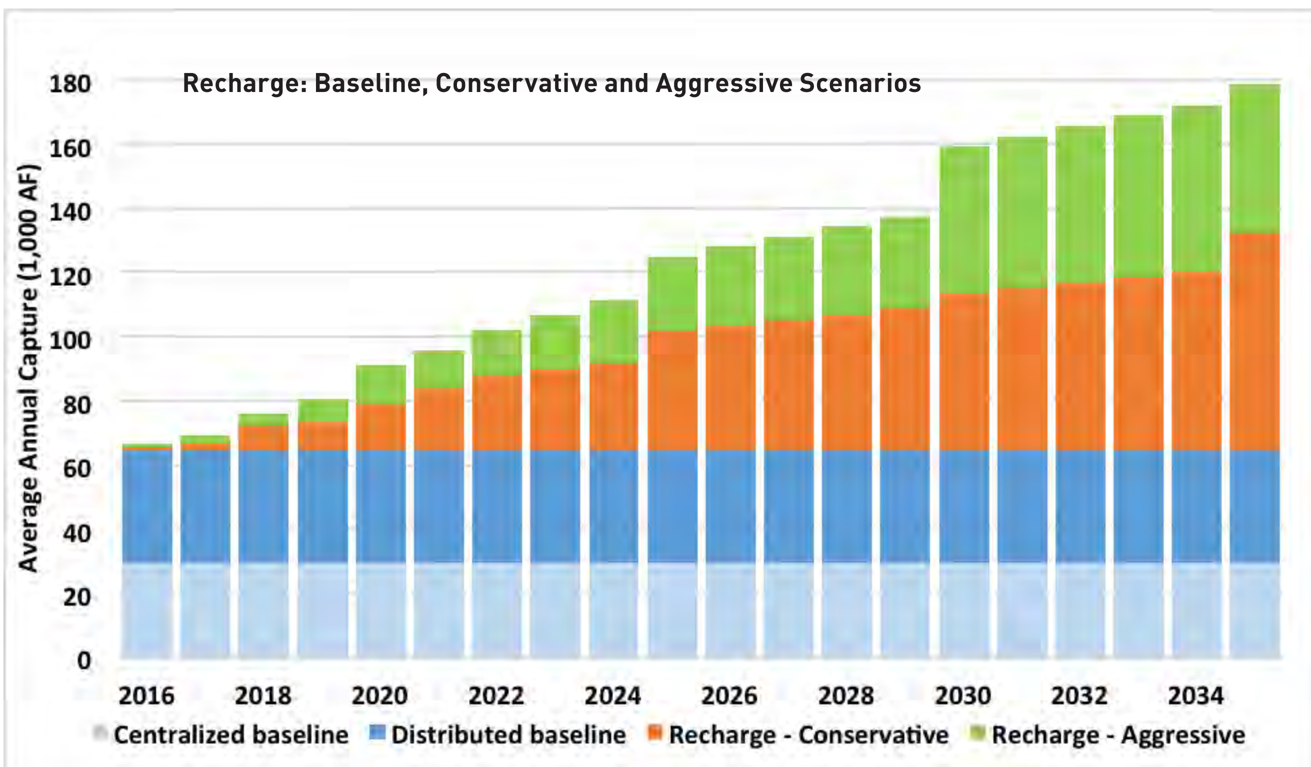
The SCMP defines five-year targets for stormwater capture over the next twenty years (2020, 2025, 2030, and 2035) and presents recommended avenues for implementation using a combination of centralized and distributed projects. The projected average annual capture through time is illustrated on Exhibit 7G.

For centralized projects, a comprehensive list of alternatives was compiled from review of previously-implemented stormwater capture studies, LADWP's current list of centralized projects, new project concepts, and stakeholder input. Implementation phasing was developed by analyzing the status of each project, understanding the technical complexity of each project, determining the level of permitting required, and assessing the individual project costs and partnership opportunities. These projects are described in Section 7.4.

For distributed capture, program type alternatives were developed by creating categories based on different combinations of project attributes, including tributary area (either projects capturing runoff from a single property or those that capture runoff from an entire neighborhood), land use type (private property land uses or streets in the public right of way), and ultimate use of captured water (aquifer recharge or direct use). This categorization includes (1) on-site infiltration, (2) on-site direct use, (3) green street programs, (4) subregional infiltration, and (5) subregional direct use. These programs are described in Section 7.5.

Using the SCMP centralized and distributed implementation rates for the Conservative Scenario, LADWP can more than double the existing capture over the next 20 years to approximately 132,000 AFY.

Exhibit 7G
Potential Average Annual Capture through Time



Tujunga Spreading Grounds

7.4 Centralized Stormwater Capture Projects

Existing centralized stormwater capture facilities will require infrastructure improvements to maximize their capture capacity during extreme wet years. Weather patterns vary dramatically in Los Angeles with extreme wet years and extreme dry years. Therefore, new projects are necessary to expand the capability to capture a larger portion of stormwater flows during wet years. Multiple opportunities exist to develop new recharge projects and improve existing recharge projects in the SFB as identified in the SCMP. LADWP is proactively working in close partnership with LACFCD on multiple stormwater projects. LADWP, in collaboration with LACFCD has supported and contributed resources toward the design, construction, and implementation of a variety of projects to increase groundwater recharge of the SFB. Additionally, multiple agreements between LADWP and LACFCD have been approved to facilitate the completion of recharge studies, design work, and construction projects in the SFB for groundwater recharge, flood protection, and other benefits.

The SCMP identifies a full suite of future centralized stormwater capture projects for implementation in the 20-year timeline for the Conservative Scenario, of which the most significant projects are summarized in Exhibit 7H. To guide LADWP in prioritizing projects, the SCMP developed evaluation criteria that were used to score each of the projects. The ranking criteria included items such as stormwater capture potential and cost, as well as ownership and partnership opportunities. Each of these criteria was weighted based on its relative importance to LADWP. Under the SCMP Conservative Scenario for 2035, centralized stormwater capture projects will increase stormwater capture by approximately 35,000 AFY for a total centralized capture of 64,000 AFY, raising groundwater levels and ensuring future water supply reliability.

Each future project listed in Exhibit 7H is described below.

Exhibit 7H
Potential Centralized Stormwater Capture Programs

Project	Historical Annual Recharge (AFY)	Increased Annual Recharge (AFY)	Expected Annual Recharge (AFY)	Estimated Project Completion	Total Project Cost (Millions $ 2015)
Big Tujunga Dam Sediment Removal	0	500	500	2021	$ 33.00
Boulevard Pit Multi-use Project	0	9,760	9,760	2034	$ 118.00
Branford Spreading Basin Upgrade	552	597	1,149	2019	$ 1.10
Bull Creek Stormwater Capture	0	3,000	3,000	2020	$ 8.80
Canterbury Power Line Easement	0	1,000	1,000	2034	$ 29.03
East Valley Baseball (Strathern) Park	0	750	750	2024	$ 16.15
Hansen Dam Water Conservation	0	3,400	3,400	2024	$ 6.00
Hansen Spreading Grounds	13,647	0	15,747[1]	0	$ -
Lakeside Debris Basin	0	238	238	2034	$ 0.12
Lopez Spreading Grounds Upgrade	587	480	1,067	2019	$ 8.00
Old Pacoima Wash	0	1,000	1,000	2024	$ 44.22
Pacoima Dam Sediment Removal	0	700	700	2024	$ 85.00
Pacoima Spreading Grounds Upgrade	6,851	2,000	8,851	2019	$ 30.00
Rory M. Shaw (Strathern) Wetlands Park	0	590	590	2019	$ 46.00
Sheldon Pit Multi-use Project	0	4,500	4,500	2034	$ 75.00
Tujunga Spreading Grounds Upgrade	5,034	4,200	9,234	2017	$ 27.25
Valley Generating Station Stormwater Capture	0	118	118	2020	$ 1.62
Van Norman Stormwater Capture	0	2,308	2,308	2021	$ 10.00
Whitnall Hwy Power Line Easement	0	110	110	2018	$ 11.00
Total Historical/Baseline + Future Capture	**26,671[2]**	**35,251**	**64,022[1]**		**$ 550.29**

Source: LADWP, Stormwater Capture Master Plan, 2015.

1. Hansen Spreading Grounds is a completed project that historically recharges 13,647 AFY. Recent upgrades in 2012 increased its capacity by 2,100 AFY to 15,747 AFY. This increased capacity did not contribute to historical baseline.
2. There is a known discrepancy between baseline actual capture (26,671 AFY) and existing SCMP modeled capture (29,000 AFY), but difference is assumed to be negligible.

Big Tujunga Dam Sediment Removal. The Big Tujunga Dam Sediment Removal Project will remove accumulated sediment from Big Tujunga Reservoir. It is estimated that the total amount of accumulated sediment in the Big Tujunga Reservoir is approximately 2 million cubic yards. Additional sediment is expected to flow into the reservoir over the next few years as the watershed recovers from recent forest fires. The sediment removal project will permanently remove up to 4.4 million cubic yards of sediment from the reservoir. The project will be completed over approximately five years starting in the summer of 2015 and will result in an increased annual capture/recharge of 500 AFY.

Boulevard Pit Multi-Use Project. The Boulevard Pit Multi-Use Project is an active aggregate mine operated by Vulcan Materials Company (Vulcan) which Vulcan estimates will be in service through 2020. The site is approximately 140 acres and has been mined to a depth of more than 250 feet below ground surface at its deepest point. If acquired and enhanced with stormwater capture facilities, then the available storage capacity for stormwater would be approximately 15,000 AF. According to the latest draft of the "Tujunga Wash Watershed Groundwater Recharge Master Plan", the average annual groundwater recharge benefit from converting the Boulevard Pit into a stormwater detention facility has been estimated at 9,760 AF.

Branford Spreading Basin Upgrade. The Branford Spreading Basin Upgrade will remove fine silts from the basin and install new pumps to drain the basin and transfer water to the Tujunga Spreading Grounds. The expected additional stormwater capture associated with this project is 597 AFY.

Bull Creek Stormwater Capture. The Van Norman Complex has a 13 square mile tributary area and has large potential for stormwater capture. These flows exit the Van Norman Complex through Bull Creek and are eventually lost to the ocean via the Los Angeles River. This project proposes conserving a portion of the lost water by diverting flows from Bull Creek, using a six-foot high rubber dam, and conveying flows through a 60-inch pipeline to Pacoima Spreading Grounds, where it would spread and recharge the SFB. The project will capture 3,000 AFY of stormwater.

Canterbury Power Line Easement. The Canterbury Power Line Easement project would modify the 18.8 available acres of the Canterbury Power Line Easement to construct 24 recharge basins. The recharge basins would receive and retain stormwater from the adjacent Pacoima Spreading Grounds and local flows from neighboring tributary area between the Pacoima Diversion Channel and the Canterbury Easement. Constructing the Canterbury Power Line Easement project is expected to capture 1,000 AFY of stormwater.

East Valley Baseball (Strathern) Park. The East Valley Baseball (Strathern) Park project will modify approximately 9 acres of land to construct three infiltration basins. The infiltration basins will receive and retain stormwater from the Tujunga Spreading Grounds and tributary flows from a local storm drain. The project is anticipated to capture 750 AFY of stormwater.

Hansen Dam Water Conservation. In 1999 the U.S. Army Corps of Engineers (USACE) completed a feasibility study to examine operational changes and facility improvements at the Hansen Dam as part of a cost-shared study with LACFCD. The only structural modification associated with the plan is the conversion of the two ungated outlets to slide gate outlets. Operational changes include allowing the water conservation pool to encroach into the flood control pool up to an elevation of 1,030 feet during the flood season (October 1 through February 28, as defined by USACE). This project will increase stormwater capture by 3,400 AFY.

Lakeside Debris Basin. The 70-acre Lakeside debris basin property, located just east and adjacent to the interchange of the 5 and 405 Freeways, is owned by the LADWP. The LADWP has developed a joint project with the Department of Recreation and Parks to plan, design, and construct sports fields within this property. This project will result in stormwater capture of 238 AFY.

Lopez Spreading Grounds Upgrade. The Lopez Spreading Grounds Upgrade involves deepening the existing Lopez Spreading Grounds and improving the intake and delivery system. LACFCD is the lead agency for the project. Additional stormwater capture in the amount of 480 AFY is expected from the project.

Old Pacoima Wash. The Old Pacoima Wash Stormwater Infiltration Project would involve construction of multiple infiltration basins in an approximately two-mile stretch of the Old Pacoima Wash. Each infiltration basin would receive and retain stormwater from the upstream Pacoima Spreading Grounds, and would act as an extension of the spreading grounds. Constructing the Old Pacoima Wash infiltration basins project is expected to capture 1,000 AFY in stormwater

Pacoima Dam Sediment Removal. The Pacoima Dam Sediment Removal project involves removing sediment from behind Pacoima Dam to increase storage volume. The sediment build-up behind the dam has decreased the capacity to about 3,300 AF. The project will involve excavating 5 million cubic yards of sediment and increasing the storage volume by 3,000 AF. Increased storage would decrease the number of reservoir spill events and increase the available recharge flow for the Pacoima and Lopez Spreading Grounds. The excavation will extend over 7,000 feet upstream of the existing dam. The project is projected to produce an additional annual water recharge benefit of 700 AFY.

Pacoima Spreading Grounds Upgrade. LADWP in conjunction with LACFCD is upgrading the Pacoima Spreading Grounds by improving the intake and stormwater storage capacity. Annual average stormwater capture is expected to increase by approximately 2,000 AFY with completion of the project. Other project benefits include flood protection, water quality improvements, and passive recreation.

Rory M. Shaw (Strathern) Wetlands Project. The Rory M. Shaw (Strathern) Wetlands Park Project consists of constructing stormwater capture and treatment facilities within the bounds of a 46-acre site formerly used as a gravel pit. This project will construct detention ponds and wetlands to store and treat stormwater runoff. The treated flows will then be pumped to the adjacent Sun Valley Park for infiltration in the underground basins. In addition to increased groundwater recharge, flood protection, and water quality improvements, the project will include habitat restoration and recreational opportunities. This project will increase stormwater capture by 590 AFY.

Sheldon Pit Multi-Use Project. The Sheldon Pit is located immediately adjacent to the LACFD's Tujunga Wash Channel on the south east bank. The pit was an active aggregate mine and is now operated by Vulcan for fine sediment placement and presently Vulcan has no plans to cease operations. The site is approximately 138 acres and has been mined to a depth of approximately 250 feet below ground surface at its deepest point. If acquired and enhanced with stormwater capture facilities along with multi-use attributes, then the available capacity of storage for stormwater would be approximately 6,000 AF. This project entails a massive water conservation effort by diverting water from Tujunga Wash into Sheldon Pit for groundwater recharge while open space attributes would provide benefits such as habitat enhancement and both active and passive recreational opportunities. The expected additional stormwater capture associated with this project is 4,500 AFY.

Tujunga Spreading Grounds Upgrade. LADWP and the LACFCD are cooperatively working to enhance the Tujunga Spreading Grounds. Enhancements include deepening and consolidating the existing basins into 9 large spreading basins, installing two high flow intakes with 60-foot inflatable rubber dams, and modifying the existing intake to improve water quality and remove sediments. Other equipment to be installed includes control houses, slide gates and spillways, and a remote control telemetry system. The project plan incorporates community access and open space for passive recreation, limited to operational constraints. The City will maintain the open space attributes of the project, and the LACFCD will continue to operate the recharge facilities. The project will increase stormwater capture by 4,200 AFY.

Valley Generating Station Stormwater Capture Project. LADWP is leading efforts to capture and infiltrate stormwater from the Valley Generating Station, from adjacent streets, and from the Tujunga Wash Channel. The project will capture and infiltrate all stormwater from the Valley Generating Station, increasing stormwater capture by 118 AFY.

Van Norman Stormwater Capture Project. This project will involve an outlet modification and cleanout of the Lower San Fernando Dam to allow for stormwater capture. Operational changes will be made to allow for controlled dam releases. This will allow for stormwater that is stored and captured at Van Norman Complex to run into the future Bull Creek Stormwater Capture Project pipeline and eventually infiltrate in Pacoima Spreading Grounds. This project will increase stormwater capture by 2,308 AFY.

Whitnall Hwy Power Line Easement. The Whitnall Highway Power Line Easement stormwater capture project is located in the Sun Valley Watershed in the northeast San Fernando Valley. Stormwater runoff will be captured at several locations along the easement and directed into a network of swales, culverts, and infiltration basins. Additional uses of the project site may include open space and recreational enhancements. The project will result in up to 110 AFY of stormwater capture.

7.5 Distributed Stormwater Capture

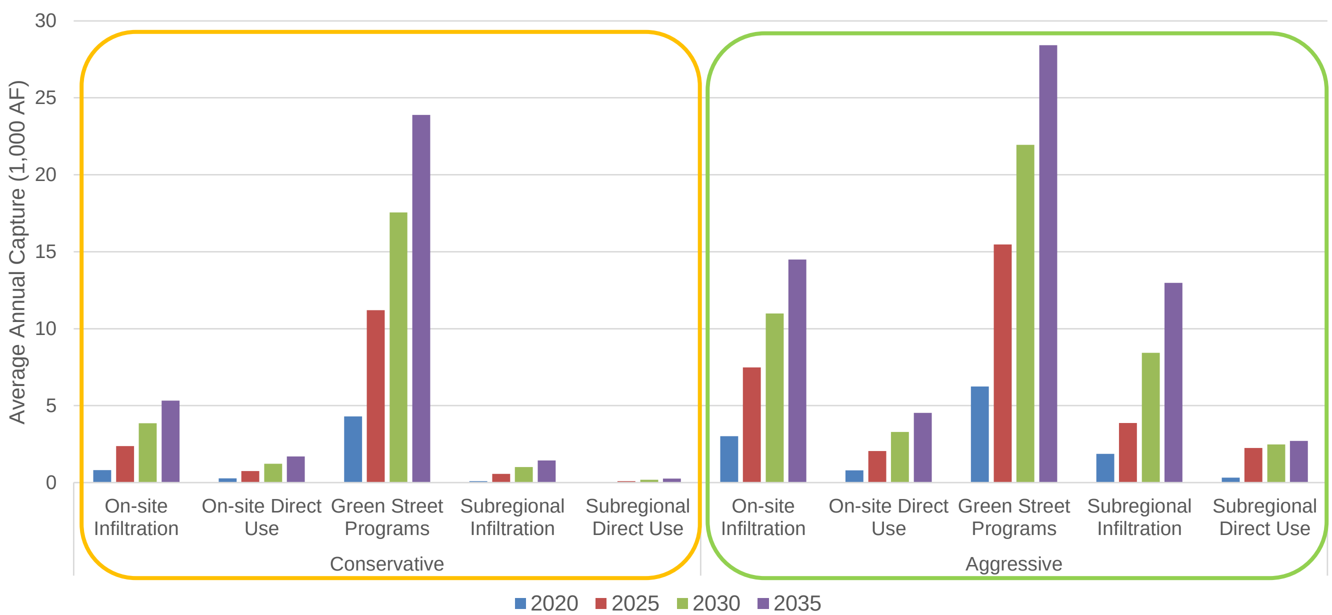
Distributed stormwater/runoff capture refers to capturing localized dry and wet weather runoff, and is further categorized as groundwater recharge capturing less than 100 AF or any direct stormwater capture system capturing less than 10 AF. Dry weather runoff is any runoff that occurs in the absence of rainfall from inefficient irrigation systems, overwatering, A/C condensate, or other wasteful outdoor water use practices, while wet weather runoff occurs as a direct result of rainfall. Wet weather runoff represents a significantly larger volume of water than dry weather runoff, but either weather runoff can be beneficially used.

Throughout the City there are opportunities to capture localized dry and wet weather runoff for local reuse. However, Los Angeles' storm drain systems have historically been designed to protect life and property from flood impacts by quickly redirecting rainfall and runoff from impervious surfaces into the City's storm drain system and ultimately the Pacific Ocean without regard to water supply or water quality impacts.

While centralized stormwater capture plays a key role in groundwater recharge in the City of Los Angeles, space constraints limit opportunities for new large centralized facilities and have changed the focus towards distributed stormwater capture. Distributed stormwater capture includes stormwater management BMPs that utilize vegetation, soils, and natural processes to manage stormwater runoff close to the source. Distributed facilities can be placed throughout the City on any landscape, including parks, public and private development, public infrastructure and rights of way, and entire residential blocks they can therefore be installed at numerous locations within the highly developed landscape of Los Angeles.

Under the SCMP Conservative Scenario for 2035, distributed stormwater capture will increase by 33,000 AFY (31,000 AFY for infiltration and 2,000 AFY for direct use).

Exhibit 7I
Distributed Capture by Program (excludes baseline/existing capture)



7.5.1 Program Alternatives

For distributed capture, the SCMP program type alternatives that will provide the projected stormwater capture increase of 33,000 AFY include:

- On-site infiltration;
- On-site direct use;
- Green streets;
- Sub-regional infiltration; and
- Sub-regional direct use.

Each of these is described below and Exhibit 7I illustrates the amount of additional distributed stormwater capture by program type through the 20-year SCMP implementation timeline. Implementation of green street programs constitutes the largest component of future distributed capture.

7.5.1.1 On-site Infiltration

On-site infiltration is the practice of collecting stormwater runoff from impervious or compacted areas on a property for infiltration within the same parcel. BMPs that can be implemented as part of on-site infiltration include permeable pavement, bio-infiltration, and subsurface infiltration. Bio-infiltration BMPs can take a variety of forms, but they all have the common elements of storage, bio-filter media, and plants adapted to tolerate periods of inundation and dryness. Specific bio-infiltration types are described below.

Rain Garden/Bio-Infiltration Basin. A rain garden is a depressed vegetated area underlain by porous soil media and sometimes open-graded gravel. The wide, shallow excavation allows runoff to collect and be used by the vegetation. Water in excess of what the plants need to survive can slowly seep into the surrounding soils. Large-scale rain gardens are often referred to as bio-retention or bio-infiltration basins. Not only do they provide for an attractive landscape, but they are also effective in treating and infiltrating stormwater for local groundwater recharge. Bio-infiltration basins typically have a deeper gravel layer to accommodate larger runoff volumes and some form of pre-treatment is provided due to the higher amount of debris, trash, and sediment in the inflow due to the larger tributary area.

Tree Wells/Planters. Tree wells and planters are a type of bio-infiltration BMP that is most typically used in parking lots, highly-trafficked pedestrian corridors, and commercial or residential parkways and streetscapes. Storage is provided in the void space of the soil, and a gravel base is used to maximize infiltration. These BMPs have a small footprint, providing wide application to locations where space constraints exist. Planters are designed to treat roof runoff and runoff from small tributary areas, accepting runoff from roofs, walkways, sidewalks, or parking areas and holding the runoff so that it can slowly be infiltrated into the ground.

Vegetated (Parkway) Swales. A vegetated swale is a shallow, vegetated hydraulic conveyance that collects runoff while slowing it down and allowing it to infiltrate. Infiltration capacity can be maximized through the use of check dams running perpendicular to flow. Vegetated swales are most commonly found along roadways.

Bump-Outs. A curb bump-out is traditionally a traffic calming measure in which the curb is extended into a crosswalk or roadway to reduce crossing distance for pedestrians, increase pedestrian safety, and create the visual effect of the roadway narrowing for drivers. Curb bump outs can act as bio-infiltration BMPs when runoff from the roadway, sidewalks, or the roofs of adjacent buildings is allowed to enter the bump out via a curb cut.

7.5.1.2 On-site Direct Use

On-site direct use is the practice of collecting stormwater generated on-site for non-potable on-site uses (e.g. irrigation or toilet flushing). On-site direct use reduces potable demand (water conservation), therefore taking pressure off the municipal supply. Rain barrels and cisterns are the primary BMPs for on-site direct use.

Rain Barrels. Rain barrels are distributed stormwater capture devices used to store rainwater collected from roofs via roof rain gutter systems. Harvested water can be used for outdoor irrigation at a later time. If overflow infiltration is provided, and/or greater roof area is utilized, annual rainfall volume captured can be significantly greater. Through participation in the SoCal Water$mart Program, LADWP customers are currently eligible to receive a rebate for a maximum of four rain barrels of up to $100 per rain barrel with a minimum size of 50 gallons. More information on this program is available in Chapter 3, Conservation.

Cisterns. Cisterns are larger than rain barrels and can range from 100 to 10,000 or more gallons. They store diverted runoff from roof areas and other impervious surfaces. Cisterns have applicability for nearly all land uses as they can be easily scaled up or down to fit size and water use demands of a site. Residential, commercial, institutional, industrial, and educational land uses can implement cisterns to capture stormwater and use it for irrigation, toilet flushing, or other non-potable uses (i.e., cooling towers, cleaning tools or equipment, concrete mixing, dust control, etc.). Because residential irrigation can account for up to 40 percent of domestic water consumption, water conservation measures such as cisterns can be utilized to reduce demands, especially during hot summer months. Through participation in the SoCal Water$mart Program, LADWP customers are currently eligible to receive a rebate for a maximum of one cistern of up to $400 per cistern with a minimum size of 200 gallons. More information on this program is available in Chapter 3, Conservation.

The Great Los Angeles Water Collaborative, formerly known as the Multi-Agency Collaborative Phase II, is a pilot project demonstrating the use of cisterns to further stormwater capture initiatives to increase water supply, improve water quality, and flood attenuation. In partnership with TreePeople, the project is equally funded by LADWP, LASAN, and LACFCD, to collaboratively plan, fund, implement, and monitor landscape transformation at six properties in the City of Los Angeles, including electronically monitored and remote controlled cisterns. The project will seek to demonstrate the viability of increasing stormwater capture for groundwater recharge and on-site reuse in lieu of potable water. Cisterns being installed range in size from 420 gallons to 1,981 gallons. Multiple tanks are installed per site and result in systems that range from 840 to 3,962 gallons. The project also includes an analysis of the pilot-to-scale potential for this project-type. Installation of cisterns will be complete by March 2016.

Exhibit 7J is an underground rain-harvesting cistern. This 216,000 gallon cistern is located at Coldwater Canyon Park, harvesting local rainwater. Stormwater is collected from structure rooftops, fire lane, parking lot, and the surrounding landscape. The water is filtered and then used throughout the year to irrigate landscape on the top level of the park. The underground tank is 70 feet in diameter and 8 feet deep.

Exhibit 7J
Construction of Underground Cistern for Stormwater Capture

(Photo courtesy of TreePeople)

7.5.1.3 Green Street Programs

A green street is a right-of-way that maximizes stormwater capture through a combination of stormwater BMPs and design considerations. Practices could be placed in the street and sidewalk (permeable pavement, dry wells) or in the parkways (vegetated swales, bio-retention curb bump-outs, tree wells, and planters, and bio-retention basins). Green streets provide an alternative to traditional impervious roadways and streetscapes by incorporating one or more BMPs to manage stormwater runoff while still maintaining the roadway's primary function of accommodating vehicular traffic and safe pedestrian access. Stormwater BMPs capture and infiltrate runoff from both the street itself, as well as some percentage of adjacent properties. Green streets may be implemented in residential and commercial streets, at street-ends that dead end at major rivers (i.e. "Rio Vistas"), and in specially-zoned areas such as Pedestrian Oriented Districts and Business Improvement Districts.

7.5.1.4 Subregional Infiltration

In sub-regional infiltration, stormwater runoff is collected from multiple parcels, city blocks, or entire neighborhoods into a single infiltration BMP within the public right-of-way or adjacent public/private lands. Sub-regional infiltration programs often divert water from a storm drain line; however, in some instances, they may be fed via surface flow. BMPs that could be used for a sub-regional infiltration program include underground infiltration galleries and bioretention.

7.5.1.5 Sub-regional Direct Use

In sub-regional direct use, stormwater runoff is collected from multiple parcels, blocks, or an entire neighborhood for use in indoor or outdoor non-potable uses. Flows are routed into storage facilities, such as a cistern or pond, by diverting storm drain infrastructure from the public right-of-way onto a private or publicly-owned parcel with available space and adequate reuse purpose. Stored water is most often treated and pumped to its end purpose, which may include irrigation, toilet flushing, or cleaning vehicles and equipment.

7.5.2 Distributed Stormwater Capture Projects

As an outgrowth of the 2006 City of Los Angeles Water Integrated Resources Plan (IRP), came the development of the SCMP with its increased emphasis on stormwater capture. Within the SCMP neighborhood recharge concept efforts have evolved from the conceptual stage visualized in the IRP to actual identified projects in the City that infiltrate wet weather runoff as close as possible to the point of origin. A few of the identified projects are highlighted below:

Laurel Canyon Boulevard Green Streets Project. The Laurel Canyon Boulevard Green Street Project will construct a series of vegetated infiltration swales and dry wells along the northeast side of Laurel Canyon Boulevard, between Terra Bella and Kagel Canyon Streets. During storm events, stormwater runoff will be captured, treated, and infiltrated to replenish the San Fernando Groundwater Basin. The project will also offer learning opportunities to help educate the community on watershed related issues, improve curbs, gutters, sidewalks, and decrease local flooding during storm events. The project will collect stormwater runoff from approximately 123 acres of residential area and infiltrate nearly 40 acre-feet of water per year.

Burbank Boulevard Widening Project. The Burbank Boulevard Widening Project is a street and sidewalk improvement project combined with stormwater capture elements. The project is located on Burbank Blvd between Lankershim Boulevard and Cleon Avenue in North Hollywood and will capture surface runoff from the surrounding 57 acre tributary area. The project will benefit the environment, enhance public access, reduce local flooding, and augment the City's groundwater supply. Construction is anticipated to begin mid-2016. LADWP plans to contribute to the project for the installation of 16 dry wells.

Branford Street: Laurel Canyon to Pacoima Wash Stormwater Capture Project. The Branford Street Stormwater Capture Project will capture runoff from a 173 acre tributary area that has no storm drains. The project is in Council District 6 and 7, located near the intersection of CA-170 and I-5. Project could capture and recharge up to 148 acre-feet per year on average into the San Fernando Groundwater Basin through various stormwater BMPs.

Great Street: Lankershim Boulevard (Chandler to Victory). The Lankershim Boulevard Stormwater Capture Project will capture runoff from a 83 acre tributary area that currently has no storm drains. The project is in Council District 2 and could capture and recharge up to 105 acre-feet per average rainfall year into the San Fernando Groundwater Basin. Potential BMPs that could be implemented in this project include parking lot pavers, infiltration swales and chambers, parkway swales, and dry wells along curb and gutter.

Great Street: Van Nuys Boulevard (Laurel Canyon to San Fernando). The Van Nuys Boulevard Stormwater Capture Project is located in Council District 7 and will capture runoff from a 99 acre tributary area that currently has no storm drains. The intersection between Van Nuys Boulevard and Laurel Canyon Boulevard is currently the confluence point for the 99-acre watershed. The project has the potential to capture and recharge up to 95 acre-feet per year on average into the San Fernando Groundwater Basin through various stormwater BMPs.

Glenoaks & Filmore Stormwater Capture Project. The Glenoaks-Filmore Stormwater Capture Project is located in a sub-watershed that would benefit from the installation of stormwater capture BMPs. The project is located in Council District 7, near the intersection of CA-118 and I-210. The project will capture and recharge an average of 86 acre-feet per average rainfall year into the San Fernando Groundwater Basin through various stormwater BMPs

Agnes Avenue: Vanowen to Kittridge Stormwater Capture Project. The Agnes Avenue Stormwater Capture Project is located in a sub-watershed that would benefit from the installation of stormwater capture BMPs. The project is located in Council District 2, near the intersection of CA-170 and Vanowen Street. The project will capture runoff from a 56 acre tributary area that currently has no storm drains. The project could capture and recharge up to 60 acre-feet per year on average in the San Fernando Groundwater Basin through various stormwater BMPs.

Case Study:
Woodman Avenue Green Infrastructure Project

The Background

The Woodman Avenue Green Infrastructure Project (Project) was initially proposed by the local Panorama City Neighborhood Council during the development of the Tujunga-Pacoima Watershed Plan process, which The River Project authored. The Project helps recharge the San Fernando Groundwater Basin, improves water quality, and alleviates local flooding.

The Project

The Woodman Avenue Green Infrastructure Project was completed in February 2014.The total Project cost was $3.4 million. Proposition grant funding contributed $1.65 million towards the Project cost. LADWP contributed $1.5 million, and LASAN provided the remaining $250,000.

The Project replaced an existing 16-foot wide, 3,500-foot long concrete median. The Project captures surface runoff, from approximately 111 acres, that previously ran along street gutters and into storm drains, through the Tujunga Wash and Los Angeles River, and into the ocean. This runoff is now directed into a vegetated swale, where flows percolate into an underground retention system for infiltration.

Public Right-of-Way Improvements

Bioswale
The newly installed median includes bio-swales to capture and treat stormwater runoff from the local sub-watershed mostly from residential land use. The bioswales are open shallow channels with gently sloped sides and bottoms filled with vegetation and river rock where stormwater runoff is collected. Bioswales help reduce the flow velocity and treat stormwater runoff by filtering it through the vegetation in the channel, through the subsoil matrix, and/or into the underlying soils. In addition, bioswales trap particulate pollutants (suspended solids and trace metals), promote infiltration and serve as part of the whole stormwater drainage system installed for this project.

Infiltration Gallery
A large infiltration gallery was installed underneath the street right-of-way. The gallery is a sub-surface stormwater collection system, constructed with perforated pipes into which runoff water flows and is then allowed to infiltrate into the ground to recharge the local groundwater basin.

Decomposed Granite Walkway
A walkway was installed to maintain pedestrian access in the median. A permeable decomposed granite walkway will help reduce runoff and promote infiltration.

The Benefits
The finished project incorporates a mixture of strategies to produce multiple levels of benefits not only to the neighborhood, but also to the local and regional community that can take this work as encouragement:

- Capture stormwater and dry-weather runoff to prevent flooding and decrease pollution of local rivers and oceans
- Reduce impermeable surfaces and increase groundwater recharge
- Improve neighborhood aesthetics through increased green space and public right-of-way improvements
- Increase groundwater recharge by 55 acre-feet per year
- Encourage community awareness of water and associated environmental issues.

Bioswale along Woodman Avenue Median

Case Study:
Garvanza Park

The Background

Garvanza Park (Project) was proposed as part of the Arroyo Seco Watershed Management and Restoration Plan (WMRP), completed in 2006 by North East Trees. The Project is located at Garvanza Park in Highland Park. The Project will capture rainwater and urban runoff from a more than 85-acre tributary area in and around Garvanza and Highland Park.

The Project

The Project began in late 2010 and was completed by May 2012. The total Project cost was $3.884 million. LADWP contributed $244,000. The remaining Project costs were funded by Proposition 40, Proposition 13, Los Angeles Supplemental Environmental Project funds, and LASAN. The Project captures and treats stormwater and urban runoff diverted from the Avenue 63 storm drain into an underground BMP treatment system consisting of a hydrodynamic separator, settling basin, retention chamber and infiltration chamber.

Public Right-of-Way Improvements

Underground tanks

Two large underground tanks capture up to 3 acre-feet per rain event. The stormwater is harvested and cleaned through a pre-treatment system. Some of the rainwater enters into a cistern and allowed to infiltrate to replenish groundwater. The rest of the rainwater enters another cistern where water is stored and used for subsurface park irrigation for more than 20% of Garvanza Park, conserving potable water supplies.

Storage tanks at Garvanza Park

The Benefits

The finished project incorporates a mixture of strategies to produce multiple levels of benefits:

- Provide storage volume and treatment for a ¾" storm event
- Meet all standards for dry- and wet-weather runoff, as published in the Metals TMDL for the Los Angeles River
- Bacteria reduction to meet or reduce exceedance days on TMDL limits for the Los Angeles River
- Achieve 100% capture of trash from the upstream watershed in compliance with the Los Angeles River Trash TMDL.

Underground infiltration gallery in Garvanza Park

Case Study:
Sun Valley EDA Public Improvements Project

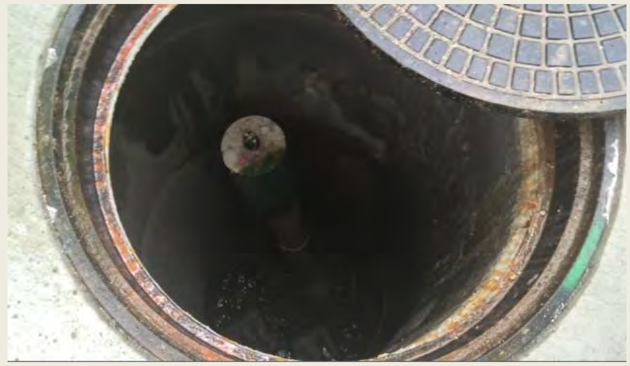
The Background
Originally intended to be a street improvement project, the Sun Valley Economic Development Administration (EDA) Public Improvements Project (Project) is a superb example of the power of multi-agency collaboration. The Project is a combined effort between the Los Angeles Bureau of Engineering, the Los Angeles Bureau of Sanitation, and the Los Angeles Department of Water and Power combining street & sidewalk improvements with stormwater capture. The Project benefits the environment, enhances public access, reduces local flooding, and augments the City's groundwater supply.

The Project
The Project captures surface runoff from approximately 146 acres that currently flows along street gutters to storm drains, through the Pacoima Diversion Channel, and ultimately down the Los Angeles River and into the Pacific Ocean. The Project is located on Branford Street between San Fernando Road and Arleta Avenue in Arleta. Construction has been completed as of early 2016. Total Project cost was $6.66 million. LADWP contributed $2.44 million for stormwater capture elements, a grant funded $3.165 million, and LASAN matched the remaining $1.055 million Project cost.

Intersection Prior to Construction

Public Right-of-Way Improvements

Dry-Wells
Street gutter flows are diverted into over 31 dry wells for groundwater basin infiltration. Each dry well system consists of three components: a catch basin to capture street flow, a settling chamber which captures sediment & contaminants, and an infiltration chamber which helps stormwater to percolate into the ground.



Infiltration Chamber during Rain Event

The Benefits
The finished project incorporates a mixture of strategies to produce multiple levels of benefits:

- Capture stormwater and dry-weather runoff to alleviate flooding and decrease pollution of local rivers and oceans
- Increase groundwater recharge by 93 acre-feet per year
- Protect pumping rights for the City, guaranteeing a more reliable water supply

Intersection After Construction

Infiltration Chamber during Rain Event

7.5.3 Best Management Practices

This section provides a short review of the regulatory environment that promotes distributed stormwater capture and implementation of BMPs.

7.5.3.1 MS4 Permit

On November 8, 2012, the LARWQCB adopted NPDES MS4 Permit Order No. R4-2012-0175, which requires that large new development/redevelopment projects provide onsite or offsite best management practice (BMP) such as infiltration.

The MS4 Permit could impact BMP projects in two ways: (1) BMP projects with significant areas of disturbance could trigger the permit requirements and therefore have minimum sizing requirements for the BMPs set by the permit terms; or (2) development/redevelopment projects that would have otherwise not included BMPs, will now have to include stormwater BMPs capable of meeting permit requirements for onsite or offsite retention of stormwater. More information on the Los Angeles County MS4 Permit is available on the LARWQCB website at: http://www.waterboards.ca.gov/losangeles/.

7.5.3.2 Low Impact Development

LADWP, in conjunction with other City departments, is developing programs to highlight water conservation through Low Impact Development (LID) and installation of BMPs. LID is a stormwater management approach that is designed to reduce runoff of water and pollutants from the site(s) at which they are generated. BMPs consist of practices designed to infiltrate runoff for groundwater recharge, reduce runoff volume, and capture rainwater for reuse.

The City has taken significant strides towards promoting distributed capture and infiltration of runoff through development of a suite of distributed projects. A Low Impact Development (LID) Ordinance was adopted in May 2012, which is a set of site design approaches and BMPs that are designed to address runoff and pollution at the source. The City's LID ordinance has significant benefits to stormwater capture because it requires that all development and redevelopment projects that create, add, or replace 500 square feet or more of impervious area to capture the three-quarter inch rain event for infiltration or reuse on-site. Single-family residences can comply in a more simple way by installing rain barrels, permeable pavement, rainwater storage tanks, or infiltration swales.

In general, implementing integrated LID practices into new development and retrofit of existing facilities can result in enhanced environmental performance while at the same time reducing development costs when compared to traditional stormwater management approaches. According to the USEPA, infrastructure costs associated with LID practices as compared to traditional stormwater treatment practices result in significant cost savings ranging between 15 percent and 80 percent less than traditional practices.

Retrofit of LADWP Facilities to Meet LID Standards. LADWP is assessing its existing facilities for potential retrofits using LID BMPs. LID BMPs under consideration include pervious pavement, stormwater capture, curb cuts, bioretention cells, and amended soils. Expected benefits include: increased groundwater recharge; decreased outdoor water use; increased compliance with stormwater regulations and Model Water Efficient Landscape Ordinance; improved environmental conditions for employees and the public; increased awareness of LID and examples for residents.

New LADWP Facility Development Using LID Standards. LADWP's Watershed Management Group developed a framework for implementation of LIDs and BMPs. Within the framework, LID and BMPs are taken into consideration during the planning, design, implementation, and maintenance processes associated with new LADWP facilities. Benefits include: reduced maintenance costs for stormwater infrastructure and landscape; reduced costs for grading by using natural drainage; reduced sidewalk cost by using narrower sidewalks; increased groundwater recharge; and reduced runoff volume and pollutant loading.

7.5.3.3 Incentive Programs that Promote Stormwater Capture

In addition to investing in centralized stormwater projects to recharge groundwater, LADWP has encouraged customers to participate in parcel-based stormwater capture incentive programs to promote stormwater infiltration. LADWP provides incentives for customers to install rain barrels and cisterns placed on their property. Through its partnership with MWD's SoCalWaterSmart website, LADWP's Water Conservation Program offers rebates to offset the cost of rain barrels (minimum capacity of 50 gallons) and cisterns (minimum capacity of 200 gallons). Customers can request rebates for up to four rain barrels or one cistern through the SoCalWaterSmart.com website.

Originally launched in October 2013, the program offered a $75 rebate for rain barrels. In response to Mayor Eric Garcetti's Executive Directive No. 5, the rebate amount was increased to $100 in November 2014. In November 2015, LADWP further expanded its Water Conservation Program to include a cistern rebate of $400. Additional incentive programs to advance conservation and stormwater capture initiatives are continually being studied by LADWP.

7.5.3.4 Legislation/Ordinances that Promote Stormwater Capture

Recently, several pieces of legislation that could promote stormwater capture and storage have been passed on a regional and state-wide level:

- As part of LASAN's compliance with the new LA County MS4 Permit It has developed EWMP plans.
- County of Los Angeles LID ordinance, which became effective in October of 2008 and amended in November of 2013, requires the use of LID principles in all development projects except road and flood infrastructure projects.
- The State Recycled Water Policy mandates specific goals for stormwater use by 2020 and 2030.
- Assembly Bill No. 1881 and Senate Bill SBX7-7 specify water conservation measures that promote stormwater capture and storage as a means of compliance.
- City of Los Angeles Council Motion 14-0748, Development of draft ordinance that requires all public street construction and reconstruction projects to incorporate Stormwater Management Guidelines for Public Street Construction and Reconstruction (Sustainable Streets Ordinance).
- Executive Directive No. 5 signed by Mayor Garcetti on October 14, 2014, provided strategies to comply with state-wide conservation orders and address the ongoing challenges to water supply reliability.
- Adoption of Los Angeles Sustainable City pLAn on April 8, 2015, based on ED5, that calls for increasing the sustainability of the City, including reducing LADWP's purchase of imported potable water by 50% by 2025, and sourcing 50% of water locally by 2035 as outlined in Chapter 1, Introduction.

In addition, guidance documents such as Water LA's Homeowner's "How-To" Guides are becoming available to help individuals set up small-scale stormwater capture and use systems. And the U.S. Bureau of Reclamation/ LACFCD Basin Study provides specific recommendations for basin management that can ultimately be applied to large-scale centralized stormwater storage programs. Furthermore, changes in basin management, such as the Central Basin Judgment Amendment Process, may help facilitate the use of groundwater basins for storage of stormwater and other "new" water supplies, and can serve as an example for regulators to develop stormwater storage policies in basins across LA County.

7.6 One Water LA

The City's IRP is a unique approach of technical integration and community involvement to guide policy decisions and water resources facilities planning. The IRP recognizes the inter-relationship of water, wastewater, and runoff management. Initiation of the IRP began in 1999 and culminated in its adoption in 2006. Through the stakeholder driven IRP process detailed facilities plans were developed for the City's wastewater and stormwater systems through the planning horizon of 2020.

One Water LA 2040 (One Water) plan is an initiative building upon the success of the IRP. One Water extends the planning period of the IRP out to 2040 and takes into consideration an additional emphasis on environmental, social, and sustainability factors. The overarching goal of One Water is to maximize resources through the integration of multi-beneficial programs and projects to make the City greener and more sustainable. A more in-depth discussion of One Water LA is provided in Chapter 10, Integrated Resources Planning.

7.7 Integrated Regional Water Management Plan (IRWMP) Program

LADWP is a participating agency in the Greater Los Angeles County (GLAC) IRWMP which encompasses portions of 4 counties, 84 cities, and many local agencies and districts. The IRWMP aims to address water resources needs of the region in an integrated and collaborative manner to improve water supplies, enhance water supply reliability, improve surface water quality, preserve flood protection, conserve habitat, and expand recreational access in the region. An initial plan was adopted on December 16, 2006 and has been subsequently updated. An updated plan was completed in 2013 and adopted in February 2014 to comply with new requirements, improve content, and maintain eligibility for funding opportunities.

Objectives identified in the initial IRWMP were refined and updated resulting in six objectives for the IRWMP Update: improve water supply; improve surface water quality; enhance habitat; enhance open space and recreation; reduce flood risk; and adapt to and mitigate against climate change vulnerabilities. For more detailed information on the IRWMP, please refer to Chapter 10, Integrated Resources Planning.

7.8 Stormwater Capture Master Plan Costs

Detailed costs for implementation of every aspect of the SCMP were not developed, except for centralized projects where project specifics are well defined. The SCMP is a planning level document, not a programmatic document. The SCMP provides guidance for implementing cost effective distributed and centralized projects and determining whether outside funding and partnerships are necessary for implementing certain projects.

Exhibit 7K, below, compares the range of costs of the various watershed management opportunities LADWP is pursuing and/or investigating.

The replenishment cost of recharge water is estimated at approximately $60 to $4,400 per AF, inclusive of the avoided cost of Tier 1 untreated imported water and the value assigned by MWD for participation in MWD's Local Resource Program. Direct use of stormwater without recharge has a cost of approximately $1,200 to $13,800, inclusive of the avoided cost of Tier 1 treated imported want and the value assigned by MWD for participation in MWD's Local Resource Program. The difference between the two values is related to the cost of untreated imported water for groundwater recharge versus treated imported water for direct use. The estimated values of recharge water and direct use are utilized to determine if a project is cost-effective.

Within the SCMP a criteria was developed for evaluating projects based on cost. For infiltration projects with a cost range of less than $1,100 per AF and direct use projects with a cost range of less than $1,550 LADWP may implement and/or fully fund the projects. For projects with a cost range greater than these amounts, LADWP may still pursue the projects by taking the following steps to bring LADWP's share of the cost into its target range:

- LADWP may seek outside funding and partnerships to implement the project itself, or
- LADWP may provide partial funding to partners that will implement the project, or
- LADWP may consider implementing projects it determines to be beneficial without additional funding or partners on a case by case basis, or

Within the SCMP, potential financing and funding sources are described. Financing includes local bonds and State Revolving Funds. Funding opportunities include grants and project partnerships. For private property owners potential financing mechanisms include on bill financing, credits, rebates, and implementation of a program similar to the Los Angeles County Property Assessed Clean Energy Program.

Exhibit 7K
Cost Analysis

Water Source	Average Unit Cost ($/AF)
Centralized Stormwater Capture	$60 – $4,400
Distributed Stormwater Capture	
Subregional Infiltration	$600 – $1,300
Subregional Direct Use	$1,200 – $6,800
On-site Infiltration	$900 – $3,100
On-site Direct Use	$3,200 – $13,800
Green Streets	$600 – $2,400
Self-Mitigating BMPs	$4,000 – $19,100

7.9 Summary

Watershed management involves retaining as much stormwater runoff as possible for groundwater recharge. During storm events, large portions of stormwater are captured with existing centralized facilities for spreading purposes. However, increased urbanization has decreased natural infiltration, thereby contributing to declines in local groundwater levels. There is significant potential for increased stormwater capture in the City.

Groundwater recharge using captured stormwater is essential to maintaining groundwater supplies, addressing the overall long-term decrease in stored groundwater, protecting the safe yield of the groundwater basin, and ensuring the long-term water supply reliability of the SFB. Proposed centralized projects will enable the City to utilize its stored water credits in a sustainable manner and prevent conditions of overdraft in the basin. The UWMP projects that by 2040 there will be a minimum of 15,000 AFY of increased groundwater pumping in the SFB due to water supply augmentation through centralized stormwater infiltration. Anticipating that stored groundwater will rebound in response to enhanced groundwater replenishment, LADWP will work with the ULARA Watermaster to continue observing actual water levels and re-evaluate basin safe yield to allow additional increases in groundwater production over time as SFB elevations rebound.

By 2040, the UWMP projects 2,000 AFY of additional water conservation through distributed stormwater capture projects offsetting potable water use. These water savings contribute to the overall water conservation goal to meet Mayor's water use reduction targets.

The SCMP investigated potential strategies for advancement of stormwater capture and watershed management in the City, and these numbers are used in the UWMP. The Plan outlines LADWP's strategies over the next 20 years to: (1) implement stormwater programs and projects in the City; and, (2) contribute to more reliable and sustainable local water supplies; and, (3) reduce purchases of imported water to meet goals set in the Mayor's Executive Directive No. 5 and Sustainable City pLAn.

The SCMP analyzed potential capture to determine how much of the inflow to the City could realistically be captured in centralized facilities (e.g. spreading grounds), distributed facilities/infiltration BMPs (e.g. green streets), incidental distributed capture/recharge on pervious land, and direct use storage facilities (e.g. cisterns). This analysis defined two implementation scenarios (Conservative and Aggressive), creating an "envelope" of the range of potential future outcomes.

Existing stormwater recharge is 64,000 AFY. Under the SCMP implementation strategy, LADWP could increase total stormwater capture to 132,000 AFY (Conservative) or 178,000 AFY (Aggressive) by 2035. Capture volumes are summarized in the Exhibit 7F.

Residential Cistern Equipped with Real-Time Controls to Remotely Optimize Rainwater Harvesting Performance.
1,320 Gallon Capacity Dewaters onto a 100 Square Foot Rain Garden.

Chapter Eight

Metropolitan Water District Supplies

San Luis Reservoir

8.0 Overview

As a member agency of the Metropolitan Water District of Southern California (MWD), the City of Los Angeles (City) through the LADWP purchases water to supplement its supplies from local groundwater, the Los Angeles Aqueduct (LAA), and recycled water. LADWP has historically purchased MWD water to make up the deficit between City demands and City supplies. As a percentage of the City's total water supply, MWD purchased water varies from four percent in Fiscal Year Ending (FYE) 1984 to 71 percent in FYE 2015, with the five-year average of 57 percent between FYE 2011 and FYE 2015. Exhibit 1F in Chapter 1 illustrates the City's reliance on MWD water during dry years, and increasingly in recent years, as LAA supply has been cut back for environmental enhancement projects. Although the City plans to reduce its reliance on MWD supply through local supply development and conservation, it has made significant investments in MWD, and will continue to rely on the wholesaler to meet 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 purpose is to develop, store, and distribute water to meet the current and future supplemental water needs of Southern California. 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 municipal water districts, one county water authority, and 14 cities, including the City of Los Angeles.

This Urban Water Management Plan (UWMP) projects, through additional local supply development and conservation savings over the next 25 years, that LADWP's reliance on MWD water supplies will be reduced significantly from the current five-year average of 57 percent of total demand to 11 percent under average weather conditions and to 44 percent under single-dry year conditions by FYE 2040.

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 CRA. 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 Department of Water Resources (DWR) in 1960 for almost half of the SWP's water supplies, which are delivered from the San Francisco Bay/Sacramento-San Joaquin River Delta (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.

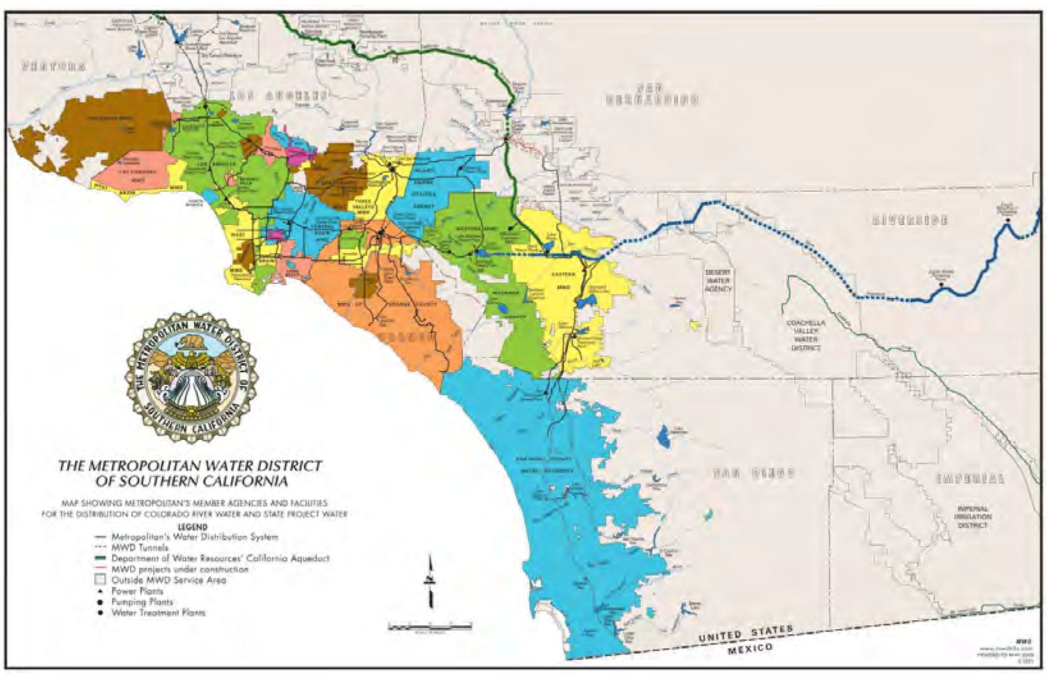
8.0.2 Governance

MWD is governed by a Board of Directors Board composed of 38 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. As of August, 2015, the City of Los Angeles has five Directors on MWD's Board and controls 20.11 percent of the vote. MWD's Administrative Code defines various tasks which the MWD 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 MWD Board.

8.0.3 Service Area

Originally serving an area of approximately 625 square miles in 1941 when water service began, 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 San Diego counties as depicted in Exhibit 8A. MWD member agencies serve 152 cities and 89 unincorporated communities. Member agencies provide wholesale, retail, or a combination of wholesale/retail water sales in their individual service territories.

Exhibit 8A
MWD Service Area



Courtesy of the Metropolitan Water District of Southern California

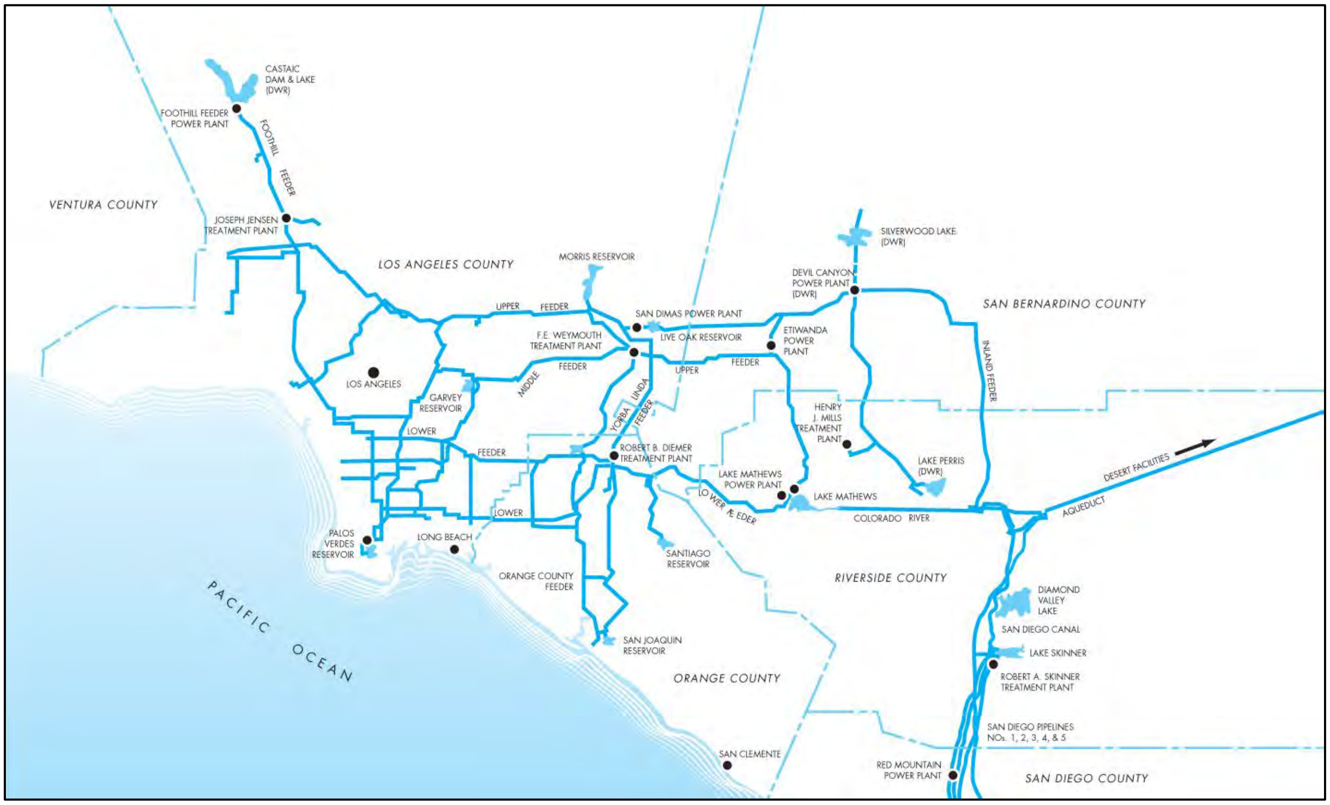
8.0.4 Major Infrastructure

MWD delivers approximately 5,000 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	1.2 million AFY
Pumping Plants	5 plants	1,617 feet of total lift
Distribution Pipelines/Tunnels	830 miles	N/A
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		1,072,000 AF
Hydroelectric Recovery Plants	16 plants	131 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, Water Transfers, Storage and Exchange Programs 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 (CRB) 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 CRB is comprised of ten gubernatorial appointees representing LADWP, MWD, San Diego County Water Authority, Palo Verde Irrigation District, Coachella Valley Water District, Imperial Irrigation District, California Department of Water Resources, California Department of Fish and Wildlife, and two public members.

8.1.1.1 The Law of the River

As Watermaster, the Secretary of the Interior secretary 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, 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.

Particularly notable among these documents are:

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. The term "States of the Upper Division" means the States of Colorado, New Mexico, Utah, and Wyoming. 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 Colorado River Basin (Basin) upstream of Lees 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 was 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.

Colorado River Aqueduct Intake - Whitsett Pumping Plant at Lake Havasu, courtesy of Metropolitan Water District

3. The California Seven Party Agreement of 1931 was developed in response to the Limitation Act and through regulations adopted by the Secretary, 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 (USBR). These priorities are shown in Exhibit 8D. Seven priorities were established with the first four priorities satisfying California's allocation of 4.4 MAF annually, the fifth and sixth priorities relating to California's share of excess Colorado River flows and the seventh priority for agricultural use in the Colorado River Basin in California. 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.

Exhibit 8D
Seven Party Agreement

<table>
<tr><th colspan="3">Listing of Priorities - Seven Party Agreement</th></tr>
<tr><th>Priority Number</th><th>Agency and Description of Service Area</th><th>Beneficial Consumptive Use (Acre-feet/year)</th></tr>
<tr><td>1</td><td>Palo Verde Irrigation District - 104,500 acres</td><td rowspan="4">3,850,000</td></tr>
<tr><td>2</td><td>Yuma Project, California Portion, not exceeding 25,000 acres</td></tr>
<tr><td>3(a)</td><td>Imperial Irrigation District and land in Imperial and Coachella Valleys</td></tr>
<tr><td>3(b)</td><td>Palo Verde Irrigation District - 16,000 acres</td></tr>
<tr><td>4</td><td>Metropolitan Water District of Southern California, City of Los Angeles and/or others on the coastal plain</td><td>550,000</td></tr>
<tr><td>5</td><td>Metropolitan Water District of Southern California, City of Los Angeles and/or others on the coastal plain</td><td>662,000</td></tr>
<tr><td>6(a)</td><td>Imperial Irrigation District and land in Imperial and Coachella Valleys</td><td rowspan="3">300,000</td></tr>
<tr><td>6(b)</td><td>Palo Verde Irrigation District - 16,000 acres of adjoining mesa</td></tr>
<tr><td>7</td><td>Agricultural Use in the Colorado River Basin in California</td></tr>
<tr><td colspan="2">Total</td><td>5,362,000</td></tr>
</table>

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). It 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. It also required the Secretary to develop the Long Range Operating Criteria and issue an Annual Operating Plan for mainstream reservoirs.

8.1.1.2 Colorado Supply Reliability

In the past 16 years (2000-2015), there have been only three years in which the Colorado River flow has been above average. The last above-average year was 2011, when the unregulated water year inflow to Lake Powell was 139 percent of average. Drought returned in 2012 with that year's runoff being among the four lowest in the recorded history of the Basin. By the end of November, 2015, the 16-year drought had decreased storage levels in Lake Mead and Lake Powell to 38 percent and 51 percent of capacity, respectively. In 2015, Lake Mead reached its lowest level in history, and the long-term outlook is for continued decline of the reservoir. These factors could reduce the amount of Colorado River water currently available to MWD.

The reliability of CRA water for MWD has decreased overtime due to drought and other factors as well. 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 CAP 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 Secretary asserted that California must come up with a plan to live within its 4.4 MAF apportionment, plus any available surplus water. Therefore, users from California 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 MAF entitlement.

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. On November 5, 2003, IID filed a validation action in Imperial County Superior Court, seeking a judicial determination that the thirteen agreements associated with the QSA are valid, legal, and binding. Other lawsuits also were filed challenging the execution, approval, and subsequent implementation

Exhibit 8E
MWD's CRA Forecast Supplies in 2040, Average Year (1922 - 2012 Hydrology)

Program	Supply (Thousands of AF)/ Year
Current	
Basic Apportionment - Priority 4	550
Imperial Irrigation District/MWD Conservation Program	85
Priority 5 Apportionment (Surplus)	16
Palo Verde Irrigation District Land Management Crop Rotation and Water Supply Program	130
Lower Colorado Water Supply Project	4
Lake Mead Intentionally Created Surplus Storage Program	400
Binational Intentionally Created Surplus	24
Forbearance for Present Perfected Rights	-2
Coachella Valley Water District State Water Project/QSA Transfer Obligation	-35
Desert Water Agency and Coachella Valley Water District SWP Table A Obligation	-118
Desert Water Agency and Coachella Valley Water District SWP Table A Transfer Callback	61
Desert Water Agency and Coachella Valley Water District Advance Delivery Account	57
Southern Nevada Water Authority Agreement Payback	-10
Subtotal of Current Programs	**1,162**
Programs Under Development	
Southern Nevada Water Authority Interstate Banking Agreement	0
Additional Fallowing Programs	25
Subtotal of Proposed Programs	**25**
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	82
To San Luis Rey Settlement Parties[1]	16
Subtotal of Non-MWD CRA Supplies	**298**
Maximum CRA Supply Capability[2]	**1485**
Minus Supply CRA Capacity Constraint of 1.20 MAF Annually	**-235**
Maximum Forecast CRA Deliveries	**1,200**
Minus Non-MWD Supplies[3]	**-298**
Maximum MWD Supply Capability[4]	**902**

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 1.20 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: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

of the QSA on various grounds. All of the QSA cases were coordinated in Sacramento County Superior Court. After more than a decade of litigation, the final challenges to the QSA were dismissed, and the agreements were upheld. MWD's existing conservation, land fallowing, and transfer programs for Colorado River supplies are independent of the QSA.

Along with MWD's apportionment, MWD has developed a number of water supply programs to improve the reliability of its Colorado River supplies, such as agricultural water transfers and storage programs. MWD has multiple programs under development as listed in Exhibit 8E. These programs combined with MWD's basic apportionment will provide MWD with approximately 1.16 MAF of Colorado River supplies in 2040 under an average year (1922 – 2012 hydrology). Proposed programs under development could add another 25 TAF per year. Non-MWD supplies conveyed through the CRA are forecast at 298 TAF for a total CRA supply availability of 1.49 MAF under average hydrology. However, the CRA has a conveyance capacity constraint of 1.20 MAF. After subtracting MWD's conveyance obligation of non-MWD supplies, MWD's supplies for 2040 under average year, single-dry year (1977 hydrology), and multi-dry year (1990 – 1992 hydrology) scenarios are all forecast at 902 TAF. Exhibit 8E summarizes the CRA supply forecast for 2040 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, hexavalent chromium (chromium-6), 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 2015 Urban Water Management Plan (UWMP).

Upper Colorado River Basin

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 Basin, dissolved by precipitation, and conveyed into the Basin's water courses.

Salinity issues have been recognized in the Basin for over 40 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, 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 the 1972 level 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 100 mg/L as a long-term average.

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 reducing 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. The U.S. Department of Energy (DOE) is responsible for remediating the site, which includes removal and offsite disposal of the tailings and onsite groundwater remediation.

Remedial actions at the site since 1999 have focused on removing contaminated water from the pile and groundwater. To date, over 4,400 pounds of uranium in contaminated groundwater have been removed. In July 2005, DOE issued its Final Environmental Impact Statement with the preferred alternative of permanent offsite disposal by rail to a disposal cell at Crescent Junction, Utah, located approximately 30 miles northwest of the Moab site.

Rail shipment and disposal of the uranium mill tailings pile from the Moab site began in April 2009, using American Recovery and Reinvestment Act (ARRA) 2009 funding which helped to accelerate initial cleanup efforts. Through August 2015, DOE has shipped over 7.7 million tons of mill tailings to the Crescent Junction disposal cell. DOE estimates completing movement of the tailings pile by 2025, depending on annual appropriations. MWD continues to track progress of the remediation efforts and work with Congressional representatives to support increased annual appropriations and expedite cleanup.

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 the Interior to highlight MWD's concern of source water protection and recommended close federal oversight. In 2009, the Department of the Interior placed a two-year hold on mining claims for 1 million acres adjacent to the Grand Canyon area to conduct additional analyses. In January 2012, the Department of the Interior placed a 20-year moratorium on new uranium and other hard rock mining claims. The moratorium has been challenged by a number of industry groups and was most recently upheld by a U.S. District Court in September 2014. Meanwhile, local conservation groups continue to defend the moratorium and are seeking additional protection of lands with mines that have been inactive for long periods of time, but may resume operations.

Chromium-6

Chromium-6 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-6 in its operations. Monitoring levels 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. In January 2011, a final treatment remedy was selected, and an Environmental Impact Report (EIR) was certified. In November 2015, PG&E completed the final remedy design based on the selected remedy which involves the installation of an in-situ bioremediation treatment system. In April 2015, California Department of Toxic Substance Control required the preparation of a Subsequent EIR to address new design details. The Subsequent EIR will be completed in February 2017. Construction is expected to be completed in 2019, followed by operation of the treatment system for an estimated 30 years.

NDMA and Pharmaceuticals and Personal Care Products

NDMA is a by-product formed by secondary disinfection of some natural waters with chloramines. MWD is involved in several projects to understand the impact of different treatment processes on NDMA and its precursors at drinking water treatment plants and in distribution systems.

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. Currently, PPCP monitoring is conducted on an annual basis for MWD's source waters and treatment plants. MWD has been actively involved in studies related to PPCPs, including the improvement of analytical methods, and characterization of drinking water sources in California.

8.1.2 State Water Project

MWD began receiving water from the SWP in 1972. MWD is the largest of the 29 SWP contractors, 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 8F
Current and Projected Facilities of the State Water Project

Courtesy of the California Department of Water Resources

Exhibit 8G
Table A Maximum Annual SWP Amounts (acre-feet)[1]

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	45,350
Empire West Side Irrigation District	3,000
Kern County Water Agency	982,730
Tulare Lake Basin Water Storage District	87,471
Subtotal	**1,133,556**
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	144,844
Castaic Lake Water Agency	95,200
Coachella Valley Water District	138,350
Crestline-Lake Arrowhead Water Agency	5,800
Desert Water Agency	55,750
Littlerock Creek Irrigation District	2,300
Mojave Water Agency	85,800
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	**2,629,544**
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**

1. Source: DWR's notice "2016 State Water Project Allocation - 15 Percent" dated 01/26/2016.

State Water Project, courtesy of CA Dept. 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 662 miles of aqueduct, 32 storage facilities (reservoirs and lakes), and 25 power and pumping plants. Exhibit 8F 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 Springs 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 153.94 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 8G. 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 2014, SWP contractors received only five percent of their SWP contract allocations, a historic low.

DWR bi-annually prepares the State Water Project Delivery Reliability Report to provide contractors with current and projected water supply availability for SWP. In July 2015, DWR released the 2015 State Water Project Delivery Capability Report. The 2015 Delivery Capability Report provides estimates of the current (2015) and future (2035) State Water Project delivery capability for each SWP contractor under a range of hydrologic conditions. These estimates incorporate regulatory restrictions on Delta pumping required by the biological opinions issued by the U.S. Fish and Wildlife Service (December 2008) and National Marine Fisheries Service (June 2009). In addition, these estimates of future capability also reflect potential impacts of climate change and sea level rise.

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 (DWA) and Coachella Valley Water District (CVWD) 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 amount.

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 14.5 TAF and 10.9 TAF in 2013 and 2014, respectively.

As part of the 1994 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 the storage of SWP water for project needs.

MWD entered into a transfer agreement with 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 194 TAF 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 1.571 MAF through its SWP supplies in 2040, under average conditions (1922 – 2012 hydrology). This projection excludes SWP-related groundwater storage and water transfer programs, covered in a subsequent section of this chapter. Exhibit 8H summarizes MWD's SWP supplies by program. Current programs are expected to result in 1.323 MAF, and programs under development are expected to add an additional 248 TAF. Under multi-dry year (1990 – 1992 hydrology) and single-dry year conditions (1977 hydrology), MWD expects to receive only 566 TAF and 701 TAF, respectively.

Exhibit 8H
MWD Forecast Supplies of SWP Water in 2040 Average Year (1922 – 2012 Hydrology)

Program	Supply (Thousands of AF)
Current	
MWD Table A	976
Desert Water Agency and Coachella Valley Water District SWP Table A Transfer	99
San Luis Carryover Storage[1]	240
Article 21 Supplies	8
Yuba River Accord Purchase	0
Subtotal of Current Programs[2]	**1,323**
Programs Under Development	
Delta Improvements	248
Subtotal of Proposed Programs[2]	248
Maximum SWP Supply Capability[2]	**1,571**

1. Includes carryover water from Desert Water Agency and Coachella Valley Water District.

2. Does not include transfers and water banking associated with SWP.

Source: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

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 by-products during water treatment. MWD has upgraded treatment processes to ozone disinfection at four of MWD's treatment plants 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 has supported the expansion of DWR's Municipal Water Quality Investigations Program beyond its Bay-Delta core water quality monitoring and studies to include enhanced water quality monitoring and forecasting of the Delta and SWP.

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. Ozone disinfection is a very effective treatment for control of bromate formation. MWD has completed upgrades to use ozone as the primary disinfectant at four of MWD's treatment plants, and construction is underway for ozone facilities at the Weymouth water treatment plant.

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. Under drought conditions, MWD has further relied on groundwater storage programs and continues to participate in the California Aqueduct Pump-in Facilitation Group to ensure that water quality in the SWP is not adversely affected when considering water supply decisions. Historically, MWD has at times restricted flows from one groundwater storage program as a result of arsenic levels. One groundwater storage partner operates an arsenic treatment facility. 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, taste, and odor issues at its reservoirs allowing adjustments in other system operations.

The Sacramento Regional County Sanitation District (SRCSD), the primary discharger to the Sacramento River, is in the process of constructing wastewater treatment plant upgrades to comply with its 2010 discharge permit requirements for ammonia and nitrate removal. SRCSD expects to complete its EchoWater Project by 2023 and has stated that the project will serve multiple benefits including improving water quality in the Sacramento River. The improvements include a biological nutrient removal process for ammonia and nitrate. In 2014, the City of Stockton Wastewater Treatment Plant, a discharger to the San Joaquin River, was issued a draft permit with a more stringent nitrate discharge limit consistent with the final discharge limits issued in SRCSD's permit. The City of Stockton may have to implement similar plant upgrades as SRCSD to comply with discharge permit requirements.

NDMA and Pharmaceuticals and Personal Care Products

Similar to all of MWD's 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 higher salinity 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 TDS 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. DWR has altered the operations of the SWP to accommodate species of fish listed under the ESAs. These changes in project operations have adversely affected SWP deliveries. Between 2008 and 2014, restrictions on Bay-Delta pumping under the biological opinion have reduced deliveries of SWP water by 3 MAF to the state water contractors and by approximately 1.5 MAF to MWD.

Operational constraints likely will continue until a long-term solution to the problems in the Bay-Delta is identified and implemented.

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 20 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, could draw saline water into the south Bay-Delta area as well. Therefore, pumping in the south Bay-Delta may need to be stopped or slowed down for an extended period, and additional flows may need to be released from Lake Oroville to flush saline water out of the Bay-Delta. Any salinity introduced into the Bay-Delta may also impact Bay-Delta water quality for an extended period of time.

Recognizing the need for protecting these vulnerable 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 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 Bay-Delta restoration and water supply reliability. The Council was required to develop, adopt, and begin implementation of a Delta Plan. The

Delta Plan was adopted on May 16, 2013, and became effective on September 1, 2013. It includes binding regulations as well as nonbinding recommendations intended to ensure progress in areas such as water supply reliability, ecosystem restoration, water quality, flooding, and the economic health of the Bay-Delta. It also includes performance measures for improving water supply reliability and enhancing the Bay-Delta ecosystem. As outlined in the Delta Reform Act (Act), the Bay Delta Conservation Plan (BDCP), if approved as both a Natural Community Conservation Planning (NCCP) program by the state and a Habitat Conservation Plan (HCP) by the federal government, was to be automatically incorporated into the Council's Delta Plan as a necessary component to further the achievement of the state-mandated coequal goals – water supply reliability for California and the rehabilitation of the Bay-Delta ecosystem. The BDCP was 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 Bay-Delta. MWD was a member of the Steering Committee.

Canals of the Bay-Delta, courtesy of CA Dept. of Water Resources

The draft BDCP and the associated draft environmental impact report/ environmental impact statement (EIR/ EIS) were made available to the public for review on December 13, 2013. Comments for these documents were due on July 29, 2014. On December 19, 2014, the Brown administration and its federal partners announced several significant changes to the water conveyance portion of the BDCP, including the elimination of three pumping plants, to respond to concerns of Bay-Delta landowners and others.

On April 30, 2015, state and federal agencies proposed a new sub-alternative, Alternative 4A (California WaterFix), to replace Alternative 4 (the proposed BDCP) as the state's proposed project. Alternative 4A reflected the state's proposal to separate the conveyance facility and habitat restoration measures into two separate efforts: California WaterFix and California EcoRestore. With this change, there will be no automatic incorporation of the BDCP into the Delta Plan, and WaterFix will be a "covered action" that must be consistent with the regulatory provisions of the Delta Plan.

California WaterFix and EcoRestore would be implemented under different federal and state ESA regulatory permitting processes (Section 7 versus Section 10(a) of the federal ESA, and pursuant to section 2081 of the state ESA instead of the Natural Community Conservation Planning Act). This would fulfill the requirement of the 2009 Delta Reform Act to contribute toward meeting the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Bay-Delta ecosystem.

The new water conveyance facilities would be constructed and operated under the California WaterFix, which proposes design changes to the water conveyance facilities. Refinements to the design reduce the overall environmental/ construction impacts, and increase long-term operational and cost benefits. Some of the engineering configuration improvements include moving the tunnel alignment away from local communities and environmentally sensitive areas. Reconfiguration of intake and pumping facilities lessen construction impacts in local communities and longer-term operational impacts.

The main objective under the EcoRestore Program is the initial restoration of at least 30,000 acres of Bay-Delta habitat, with the near-term goal of making significant strides toward that objective by 2020. These restoration programs would include projects and actions that are in compliance with preexisting regulatory requirements designed to improve the overall health of the Bay-Delta. Other priority restoration projects would also be identified by the Sacramento-San Joaquin Delta Conservancy and other agencies and local governments.

The environmental analysis of California WaterFix, as well as two other additional alternatives, and updated information from the 2013 BDCP Draft EIR/EIS were included in the BDCP/California WaterFix Partially Recirculated Draft EIR/ Supplemental Draft EIS (RDEIR/SDEIS). The RDEIR/SDEIS was released for public review on July 10, 2015. The comment period ended on October 30, 2015. The final planning documents are expected to be completed in the spring of 2016.

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 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, making available water from surface reservoir and groundwater supplies stored as part of MWD's interruptible supply program, and implementing full local groundwater production. 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 1.5 MAF of storage rights in Lake Mead on the Colorado River pursuant to its intentionally created surplus agreement with the USBR. 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 itemized in Exhibit 8I.

MWD operates its three main storage reservoirs, Diamond Valley Lake, Lake Skinner and Lake Matthews, for dry-year, emergency, and seasonal storage.

Exhibit 8I
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, Garvey, Palos Verdes, and Orange County	3,500
Total Reservoir Capacity	**1,258,440**

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.

Exhibit 8J
MWD Forecast Supplies of In-Basin Surface Storage Supplies in 2040, Average Year (1922 - 2012 Hydrology)

Program	Supply (Thousands of AF)/Year
In-Basin Surface Storage (Diamond Valley Lake, Lake Skinner, Lake Matthews)	624
Lake Perris and Castaic Lake MWD Storage Rights	190
Maximum MWD Supply Capability	814

Source: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

Under an average-year scenario for 2040 (1922-2012 hydrology), 814 TAF per year of in-basin surface storage is projected to be available, exclusive of emergency supplies, as shown in Exhibit 8J.

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 2040, is forecast to be approximately 646 TAF. Approximately 312 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, 939 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 five 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. MWD has worked with local water agencies to increase groundwater storage and has implemented conjunctive water use through various programs. 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 two main types of storage programs: 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 with developing storage programs.

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 nine conjunctive use programs with a combined storage capacity of 211.9 TAF and a dry-year yield of 70.3 TAF per year, as summarized in Exhibit 8K.

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.

The MWD Board recently approved a joint study with Sanitation Districts of Los Angeles County on the feasibility of a regional recycled water project to purify and reuse wastewater for the recharge of groundwater basins and to augment water supplies within the Southern California region. The study includes a demonstration plant to verify treatment design parameters for a full-scale project, a feasibility study to determine the parameters of the delivery system and a comprehensive finance plan. At full

Exhibit 8K
In-Basin Conjunctive Use Programs

Program	Storage Capacity (Thousands of AF)	Dry-Year Yield (Thousands of AF/Year)	Balance 12/31/15 Estimated (Thousands of AF)
Los Angeles County			
Long Beach Conjunctive Use Project	13.0	4.3	6.4
Foothill Area GW Storage Project	9.0	3.0	0.6
Long Beach Conjunctive Use Project: Expansion in Lakewood	3.6	1.2	1.8
City of Compton Conjunctive Use Program	2.3	0.8	0.0
Upper Claremont Heights Conjunctive Use	3.0	1.0	0.0
Orange County			
Orange County GW Conjunctive Use Program	66.0	22.0	8.6
San Bernardino County			
Chino Basin Programs	100.0	33.0	23.0
Live Oak Basin Conjunctive Use Project	3.0	1.0	0.7
Riverside County			
Elsinore Groundwater Storage Program	12.0	4.0	0.0
Total	**211.9**	**70.3**	**41.1**

Source: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

Exhibit 8L
MWD Forecast Supplies of In-Basin Groundwater Storage in 2040, Average Year (1922 - 2012 Hydrology)

Program	Current Supply (Thousands of AF/Year)
Conjunctive Use	68
Cyclic Storage	110
Maximum MWD Supply Capability	178

Source: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

build-out, this project could provide up to 150 million gallons per day of purified water for the region. Exhibit 8L provides a summary of forecast groundwater storage supplies available in 2040 under an average year (1922 -2012 hydrology). Approximately 178 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 delivery 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 when necessary.

Exhibit 8M summarizes MWD's out-of-basin groundwater storage and transfer programs supplies in 2040, under an average year (1922 – 2012 hydrology). Current programs are expected to deliver 309 TAF in 2040. One program under development is forecasted to deliver an additional 20 TAF, for a total of 329 TAF in 2040.

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 (Semitropic Program) is a partnership formed in 1994 between Semitropic Water Storage District, 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. The program expects to have 140 TAF in its storage account by the end of 2015.

Exhibit 8M
MWD Forecast Supplies of Groundwater Storage and Transfers in 2040, Average Year (1922 - 2012 Hydrology)

Program	Supply (Thousands of AF/Year)
Current	
San Bernardino Valley MWD Minimum Purchase	20
San Bernardino Valley MWD Option Purchase	16
San Gabriel Valley MWD Exchange and Purchase	2
Central Valley Storage and Transfers	
Semitropic Water Banking and Exchange Program	70
Arvin-Edison Water Management Program	75
Mojave Groundwater Storage Program	26
Kern Delta Water Management Program	50
Transfers and Exchanges	50
Subtotal of Current Programs	**309**
Programs Under Development	
Antelope Valley/East Kern Acquisition and Storage	20
Subtotal of Proposed Programs	**20**
Maximum Supply Capability	**329**

Source: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

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). The program expects to have 140 TAF in its storage account by the end of 2015.

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. When needed, MWD can recover its stored water either through direct pumping of the groundwater or exchange at a rate of 50 TAF per year. The program expects to have 120 TAF in its storage account by the end of 2015.

MWD entered into a groundwater banking and exchange transfer agreement with Mojave Water Agency on October 29, 2003. This agreement was amended in 2011 to allow for the cumulative storage of up to 390 TAF. The agreement allows for MWD to store water in an exchange account for later return. Through 2021, and when the SWP allocation is 60 percent or less, MWD can annually withdraw the Mojave Water Agency's SWP contractual amounts in excess of a ten percent reserve. When the SWP allocation is over 60 percent, the reserved amount for Mojave's local need increases to 20 percent. Under a 100 percent allocation, the State Water Contract provides Mojave Water Agency 82.8 TAF of water.

In November 2015, the MWD Board authorized entering into agreements with Antelope Valley-East Kern Water Agency (AVEK) to develop exchange and storage programs for SWP supplies. The AVEK Program allows MWD to both exchange and store SWP supplies to provide additional water for normal and dry-year needs. Under this program, AVEK provides MWD its unused SWP supplies. For every two acre-feet provided by AVEK, MWD will return one acre-foot. The exchange program is expected to deliver 30 TAF over ten years, with 10 TAF available in dry years. MWD will also have a storage capability in the groundwater basin, with a capacity of 30 TAF, and a dry-year return capability of 10 TAF. MWD's average annual supply capability for a dry year (1977 hydrology) is 10 TAF for each program and for multiple-dry years (1990 – 1992 hydrology) is 3 TAF for each program. The AVEK Program is projected to provide benefits starting as early as 2016.

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 market 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 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 dependenting on the origin of the water. Historic transfers, as listed in Exhibit 8N, 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 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 approximately 20 percent of the water during conveyance, while transfers via the California Aqueduct to MWD's service area result in the loss of three percent water during conveyance.

8.2 MWD Supply Reliability and Projected LADWP Purchases

MWD's 2015 Integrated Water Resources Plan (IRP) update serves as the foundation for supply forecasts discussed in its UMWP and continues to ensure system reliability for its member agencies. The 2015 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 2040. MWD's subsequent 2015 draft UWMP also concluded the same full reliability during average (1922 – 2012 hydrology), single-dry (1977 hydrology), and multiple-dry years (1990 - 1992 hydrology). For each of

Exhibit 8N
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
2010 State Water Contractors Water Transfer Program	88,159
2013 Multi-Year Water Pool Demo	30,000
2015 Multi-Year Water Pool Demo	1,374
2015 State Water Contractors Water Transfer Program	12,358

1. Transfers requiring use of Bay-Delta result in a water loss of approximately 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: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

the scenarios, there is a surplus in every forecast year. Exhibit 8O summarizes MWD's reliability in five-year increments extending to 2040.

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.

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 and Financial Integrity, under various weather scenarios.

Exhibit 80
MWD System Forecast Supplies and Demands, Average Year (1922 - 2012 Hydrology)

Forecast year	**Supply (Thousands of AF per Year)**				
	2020	**2025**	**2030**	**2035**	**2040**
Current Programs					
In-Region Supplies and Programs	693	774	852	956	992
State Water Project[1]	1,555	1,576	1,606	1,632	1,632
Colorado River Aqueduct					
Colorado River Aqueduct Supply[2]	1,468	1,488	1,484	1,471	1,460
Aqueduct Capacity Limit[3]	1,200	1,200	1,200	1,200	1,200
Colorado Aqueduct Capability	1,200	1,200	1,200	1,200	1,200
Capability of Current Programs	**3,448**	**3,550**	**3,658**	**3,788**	**3,824**
Demands					
Total Demands on MWD	1,586	1,636	1,677	1,726	1,765
Imperial Irrigation District - San Diego County Water Authority Transfers and Canal Linings[4]	274	282	282	282	282
Total Demands on MWD	**1,860**	**1,918**	**1,959**	**2,008**	**2,047**
Surplus	**1,588**	**1,632**	**1,699**	**1,780**	**1,777**
Programs Under Development					
In-Region Supplies and Programs	43	80	118	160	200
State Water Project	20	20	268	268	268
Colorado River Aqueduct					
Colorado River Aqueduct Supply	5	25	25	25	25
Aqueduct Capacity Limit[2]	0	0	0	0	0
Colorado River Aqueduct Capability	0	0	0	0	0
Capability of Programs Under Development	**63**	**100**	**386**	**428**	**468**
Maximum MWD Supply Capability	**3,511**	**3,650**	**4,044**	**4,216**	**4,292**
Potential Surplus	**1,651**	**1,732**	**2,085**	**2,208**	**2,245**

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 1.20 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: 2015 Urban Water Management Plan, Metropolitan Water District of Southern California

8.3 LADWP's Costs for Purchased Water

8.3.1 MWD Rate Structure

MWD's rates are structured on a tier–based system with two tiers. Eight 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.

The costs of maintaining existing supplies and developing additional supplies are recovered through the two-tiered pricing approach. The Tier 1 Supply Rate recovers the cost of maintaining a reliable amount of supply. Each member agency has a predetermined amount of water that can be purchased at the lower Tier 1 Supply Rate. Purchases in excess of this limit will be made at the higher Tier 2 Supply Rate. The Tier 2 Supply Rate reflects MWD's cost of purchasing water transfers north of the Bay-Delta. The Tier 2 Supply Rate encourages the member agencies and their customers to maintain existing local supplies and develop cost-effective local supply resources and conservation.

Exhibit 8P summarizes the rates and charges for member agencies effective on January 1 of 2014, 2015, and 2016.

Exhibit 8P
MWD Rates and Charges

Rates and Charges	Effective Rate January 1		
	2014	**2015**	**2016**
Tier 1 Supply Rate ($/AF)	148	158	156
Tier 2 Supply Rate ($/AF)	290	290	290
System Access Rate ($/AF)	243	257	259
Water Stewardship Rate ($/AF)	41	41	43
System Power Rate ($/AF)	161	126	138
Full Service Untreated Volumetric Cost ($/AF)			
Tier 1	593	582	594
Tier 2	735	714	728
Treatment Surcharge ($/AF)	297	341	348
Full Service Treated Volumetric Cost ($/AF)			
Tier 1	890	923	942
Tier 2	1032	1055	1076
Treated Replenishment Water ($/AF)	558	601	651
Treated Interim Agricultural Water Program ($/AF)	615	687	765
Readiness-to-Serve Charge ($ Million)	166	158	153
Capacity Charge ($/cfs)	8,600	11,100	10,900

Source:2015 Urban Water Management Plan, Metropolitan Water District of Southern California

8.3.2 LADWP's Purchased Water Costs

MWD's water rates vary from $594 per AF of tier 1 untreated water to $1,076 per AF of tier 2 treated water in 2016. 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. Exhibit 8Q illustrates the various levels of tier 1 and tier 2 purchases by LADWP over the past seven years.

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 share of the Readiness-to-Serve Charge is 17.36 percent, or $26.57 million in 2016. The Capacity Charge is calculated based on the maximum 3-year peak day demand placed by a member agency on MWD's distribution system between May 1 and September 30 and is applied with a one year lag. The City's 2016 Capacity Charge is $8.53 million based on the daily peak flow of 782.5 cfs in summer 2014. Both charges will add $35.1 million to LADWP's MWD water purchase in 2016.

Exhibit 8Q
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
Calendar Year	Untreated	Treated	Untreated	Treated				
	%	%	%	%	%	%	%	%
2009	66%	20%	10%	3%	87%	13%	76%	24%
2010	62%	38%	0%	0%	100%	0%	62%	38%
2011	45%	55%	0%	0%	100%	0%	45%	55%
2012	73%	21%	3%	4%	94%	6%	75%	25%
2013	58%	18%	19%	4%	77%	23%	78%	22%
2014	65%	20%	12%	3%	86%	14%	77%	23%
2015	80%	20%	0%	0%	100%	0%	80%	20%
Seven-year AVERAGE	61%	27%	9%	2%	88%	12%	70%	30%