City of Los Angeles

Recycled Water Master Planning

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

Long-Term Concepts Report

Prepared by:

RMC in association with CDM Smith

Volume 1 of 2: Report

March 2012

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Table of Contents

Volume 1 of 2: Report

Executive Summary

Appendices

Volume 2 of 2: Appendices

Tables

Figures

Abbreviations and Acronyms

AF	Acre-Feet
AFY	acre-feet per year
AOP	Advanced Oxidation Process
AQMD	Air Quality Management District
AWP	Advanced Water Purification
AWPF	Advanced Water Purification Facility
BOS	City of Los Angeles, Bureau of Sanitation
BWP	Burbank Water and Power
CBMWD	Central Basin Municipal Water District
CDP	Criterium® DecisionPlus®
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
cfs	cubic feet per second
City	City of Los Angeles
CRWRF	Carson Regional Water Reclamation Facility
CWC	California Water Code
DCTWRP	Donald C. Tillman Water Reclamation Plant
ECIS	East Central Interceptor Sewer
ELWRF	Edward C. Little Water Recycling Facility
EQ	Equilibrium Basin
gpm	Gallons per minute
GWP	Glendale Water and Power
GWR	groundwater recharge
HSG	Hansen Spreading Grounds
HTP	Hyperion Treatment Plant
IAA	Integrated Alternatives Analysis
LACDPH	Los Angeles County Department of Public Health
LACDPW	Los Angeles County Department of Public Works
LADWP	City of Los Angeles Department of Water and Power
LACSD	Sanitation Districts of Los Angeles County
LAGWRP	Los Angeles-Glendale Water Reclamation Plant
LBWD	Long Beach Water District
LVMWD	Las Virgenes Municipal Water District
MBR	Membrane Bioreactor
MF	Microfiltration
mgd	million gallons per day

mg/L	Milligrams per liter
MWD	Metropolitan Water District of Southern California
NdN	Nitrification Denitrification
NEPA	National Environmental Policy Act
NPR	Non-Potable Reuse
PSG	Pacoima Spreading Grounds
PWP	Pasadena Water and Power
RO	Reverse Osmosis
RMC	RMC Water and Environment
RWMP	Recycled Water Master Planning
RWAG	Recycled Water Advisory Group
RWQCB	Regional Water Quality Control Board
SWP	State Water Project
SWRP	Southeast Water Reliability Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TIWRP	Terminal Island Water Reclamation Plant
TM	Technical Memoranda
TSG	Tujunga Spreading Grounds
USACE	US Army Corp of Engineers
VSL/FA	Valley Spring Lane/Foreman Avenue
WBMWD	West Basin Municipal Water District
WRD	Water Replenishment District
WRP	Water Reclamation Plant

Executive Summary

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

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

The RWMP documents include an evaluation of alternatives – strategies that take into account forward-looking groundwater replenishment (GWR) options as well as the more familiar form of recycling water for non-potable reuse (NPR) purposes, such as for irrigation and industry. This NPR Master Planning Report is one element of the RWMP documents. It is a thorough examination of the potential non-potable market across the City and the potential for increased reuse from existing City water reclamation plants as well as from other regional plants.

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

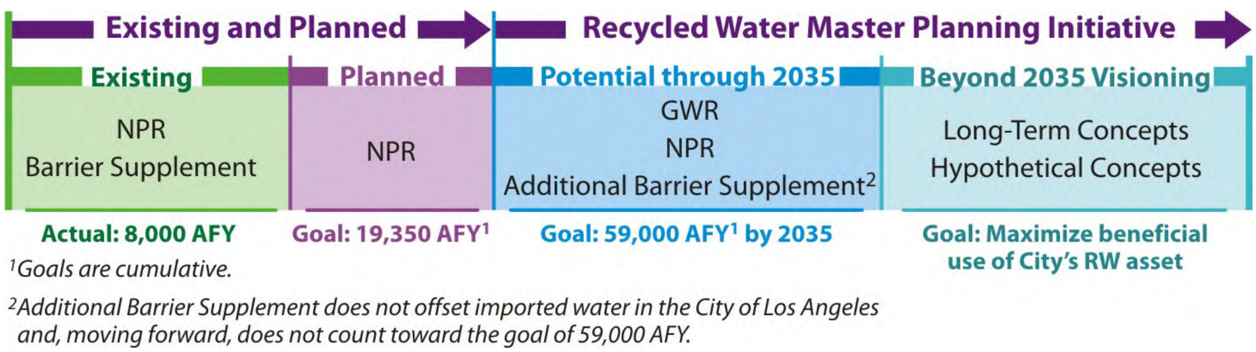
LADWP and BOS acknowledge that the implementation of long-term concept projects will face significant challenges. There will be significant changes in the regulatory arena and technology in the future to which strategies conceived today will have to adapt. The process of siting, designing, permitting and constructing massive new infrastructure within urban areas is difficult now; it will only become more complex and challenging as Los Angeles continues to become more densely populated. Inter-agency agreements will become an even greater necessity as more recycled water replaces potable water in the total Los Angeles water supply. In addition, many of the long-term concepts require extremely large capital expenditures. The long-term concepts presented in this report are not the only strategies that can be implemented, but they encapsulate potential pathways available to the City under the current regulatory setting to go beyond the near-term goal of increasing the use of recycled water to offset imported potable supplies and maximize reuse of the City's available recycled water supplies.

ES.1 Introduction

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

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

Figure ES-1: Overview of RWMP Components



Purpose of this Long-Term Concepts Report

The purpose of this Long-Term Concepts Report is to develop projects that have the potential to maximize the beneficial reuse of recycled water produced at the City's existing treatment plants, at a potential new satellite plant, and/or at plants operated by outside agencies. The long-term project concepts are intended to expand recycled water reuse beyond the 59,000 AFY goal of the GWR and the NPR Master Planning Reports.

The long-term project concepts were developed to achieve two parallel goals which are essential to a successful long-term recycled water strategy for the City:

- Maximize recycled water reuse from the City's existing treatment plants: Los Angeles-Glendale Water Reclamation Plant (LAGWRP), Hyperion Treatment Plant (HTP), Terminal Island Water Reclamation Plant (TIWRP) and Donald C. Tillman Water Reclamation Plant (DCTWRP).

- Maximize the offset of imported Metropolitan Water District (MWD) water, using recycled water from City treatment plants and/or from outside agencies.

LADWP's 2010 UWMP shows that imported water would be expected to supply approximately 168,027 AFY by 2035. The long-term project concepts are intended to offset MWD supplies to the extent possible (up to 168,027 AFY) by 2085.

Recycled Water Master Planning Approach

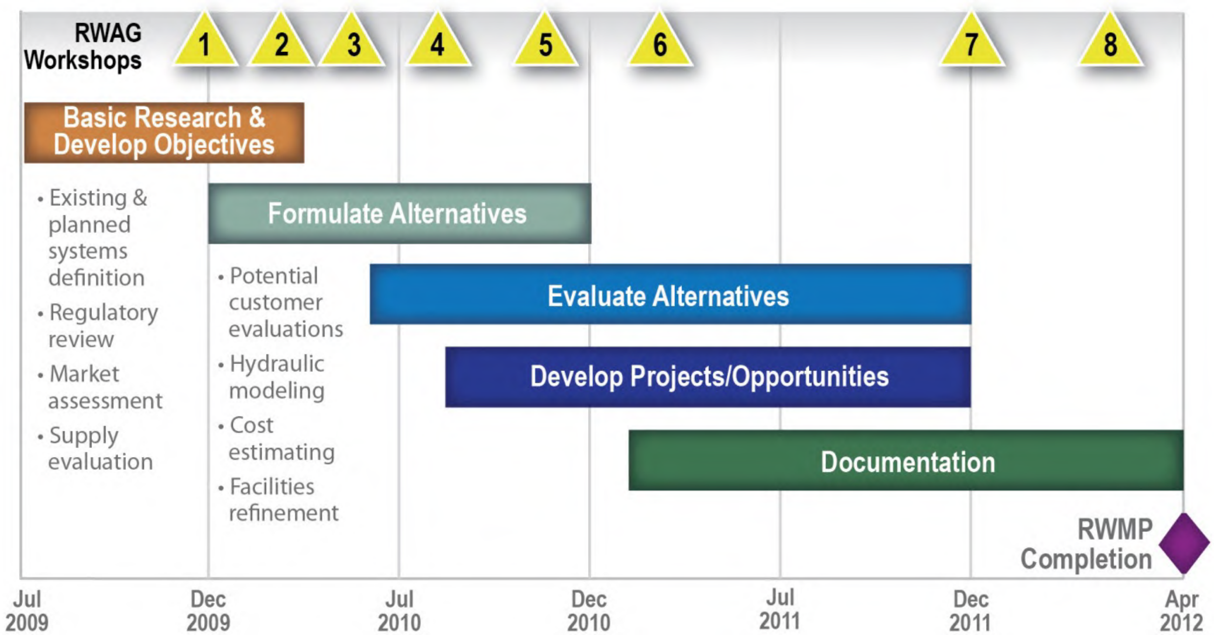
The RWMP multi-year planning process has focused on four major steps:

- Perform basic research and develop planning objectives;
- Formulate alternatives, based upon the research and objectives;
- Evaluate alternatives; and,

Develop viable projects and opportunities.

Through the Recycled Water Advisory Group (RWAG), stakeholders have been involved in discussions with the recycled water planning team since late 2009. Their input has been folded into each of these major steps, resulting in viable projects and opportunities that include insights and interests of a very diverse cross-section of the Los Angeles community. **Figures ES-2** illustrates the main RWMP steps and timeline.

Figure ES-2: Recycled Water Master Planning Approach and Schedule



Organization of the Long-Term Concepts Report

The purpose of this report is to develop a "menu" of potential long-term concept projects that could be implemented to help maximize LADWP's recycled water deliveries beyond 2035 UWMP goals.

The **Long-Term Concepts Report** is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Approach
- Section 3 – Project Technical Assessment
- Section 4 – Development of Long-Term Project Concepts
- Section 5 – Evaluation of Long-Term Concepts
- Section 6 - Long-Term Scenarios and Themes
- Section 7 – References
- Appendices

The long-term concepts effort identified:

- A wide array of wastewater diversion, flow equalization, and treatment expansion and/or upgrade projects that would maximize recycled water production from the existing treatment plants.
- Local and regional indirect potable reuse opportunities (including interconnections with neighboring agencies) that could provide a mechanism for beneficial reuse of the maximized recycled water.
- Non-potable reuse projects that could be served by any remaining and expanded recycled water sources, including interagency interconnections.

ES.2 Approach

The long-term goal for the recycled water program is to maximize reuse, and in the process offset additional demands for imported water beyond the 2035 goal of 59,000 AFY. The evaluation includes development of long-term project concepts in the Valley and Metro/Westside service areas for LADWP; technical development and refinement of the project concepts; detailed evaluation and comparison of project concepts; and development of a list of prioritized project concepts that can be used to build various scenarios for maximizing reuse and offsetting imported supplies.

The long-term project concepts evaluation process is presented in **Figure ES-3**.

Figure ES-3: Long-Term Project Concepts Evaluation Approach

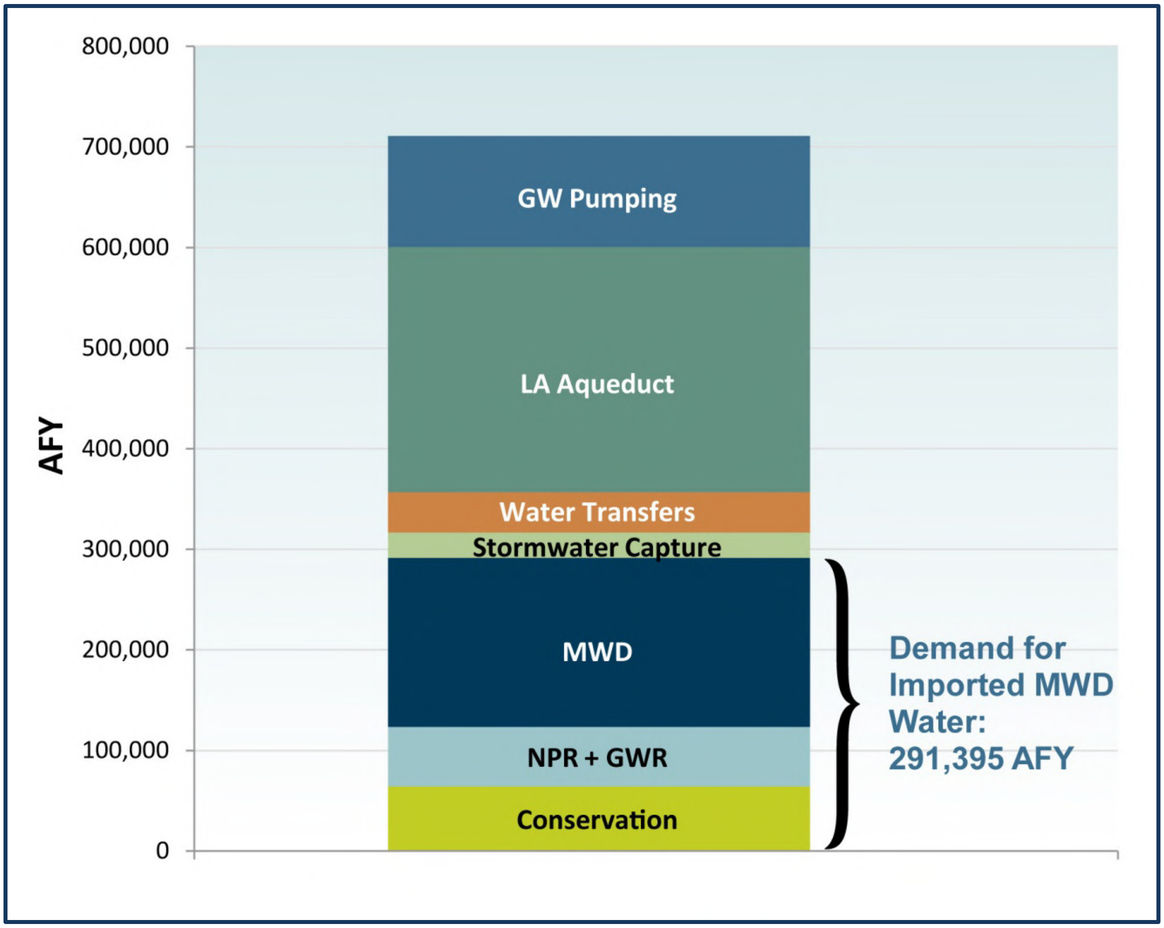
Conceptual Goals for Long-Term Project Concepts

The conceptual goals for the long-term project concepts include offsetting the need for MWD imported water supplies and maximizing reuse. **Figure ES-4** shows that, of the 710,800 AFY of total demand in the year 2035, MWD imported water would be expected to supply 291,395 AFY[1]. This number includes 168,027 AFY of anticipated MWD demand. The long-term project conceptual goal is to offset MWD supplies to the extent possible (up to an additional 168,027 AFY) by 2085.

[1] LADWP 2010 UWMP.

The MWD imported water demand includes 64,368 AFY of conservation and 59,000 AFY of existing and near-term NPR and GWR water demands. These demands would have been supplied with MWD imported water sources if conservation and/or recycled water programs had not been implemented. Water supplied from the Los Angeles Aqueduct (244,000 AFY), water supplied from groundwater (110,405 AFY), stormwater capture (25,000 AFY) and water transfers (40,000 AFY) were also not included in the MWD imported water estimate.

Figure ES-4: 2035 LADWP Potable Water Supplies



Note: AWPF water currently provided to the Dominguez Gap Barrier is included in "NPR + GWR"

Basis for Long-Term Scenarios

The long-term scenarios build upon the initial 123,368 AFY of conservation plus non-potable recycled water and GWR shown in Figure ES-4. Establishing long-term scenarios is based on three different "milestone" amounts of recycled water reuse as described in **Table ES-1** and illustrated in **Figure ES-5**.

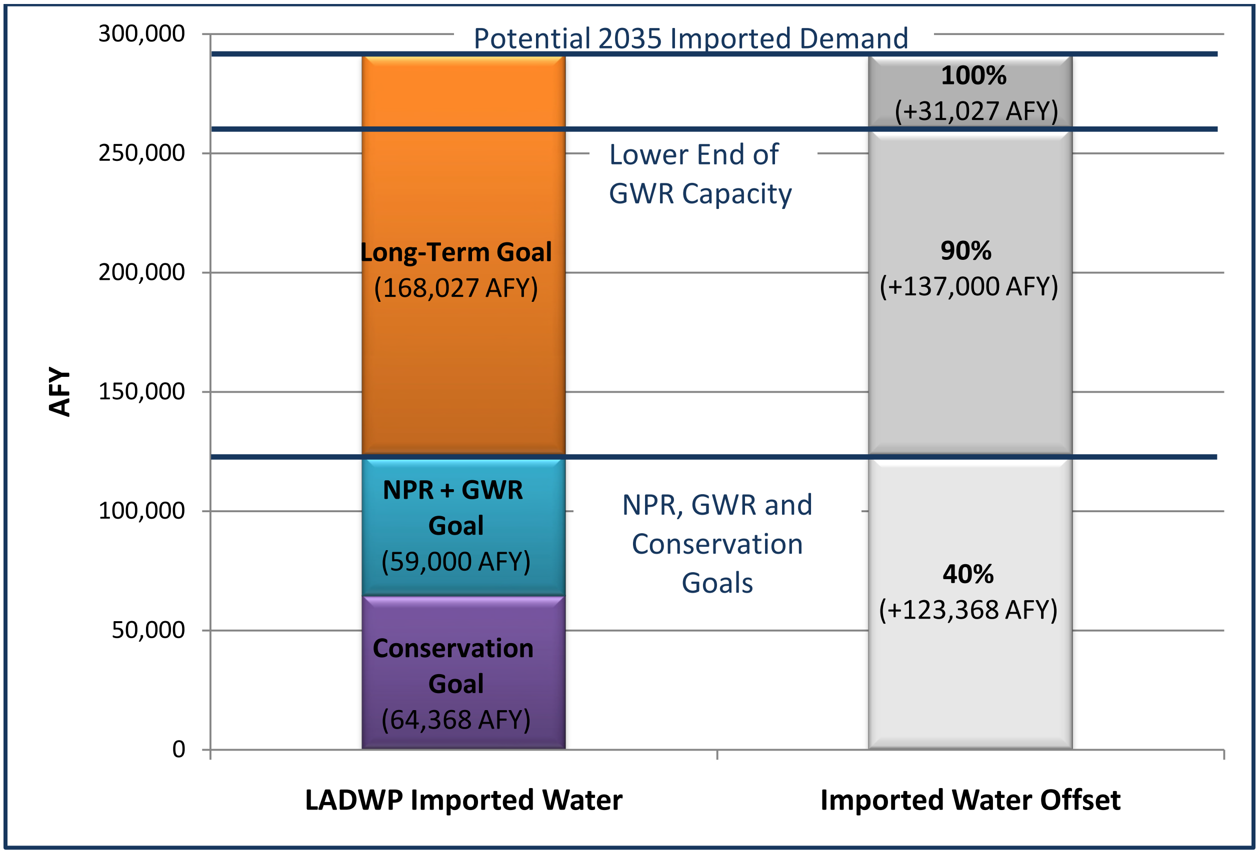
Table ES-1: "Milestone" Basis for Long-Term Scenarios

Total Imported Offset (AFY)	Reuse from Long-Term Projects (AFY)	Percent MWD Offset[1]	"Milestone" Basis
123,368	0	40 percent	This is the "baseline" condition prior to implementation of long-term concepts. It represents existing and planned conservation, existing NPR, near-term NPR, and GWR. [2,3]
260,368	+137,000	90 percent	This is the first milestone for long-term concepts. It represents the estimated groundwater recharge potential of San Fernando, Central, West Coast, and Raymond Basins.[3]
291,395	+31,027 (168,027 cumulative)	100 percent	This is the second milestone for long-term concepts. It represents the projected imported MWD supply in 2035.[4]

Notes:

1. Offset percentages are further defined in Section 6 of the full Long-Term Concepts Report.
2. Includes 64,368 AFY of conservation and 59,000 AFY of existing, planned and potential NPR and GWR recycled water programs that are expected to be implemented by fiscal year 2034-2035.
3. Draft Regional Groundwater Assessment TM (Appendix F) and Groundwater Replenishment Evaluation TM.
4. LADWP's 2010 UWMP, adopted May 2011.

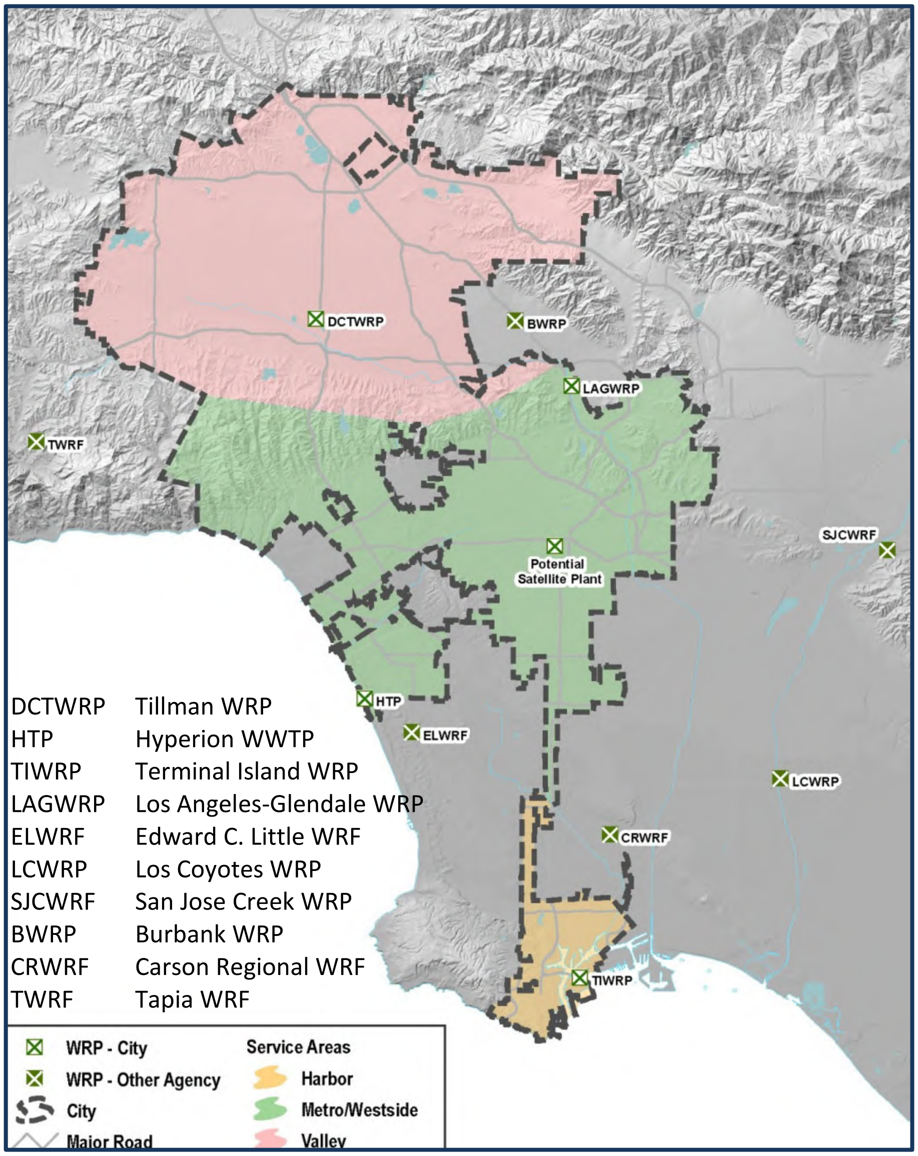
Figure ES-5: "Milestone" Basis for Long-Term Scenarios



ES.3 Technical Assessments

The **Long-Term Concepts Report** included opportunities to maximize the beneficial reuse of effluent produced, or potentially produced, at each of the City's existing treatment plants: LAGWRP, HTP, TIWRP and DCTWRP. [2] **Figure ES-6** shows all the City and non-City facilities identified as potential sources to provide recycled water to the City's service areas.

Figure ES-6: Long-Term Supply Locations



[2] Harbor project concepts were originally included in the Long-Term Concepts Report analysis. They were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report and these projects are no longer included in the discussion of Long-Term Concept Projects. Background research conducted for TIWRP is included in this report for completeness.

Los Angeles-Glendale Water Reclamation Plant

There are two project options for potential development of recycled water production at LAGWRP.

Project Option 1 expands LAGWRP existing influent capacity by 12 mgd (for a total influent capacity of 32 mgd) resulting in an increase of recycled water production of 9 mgd (for a total production of 27 mgd) with equalization.

Project Option 2 expands LAGWRP influent capacity by 28 mgd (for a total influent capacity of 48 mgd) resulting in an increase of recycled water production of 22 mgd (for a total production of 40 mgd).

Both expansion project options assume that LAGWRP would be expanded with new tertiary facilities including NdN.[3]

Hyperion Treatment Plant

The HTP has potential capacity to produce 160 mgd of purified recycled water occurring in four distinct implementation phases based on long-term plans.

These phases in combination provide a production capacity of 128 mgd within the HTP site (Phases 1 through 3) and an additional 32 mgd of production capacity using nearby off-site areas (Phase 4). A phased approach is recommended so that the recycled water production capacity can match incremental increases in recycled water demands up to the year 2040. However, there is nothing to preclude simultaneous construction of any of the phases.[4]

Terminal Island Water Reclamation Plant

The TIWRP has the potential capacity to produce 12.5 mgd of purified treated recycled water by expanding the influent treatment capacity to 16.2 mgd. The two project options include preliminary layouts for facilities with and without 50 percent treatment redundancy, assuming two different scenarios for failsafe discharge of treated effluent: (1) continued discharge through the Harbor Outfall and (2) recycled water use.[5]

Additional Analysis on TIWRP

Subsequent to the TIWRP background research effort described above, a more detailed analysis was performed to determine potential expansion improvements that could be made at the plant to maximize reuse in the Harbor area. Harbor project concepts were originally included in the Long-Term Concepts Report analysis, but they were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report. Background research conducted for TIWRP is included in the Long-Term Concepts Report for completeness.

[3] Proposed facility locations are shown in Appendix B - *LAGWRP Opportunities Final Draft TM* (Figures 3-3 and 3-6).
[4] Proposed facility locations are shown in Appendix C - *HTP Opportunities Final Draft TM* (Figure 3-3).
[5] Proposed facility locations are shown in Appendix D - *TIWRP Opportunities Final Draft TM* (Figure 3-3).

Donald C. Tillman Water Reclamation Plant

As part of the GWR Master Planning process, the City selected the DCTWRP as the staff-preferred location for an Advanced Water Purification Facility. The new AWPF would produce 30,000 AFY of advanced purified recycled water for GWR. For the **Long-Term Concepts Report**, the RWMP team assumed that expansion of the AWPF would then be required. DCTWRP is included in the long-term concepts analysis as a potential location for an expanded AWPF that could produce additional purified recycled water beyond 30,000 AFY. The feed water for the AWPF expansion would come from tertiary-treated sources other than DCTWRP (Las Virgenes Municipal Water District and Burbank Water and Power).

Metro Satellite

In the Valley and Metro/Westside service areas, a number of potential locations were identified and pre-screened based on zoning and land use to determine the feasibility of locating a satellite treatment plant in that region. Satellite treatment project options are a potential way to reach customers or groundwater recharge opportunities where existing recycled water infrastructure does not reach or to meet demands beyond the existing capacity of the recycled water system.

The Metro area, centered on the Downtown area and east of Los Angeles, has a higher total demand and is located in the proximity of the Los Angeles Forebay, an area suited for certain types of GWR. For the Long-Term Concepts Report, the Metro area was chosen to site the long-term satellite facility due to its proximity to large available sewer flows and available land to support a full-scale MBR satellite plant. The satellite concept is considered long-term because of the costs and challenges associated with developing new treatment facilities in urbanized areas of the City. The Metro Satellite project concept has many challenges. It would require that a large treatment facility be sited in an urbanized area of Los Angeles, and it would require that multiple pipelines and injection wells be sited in the same type of urban environment. It would also require that the project proponents comply with a number of permitting and institutional requirements as detailed in **Appendix J**.

Regional partnerships

Meetings with neighboring agencies were conducted to determine:

- Existing and planned recycled water systems.
- Intertie opportunities for supplementing recycled water flows available to LADWP, as well as supplementing adjacent agency/system flows to potentially offset potable water that could be made available to LADWP.
- Potential opportunities and issues associated with interagency partnerships.

Demands/Reuse Options

Each long-term project concept has a reuse component for the recycled water. This satisfies the long-term objective of maximizing reuse, which can be accomplished with either City or non-City sources. The larger project concepts require GWR to achieve maximum reuse with imported water offset; but some of the smaller project concepts utilize other options. GWR facilities include spreading grounds, injection wells, and/or seawater intrusion barriers. Other options for end use include supply to adjacent agencies outside the City's service area in exchange for access to groundwater or MWD imported potable water supplies.

Table ES-2 shows the groundwater recharge basins within and adjacent to the City's service areas. This table indicates both the recharge capacity (i.e., theoretical amount) and the recharge potential (i.e., feasible amount considering supply and other constraints). All identified groundwater recharge opportunities are shown in **Figure ES-7.**

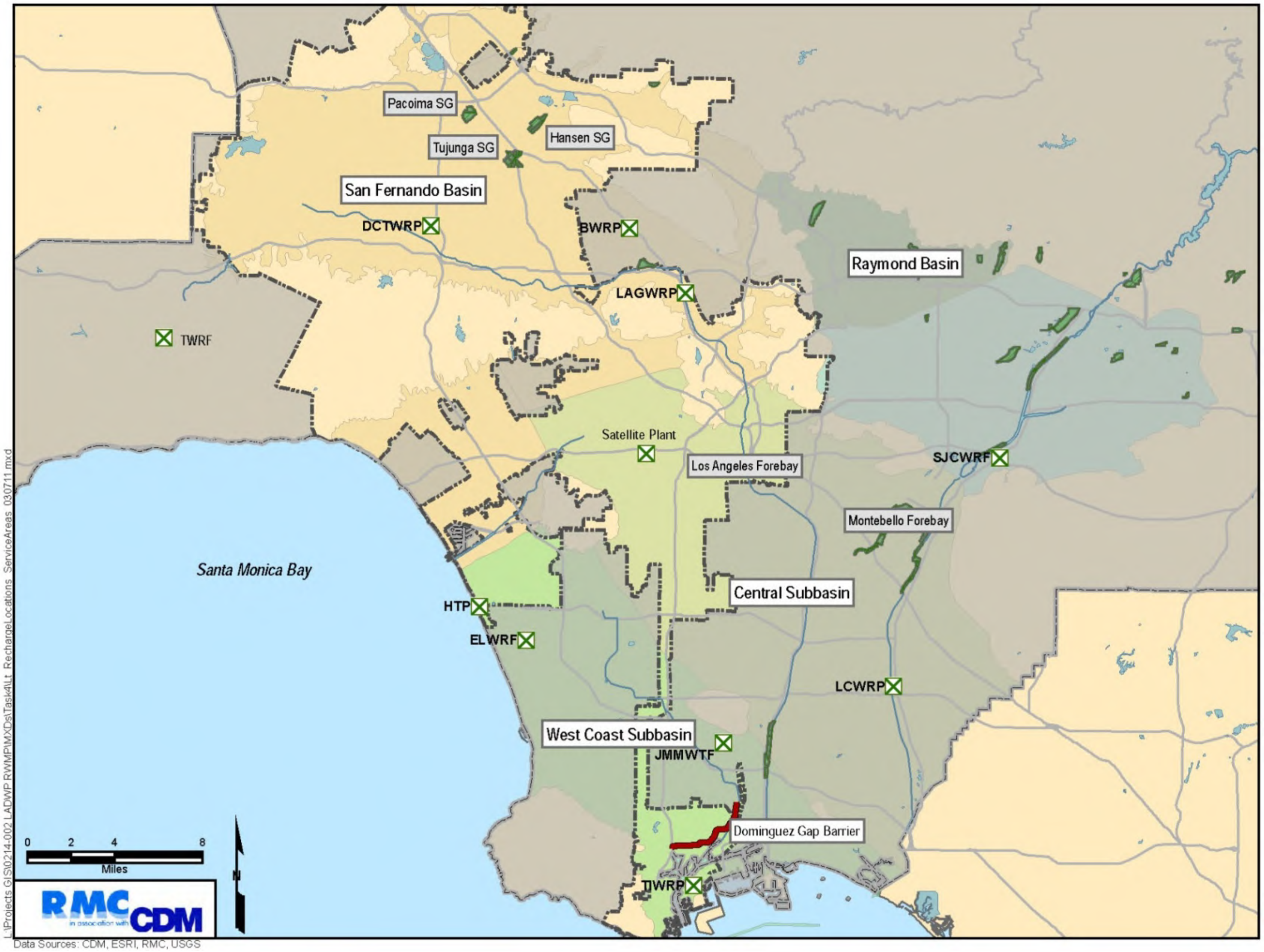
Table ES-2: Potential Long-Term Recharge Options

Basin	Type of Recharge	Recharge Capacity	Recharge Potential	TM References
Central				
Los Angeles Forebay	Injection	40,000 AFY	40,000 AFY	Appendix F
Montebello Forebay	Surface/Injection	37,000 AFY	25,000 AFY	
San Fernando				
Tujunga SG	Surface	28,500 AFY[1,2]	52,000 AFY[5]	Developed from RMC/CDM, 2011c (GWR Evaluation)
Pacoima SG		39,300 AFY[3]		
Hansen SG		20,000 AFY[4]		
Raymond	Surface/Injection	5,000-10,000 AFY	*5,000-10,000 AFY*[6]	Appendix F
West Coast	Injection	50,000 AFY	50,000 AFY	Appendix F
Total		**224,800 AFY**	**167,000 AFY**[6]	Appendix F

Notes:

1. Based on potential maximum capacity minus 7,600 AFY of average annual stormwater infiltration.
2. Not currently possible under 2008 Draft regulations. However, proposed November 2011 Draft Regulations may provide future opportunities to recharge recycled water at the TSG. Use of TSG is being included as a possibility for long-term planning purposes after 2035.
3. Based on potential maximum capacity minus 7,800 AFY of average annual stormwater infiltration.
4. Based on potential maximum capacity minus 16,000 AFY of average annual stormwater infiltration and hydrogeologic constraints to limit mounding.
5. The RWMP GWR Evaluation indicates a recharge capacity of 87,800 AFY; however, the recharge potential is supply-limited because only 30,000 AFY are available from DCTWRP and only 22,000 AFY are available from LAGWRP (for a total of 52,000 AFY).
6. It would be possible to substitute project concepts in the Raymond Basin for project concepts in the San Fernando Basin. The total value for recharge potential does not include the Raymond Basin because these projects would be mutually exclusive with projects in the San Fernando Basin.

Figure ES-7: Reuse Option Locations

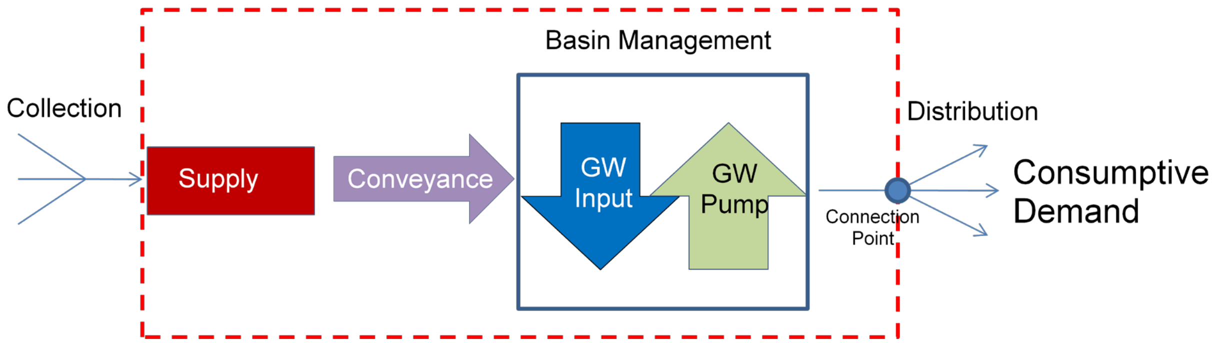


ES.4 Development of Long-Term Project Concepts

Project Concept Development Approach

Each long-term project concept was developed separately and does not depend on another project concept. Some involve components that are mutually exclusive. All the project components shown inside the red dotted line of **Figure ES-8** are included in each project concept. To satisfy the long-term objective of reducing reliance on imported water, each project concept begins from the collection system and ends at a connection point to DWP's potable distribution system.

Figure ES-8: Project Concept Development



Project Concepts

A total of ten project concepts were developed and analyzed throughout the Valley and Metro/Westside. Project concepts were named using abbreviations for the service areas: "V" for Valley and "MW" for Metro/Westside. Individual project concepts are explained in more detail in Section 4.

Harbor Service Area

Harbor project concepts were originally included in the Long-Term Concepts Report analysis, but they were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report. Some of the projects identified in the TIWRP report support LADWP's goal to increase reuse to 59,000 AFY by 2035 and some of the projects support BOS and BOE goal to maximize reuse from TIWRP.

Background research conducted for TIWRP is included in the Long-Term Concepts Report for completeness.

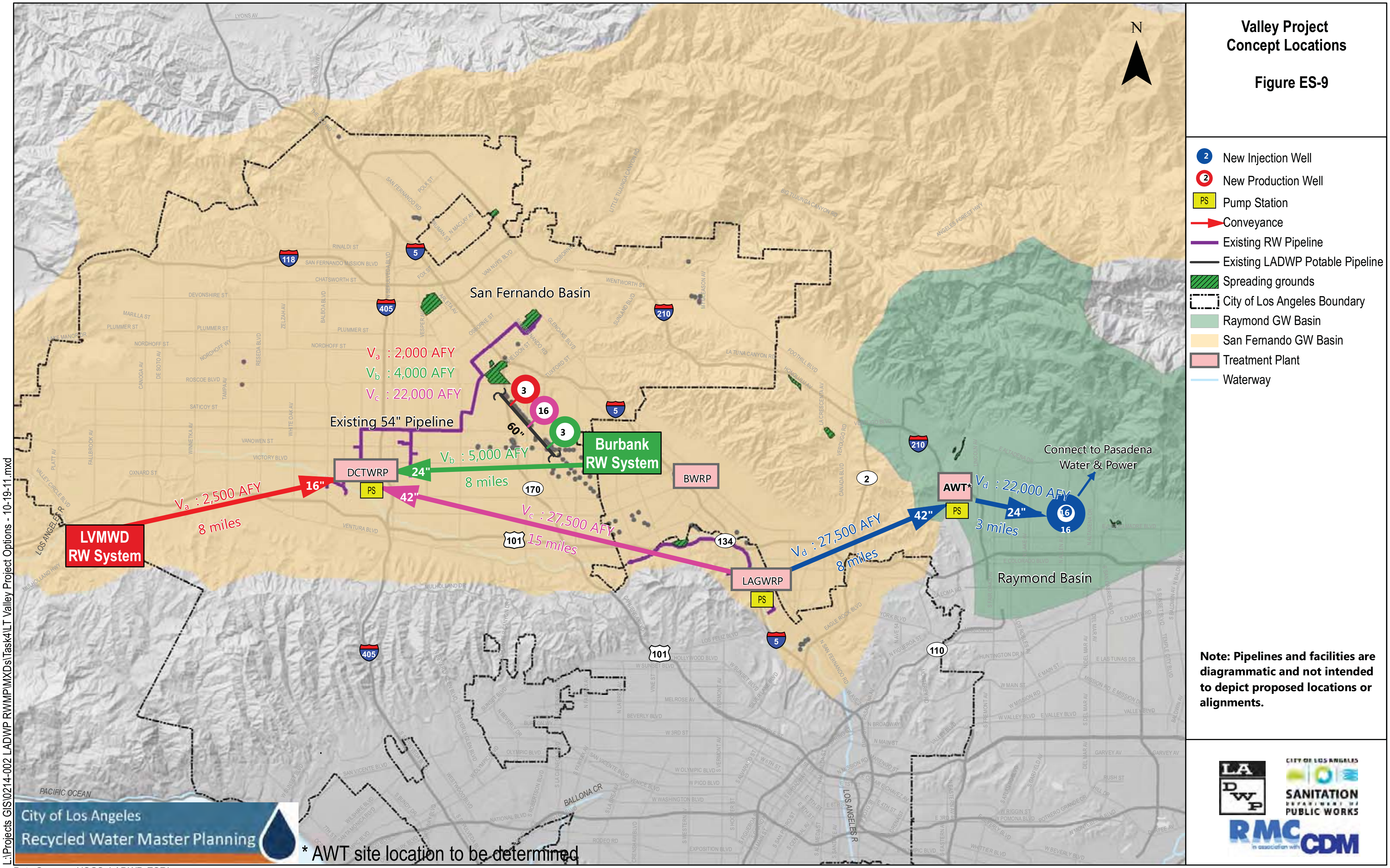
Valley Service Area

In the Valley, four project concepts were developed, shown in **Figure ES-9**. The project concepts utilize nitrified disinfected tertiary-treated recycled water supplies from LVMWD, BWP, or LAGWRP, and treat to purified recycled water quality at either DCTWRP or newly-constructed

Pasadena Water and Power facilities. Each project concept also includes conveyance, GWR, recovery via production wells, and connection back to a potable distribution system.

Metro/Westside Service Area

In the Metro/Westside, six project concepts were developed, shown in **Figure ES-10**. The project concepts utilize purified recycled water produced at HTP, West Basin Municipal Water District (WBMWD) or at a newly constructed Satellite Plant along with GWR in the West Coast Basin (WCB) and Central Basin (CB). Each project concept also includes conveyance, recovery via production wells, and connection back to a potable distribution system.



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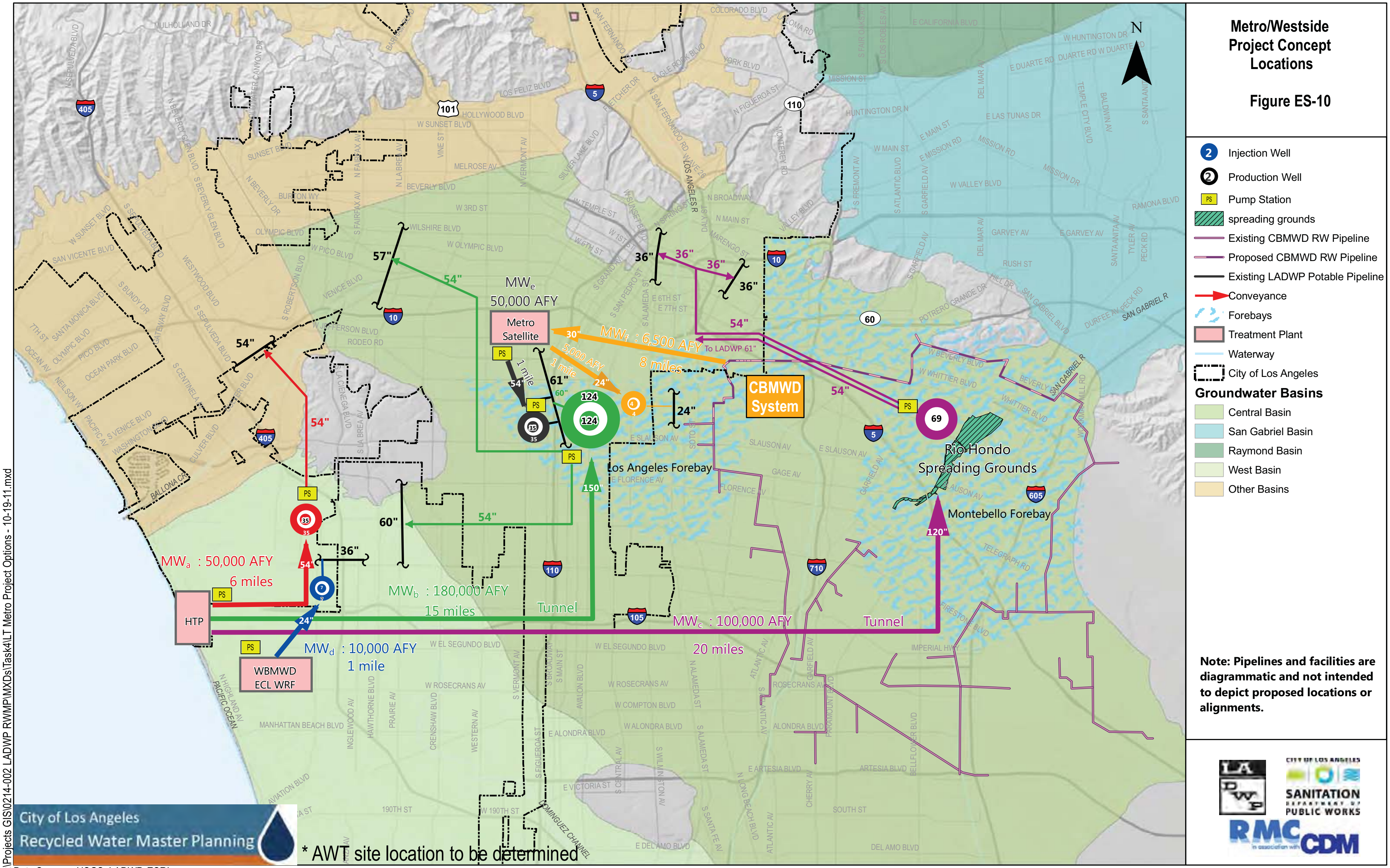
Data Sources: USGS, LADWP, ESRI



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Data Sources: USGS, LADWP, ESRI

ES.5 Evaluation of Long-Term Concepts

A detailed evaluation process was developed to enable the comparison of multiple project concepts using multiple criteria.

Recycled Water Master Planning Objectives

Six overall objectives and two threshold objectives were established for the RWMP at the beginning of the planning process. These objectives define the goals of the RWMP and establish criteria by which project concepts can be compared.

- **Threshold Objective 1** – Meet all water quality regulations and health & safety requirements, and use proven technologies. The long-term concept projects meet regulations to the extent possible, but this report acknowledges that changes to regulations may be necessary to implement some of the more innovative projects.
- **Threshold Objective 2** – Provide effective communication and education on recycled water program.
- **Objective 1 - Promote Cost Efficiency**
- **Objective 2 – Achieve Supply and Operational Goals**: The primary supply goal (LADWP) is to offset as much imported water as possible. The primary operational goal (BOS) is to reuse as much recycled water as possible from City-owned treatment facilities.
- **Objective 3 – Protect Environment**
- **Objective 4 - Maximize Implementation**
- **Objective 5 - Promote Economic and Social Benefits**
- **Objective 6** – **Maximize Adaptability and Reliability**

An analysis of long-term project concepts was completed to evaluate and compare alternatives based upon the RWMP planning objectives and performance measures. **Table ES-3** shows the objectives, evaluation criteria, performance measures, and scores for Long-Term Project Concepts.

Table ES-3: Objectives, Evaluation Criteria, Performance Measures, and Scores for Long-Term Project Concepts

Threshold Objective: Meet All Water Quality Regulations and Health & Safety Requirements, and Use Proven Technologies								Va	Vb	Vc	Vd	MWa	MWb	MWc	MWd	MWe	MWf	
								seasonal	seasonal	partly seasonal	partly seasonal						seasonal	
							GWR	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	
							NPR											
							Water Supply Source	LVMWD	BWP	LAGWRP	LAGWRP	HTP	HTP	HTP	WBMWD	Metro Sat.	CBMWD	
							Treatment (Production-AFY)	4,000	8,000	25,000	25,000	50,000	180,000	100,000	10,000	50,000	10,000	
							Storage (MG)	-	-	-	-	-	-	-	-	-	-	
							Conveyance (mi)	8	5	15	11	6	15	20	1	3	9	
							Pump Station Flow (gpm)	2,500	5,000	15,500	15,500	31,000	111,600	62,000	6,200	31,000		
							GWR Spreading Grnds (acres)	-	-	-		-	-	-	-		-	
							GWR Injection Wells (No.)	-	-	-	18	35	124	-	7	-	7	
							Production Wells (No.)	2	3	16	16	35	124	69	7	35	4	
Objective	**Weight**	**Evaluation Criteria**	**Sub-Weight**	**Overall Weight**	**Performance Measure**	**Unit**	*Distribution Connection (mi)*	1	1	3	3	4	23	13	1	7	1	**Notes**
							Differentiator?											
Promote Cost Efficiency	30%	Total Lifecycle Cost with GW Purification Cost	50%	15.0%	Total Lifecycle Cost (50-Year from 2035 to 2085)	$ million	Yes	$97.0	$124.0	$782.0	$806.0	$1,130.0	$4,371.0	$2,632.0	$405.0	$2,746.0	$268.0	1
		Unit Lifecycle Cost with GW Purification Cost	50%	15.0%	Unit Lifecycle Cost (50-Year from 2035 to 2085)	$/AF	Yes	$970	$620	$710	$730	$450	$490	$530	$810	$1,100	$1,070	2
Achieve Supply & Operational Goals	20%	Reduction in Imported Water	70%	14.0%	Reduction in volume of imported water purchases	AFY	Yes	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	3
		Overall Wastewater System Benefits	30%	6.0%	HTP service area collection system benefits	AFY	Yes	500	1,000	-22,000	-22,000	0	0	0	0	-50,000	1,500	4
Protect Environment	10%	Groundwater Quality	33%	3.3%	Improves groundwater quality	AFY	Yes	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	5
		Habitat Benefits	33%	3.3%	Benefits to LA River	AFY	Yes	10000	5000	5000	5000	10000	10000	10000	10000	10000	10000	6
		Greenhouse Gas Emissions	33%	3.3%	Greenhouse gas emissions	metric tons of CO_2 eq. / AF	Yes	-0.7	-0.6	-0.3	-0.1	-0.7	-0.8	-0.8	-1.1	-0.2	-1.0	7

1. 50-year lifecycle for permanent structures (bldgs and pipelines), and 20-year lifecycle for equipment.
2. Unit lifecycle cost. Yield assumes 100% RW (i.e., no blend) starting operation in 2035.
3. AFY number is assigned according to how much imported water would be offset for LADWP. Assumes that for "Vd" a transfer of MWD water can be made with PWP.
4. Reducing wastewater flow in HTP service area collection system; AFY number is assigned according to how much flow would be added or subtracted from HTP sewershed; lower number is better. Assumes no brine pipelines.
5. Recharging with AWT water will improve GW quality; project concepts with no GWR component score "0".
6. Measures benefits by amount of AFY that continues to be discharged to LA River beyond the current flows from DCT. "No Project" flows for Long-Term Concept Projects are assumed to be: DCT = 0 AFY, Burbank WRP = 5,000 AFY, LAG = 5,000 AFY
7. GHG emissions based on power consumption; include GHG reduction related to reduced pumping for MWD water

Table ES-3: Objectives, Evaluation Criteria, Performance Measures, and Scores for Long-Term Project Concepts (cont.)

Threshold Objective: Meet All Water Quality Regulations and Health & Safety Requirements, and Use Proven Technologies								Va	Vb	Vc	Vd	MWa	MWb	MWc	MWd	MWe	MWf	
								seasonal	seasonal	partly seasonal	partly seasonal						seasonal	
							GWR	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	
							NPR											
							Water Supply Source	LVMWD	BWP	LAGWRP	LAGWRP	HTP	HTP	HTP	WBMWD	Metro Sat.	CBMWD	
							Treatment (Production-AFY)	4,000	8,000	25,000	25,000	50,000	180,000	100,000	10,000	50,000	10,000	
							Storage (MG)	-	-	-	-	-	-	-	-	-	-	
							Conveyance (mi)	8	5	15	11	6	15	20	1	3	9	
							Pump Station Flow (gpm)	2,500	5,000	15,500	15,500	31,000	111,600	62,000	6,200	31,000		
							GWR Spreading Grnds (acres)	-	-	-		-	-	-	-		-	
							GWR Injection Wells (No.)	-	-	-	18	35	124	-	7	-	7	
							Production Wells (No.)	2	3	16	16	35	124	69	7	35	4	
Objective	**Weight**	**Evaluation Criteria**	**Sub-Weight**	**Overall Weight**	**Performance Measure**	**Unit**	*Distribution Connection (mi)*	1	1	3	3	4	23	13	1	7	1	**Notes**
							Differentiator?											
Maximize Implementation	20%	Public Acceptance	25%	5.0%	Impacts to Public from permanent facilities	Score	No	4	3	3	3	2	2	2	3	1	1	8
		Institutional Complexity	70%	14.0%	Complexity of implement./operation	Score	Yes	4	4	4	1	3	2	2	2	3	2	9
		Impacts to Community Amenity	5%	1.0%	Temporary traffic/noise/odor/dust impacts due to construction	Score	Yes	3	4	4	2	4	4	2	4	4	4	10
Promote Economic & Social Benefits	10%	Permanent job creation	50%	5.0%	Permanent job creation	Number of jobs	Yes	3	7	75	37	85	611	170	17	170	0	11
		Environmental Justice	50%	5.0%	Permanent above-ground facilities in low-income or minority tract in census data	Score	Yes	3	3	3	3	5	1	3	3	1	1	12
Maximize Adaptability & Reliability	10%	Foregone Opportunities	100%	10.0%	RW recharged outside SFB	Yes/No	Yes	N	N	N	Y	Y	Y	Y	Y	Y	Y	13

8. Score 1 = new WRP at new site; 2 = PS at new site; 3 = new WRP/PS at existing site; 4 = minor exp. at existing site or wells only; 5 = few to no impacts
9. 1 - many agreements required, complex, 2 - many agreements, less complex, 3 - moderate number of agreements, 4 - few agreements, lower complexity, 5 - project would require few or no agreements (see scoring spreadsheet)
10. Based on miles of open-trench and other surface construction. Score 1 = 20+ miles, 2 = 15-20, 3 = 10-15, 4 = 5-10, 5 = 0-5 miles; Tunneling projects receive a +1
11. Assumes 1.9 employees per mgd of AWT treatment; also assumes 1.9 employees per mgd of tertiary; projects that have tertiary and AWT expansions are counted double
12. Permanent facilities: Above-ground facilities in low-income and minority communities. Scoring: 5 - little/no impacts, 3 - wells only, 1 - treatment facilities.
13. RW recharged outside of City will keep GW storage capacity inside City open for future use. "Yes" is better.

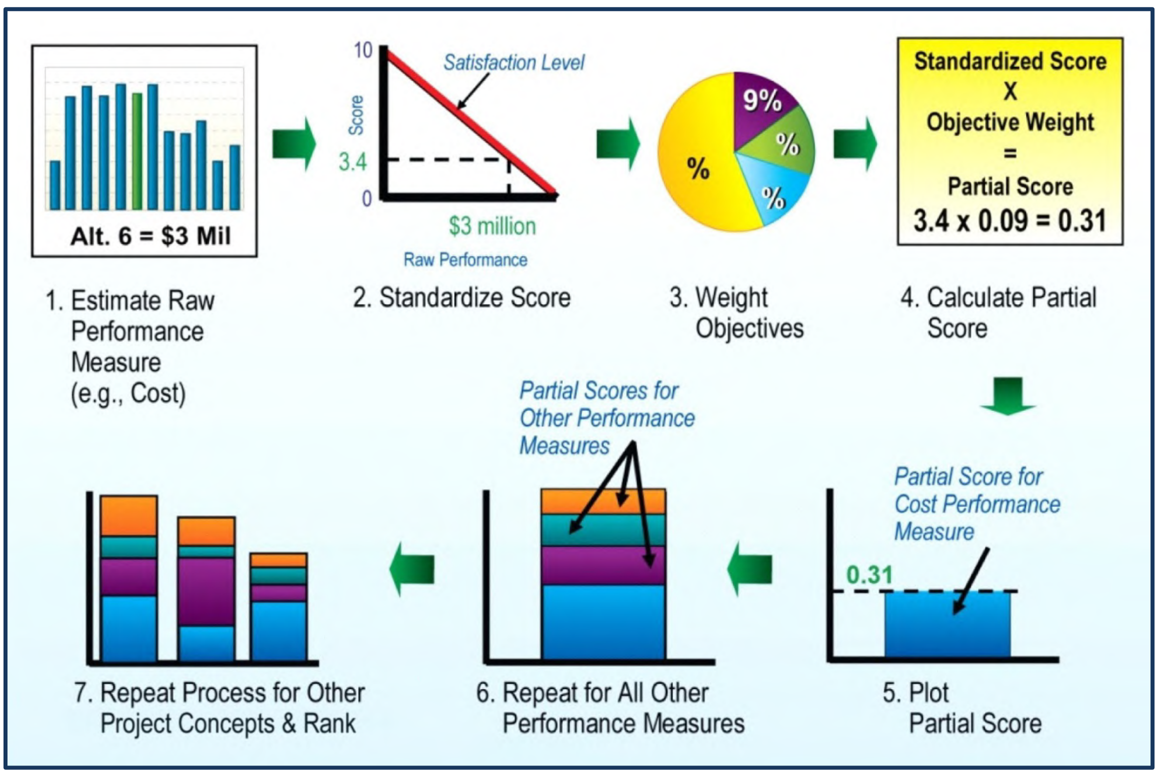
Decision Model

A decision model based on a multi-attribute rating methodology was developed to characterize project concepts. The objectives, evaluation criteria, and performance measures for each project concept were used as inputs to the decision model. Developing such a decision model is helpful when there are multiple project concepts that can be measured differently against multiple criteria, and when no single project concept clearly performs the best in all areas. In these cases, systematizing the decision process by explicitly defining and weighting criteria and then giving scores to the project concepts for those criteria can make future consideration easier and more objective.

Process

The decision model based on the multi-attribute rating methodology was developed using the commercial software Criterium® DecisionPlus® (CDP). This software was developed by Infoharvest Inc., and was selected to rank the project concepts because of its sophistication, ease of understanding and use, and its ability to conduct sensitivity analyses, if needed. There are seven basic steps of the multi-attribute rating technique, which are shown in **Figure ES-11**.

Figure ES-11: Multi-Attribute Rating Technique for Evaluating Project Concepts



Results

Valley Service Area Results

The following are a sampling of the observed results:

- Project concept Vb (source of supply water from Burbank Water Plant) scored relatively high in cost efficiency while other Valley project concepts scored lower. All scored in a similar range for cost efficiency.
- Project concepts Vd and Vc (source of supply water from Los Angeles-Glendale Water Reclamation Plant) both scored high in achieving supply and operational goals since both project concepts achieve larger reductions in wastewater flow in the HTP service area collection system.
- Project concept Vc (source of supply water from LAGWRP) scored highest for economic and social benefits because it creates the most permanent jobs.
- Project concept Vd (which sites a new AWPF at the Pasadena Water Plant) scored highest in the maximize adaptability and reliability because it recharges groundwater outside the San Fernando Basin.

Overall, project concept Vc scored the highest, followed by project concepts Vb, Vd and Va. Because some concept projects are mutually exclusive, only project concepts Vc or Vd could be recommended for potential implementation. Based on the CDP results, Vc (source of supply water from LAGWRP, GWR in the San Fernando Basin) has a higher score than Vd (source of supply water from LAGWRP, GWR outside the San Fernando Basin) and therefore would have priority in being implemented relative to the other long-term projects in the Valley Service Area.

Metro Service Area Results

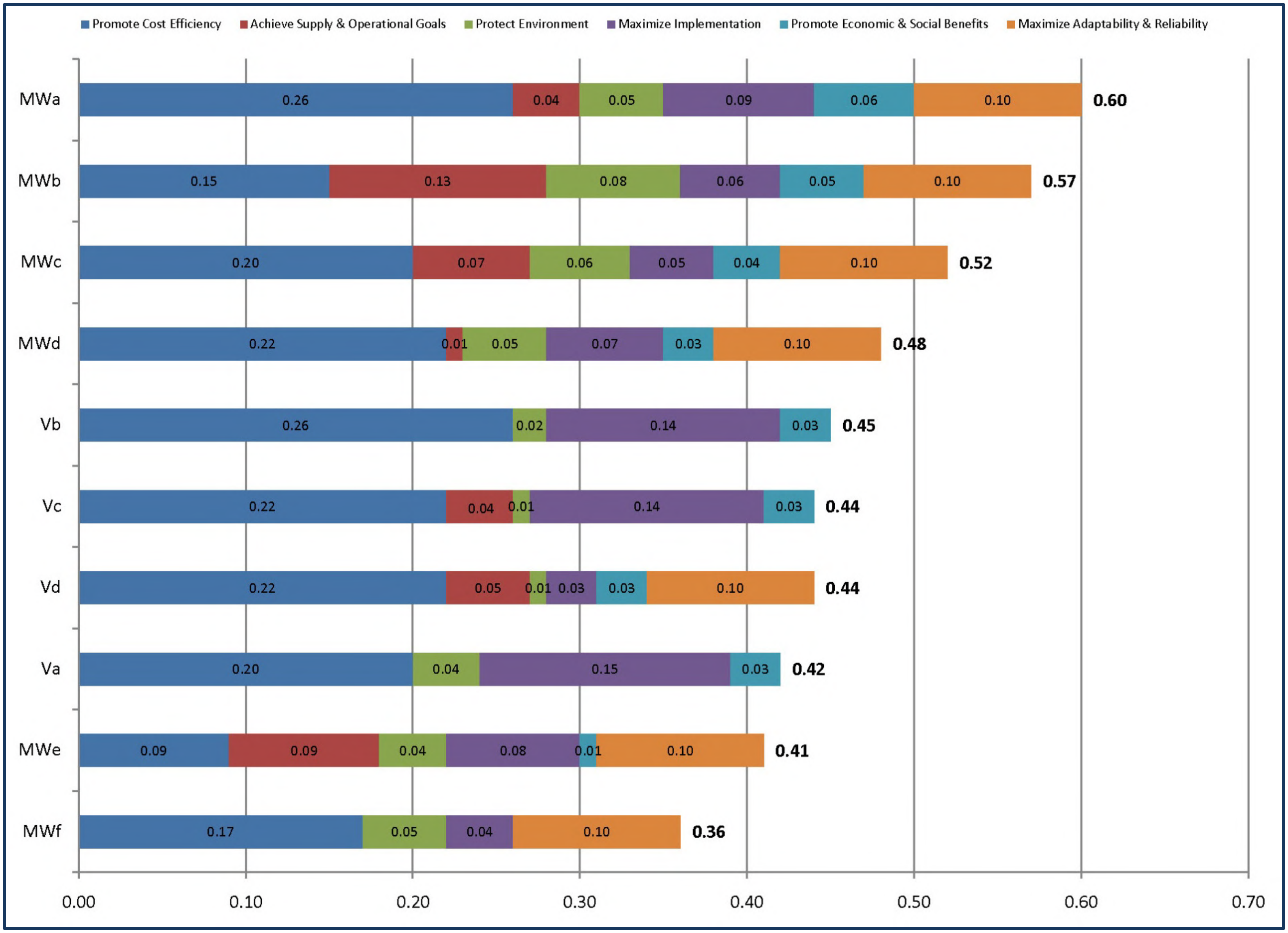
The following are a sampling of observed results:

- Project concept MWa (source of supply from HTP; GWR injection in West Coast Basin [WCB] wells) scored best in cost efficiency while MWe (source of supply from Metro Satellite, GWR injection in Central Basin [CB] wells) scored the worst due to its high unit costs.
- Project concept MWb (source of supply from HTP; GWR injection in CB wells) scored highest in achieving supply and operational goals since it offsets a large amount of imported water demand.
- Project concept MWa (HTP, WCB wells) scored highest in maximizing implementation since it has the least number of agreements needed to implement the project.
- All project concepts scored the same in the maximize adaptability and reliability since they will recharge outside the City, keeping groundwater storage capacity inside the City open for future uses.

Overall, project concept MWa scored the highest, followed by project concepts MWb, MWc, MWd, MWe and MWf. Because some project concepts are mutually exclusive, only project concepts MWa, MWb or MWc could be recommended for potential implementation. Based on the CDP results, MWa (source of supply from HTP; GWR injection in WCB wells) scored highest and therefore would have priority in being implemented.

Figure ES-12 shows graphical results for the CDP model analysis.

Figure ES-12: Long-Term Project Concepts Scoring (in Order of Ranking)



ES.6 Long-Term Scenarios and Themes

Long-term scenarios and themes were developed to provide potential implementation strategies for long-term concept projects. They are included here for discussion purposes only and are not intended to represent recommendations; nor do they include all possible strategies that could be implemented.

Establish Long-Term Scenarios

The following three scenarios were developed as an implementation framework for the long-term concept projects. They represent stages/percentages of MWD imported water offset for LADWP:

- **40 Percent:** The 40 percent scenario represents the amount of MWD offset that can be achieved through conservation (64,368 AFY), existing NPR, near-term NPR, and GWR (59,000 AFY), for a total of 123,368 AFY. This scenario represents the baseline condition for long-term concept projects (i.e., before long-term concept projects are implemented).
- **90 Percent**: The 90 percent scenario represents the MWD offset based on the estimated recharge potential in the Los Angeles area. Based on the Regional Groundwater Assessment TM (Appendix F) and the Groundwater Replenishment Evaluation TM, 167,000 AFY is the estimated combined recharge potential of San Fernando, Central, and West Coast Basins (Raymond Basin is not included because projects are mutually exclusive with San Fernando Basin). This recharge potential is based on both the recharge capacities of the groundwater basins as well as supply and other limitations. Accounting for the planned 30,000 AFY GWR project, this leaves approximately 137,000 AFY of recharge potential for the remaining basins. This would increase reuse by an additional 137,000 AFY for a total imported offset of 260,368 AFY.
- **100 Percent:** The 100 percent scenario represents the total MWD offset in 2035 (291,395 AFY) as reported in the 2010 UWMP. This scenario increases reuse by an additional 31,027 AFY. Based on LADWP's 2010 UWMP, 291,395 AFY is the total projected amount of imported water LADWP would receive from MWD in 2035, if no conservation or NPR/GWR projects were implemented (existing and future).

Develop Implementation Themes

The overall goal of the long-term project concepts is to replace 168,027 AFY of potable water supplies with recycled water. This would allow the City to increase the percentage of 2035 MWD demand offset from 40 percent to 100 percent.

The following themes were developed:

- **Valley –** This theme assumes that LADWP decides to pursue Valley project concepts first and gives priority to the highest ranked project concepts in the Valley service area to meet the 90 percent and 100 percent goals. Once all mutually exclusive project concepts in the Valley are chosen based on scores, the highest ranked project concepts from other regions are included.

- **HTP** – This theme assumes that LADWP decides to pursue HTP project concepts first and gives priority to the highest ranked project concepts for HTP. Once all mutually exclusive project concepts for HTP are chosen based on scores, the highest ranked project concepts from other regions are included.
- **Metro Satellite** – This theme assumes that LADWP decides to pursue the Metro Satellite project concept first and gives priority to the Metro Satellite project concept followed by the highest ranked project concepts from other regions.
- **Outside Agencies** – This theme assumes that LADWP decides to pursue joint projects with other agencies first. It gives priority to the highest ranked project concepts with supplies from outside agencies, followed by the highest ranked projects with other regions.
- **Maximize Reuse** - This theme assumes that LADWP decides to pursue project concepts first that meet or exceed the 100 percent milestone. It gives priority to the highest ranked project concept with the largest yield.

The baseline rating was used to rank all the project concepts. Once the project concepts were ranked, lower-ranking mutually exclusive concepts were eliminated (or reserved for particular future situations). Then a prioritized list was developed. Using the prioritized list and a chosen theme, the highest ranked project concepts can be implemented first, the second highest can be implemented second, and so on.

Harbor

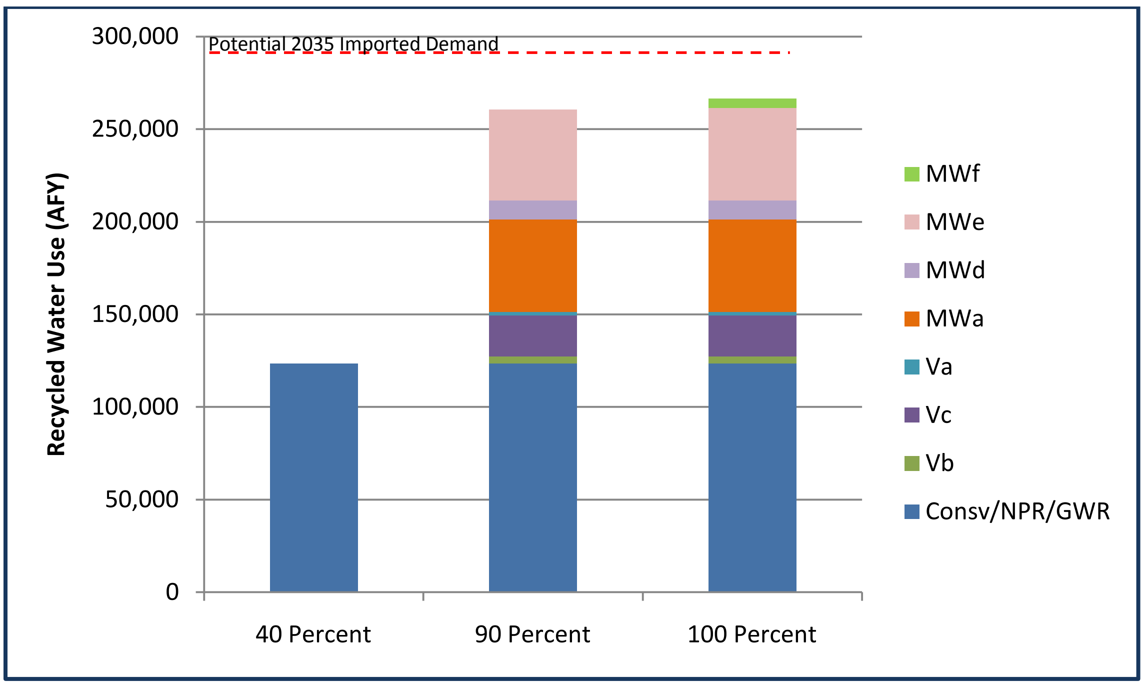
As discussed previously, Harbor project concepts were originally included in the Long-Term Concepts Report analysis, but they were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report. Background research conducted for TIWRP is included in the Long-Term Concepts Report for completeness.

Valley

The Valley theme gives priority to the highest ranked project concepts in the Valley service area to meet the 90 percent and 100 percent goals.

Based on the CDP results, the highest to lowest ranked Valley project concepts are: Vb (source of supply water from BWP, GWR to spreading), Vc (source of supply water from LAGWRP, GWR to spreading), Va (source of supply water from LVWMD, GWR to spreading), and Vd (source of supply water from LAGWRP, AWPF at PWP). Since the project concepts Vc and Vd are mutually exclusive, project concept Vc takes precedence over project concept Vd. Project concept Vc would divert sewer flows to LAGWRP that would otherwise be treated at HTP, thereby reducing the influent flows at HTP. However, the influent flow reduction does not impact MWa, which is the highest scoring MW project concept. **Figure ES-13** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

Figure ES-13: Valley Theme/ Scenarios

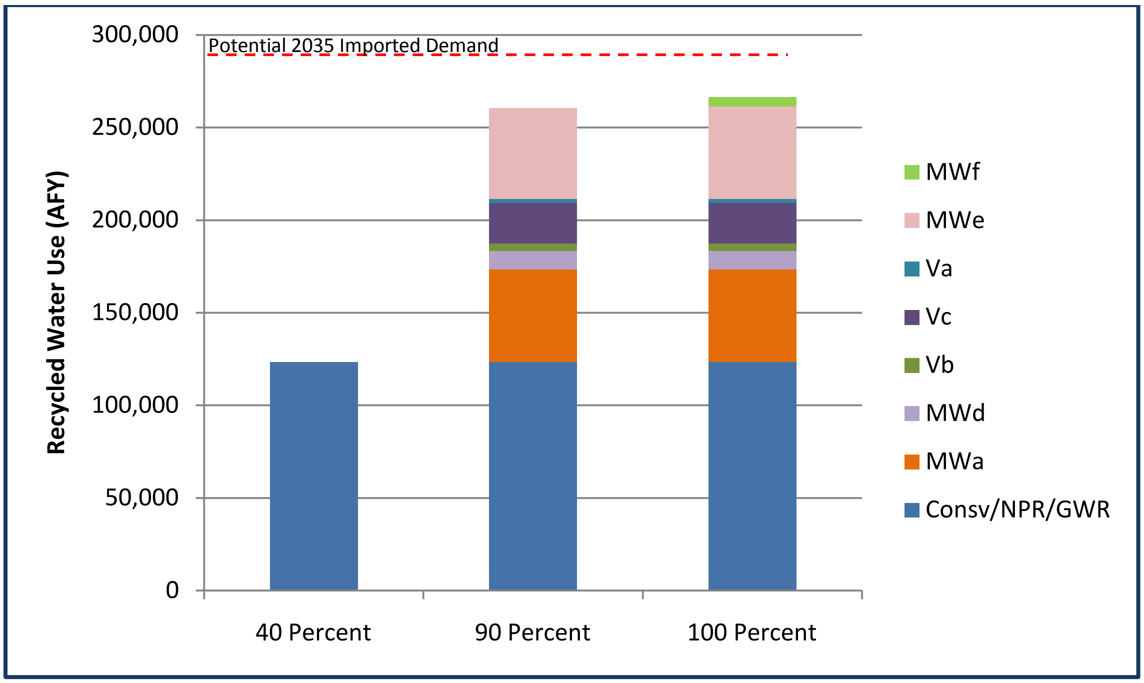


HTP

The HTP theme gives priority to the highest-ranked project concepts for HTP to meet the 90 percent and 100 percent goals. Based on the CDP results, the highest to lowest ranked HTP project concepts are: MWa (source of water supply from HTP, GWR injected to WCB wells), MWb (HTP, GWR injected to CB wells [Los Angeles Forebay]) and MWc (HTP, GWR to CB spreading grounds [Rio Hondo Spreading Grounds]).

Since all three of these projects are mutually exclusive, project concept MWa will take precedence over the other HTP project concepts. **Figure ES-14** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

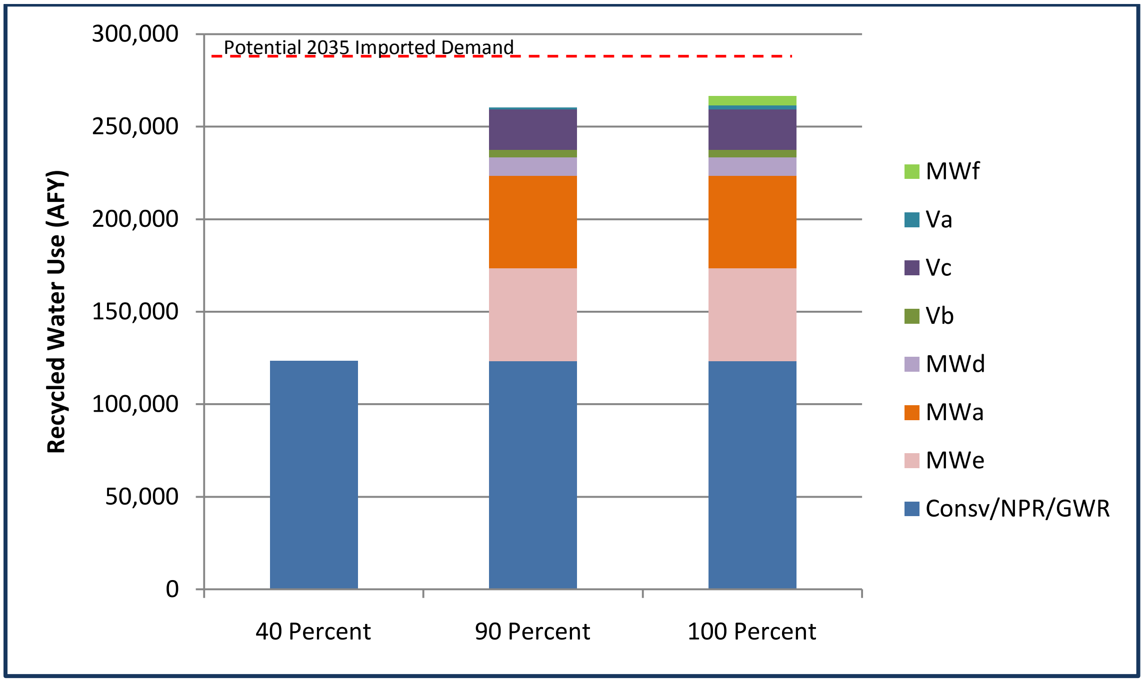
Figure ES-14: HTP Theme/ Scenarios



Metro Satellite

The Metro Satellite theme gives priority to the satellite project concept to meet the 90 percent and 100 percent goals. Therefore, project concept MWe (source of water supply from Metro Satellite plant, GWR to CB wells) would be the first implemented, followed by the other highest scored project concepts. **Figure ES-15** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

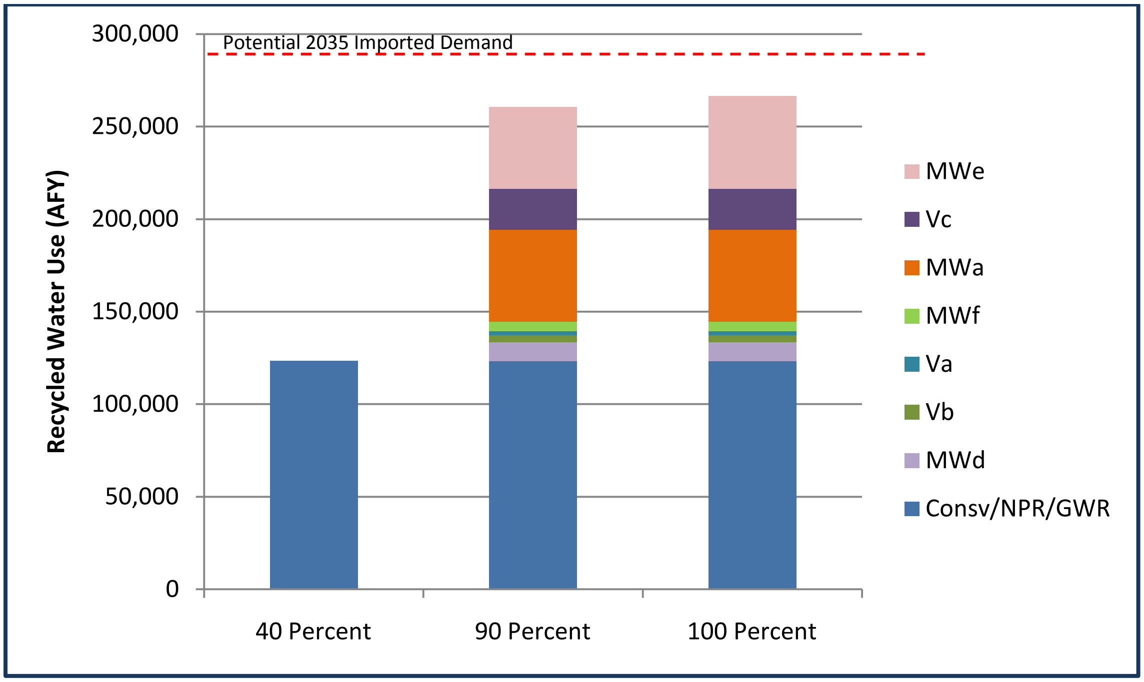
Figure ES-15: Metro Satellite Theme/ Scenarios



Outside Agencies

The Outside Agencies theme gives priority to the project concepts supplied from outside agencies. Based on the CDP results, MWd (source of supply water from WBMWD, GWR to WCB wells) would be the first implemented, followed by Vb (source of supply water BWP, GWR to spreading), Va (source of supply water from LVWMD, GWR to spreading) and MWf (source of supply water from Central Basin MWD, GWR to CB wells). To achieve the 90 percent and 100 percent goals, the next highest project concepts are chosen after that. **Figure ES-16** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

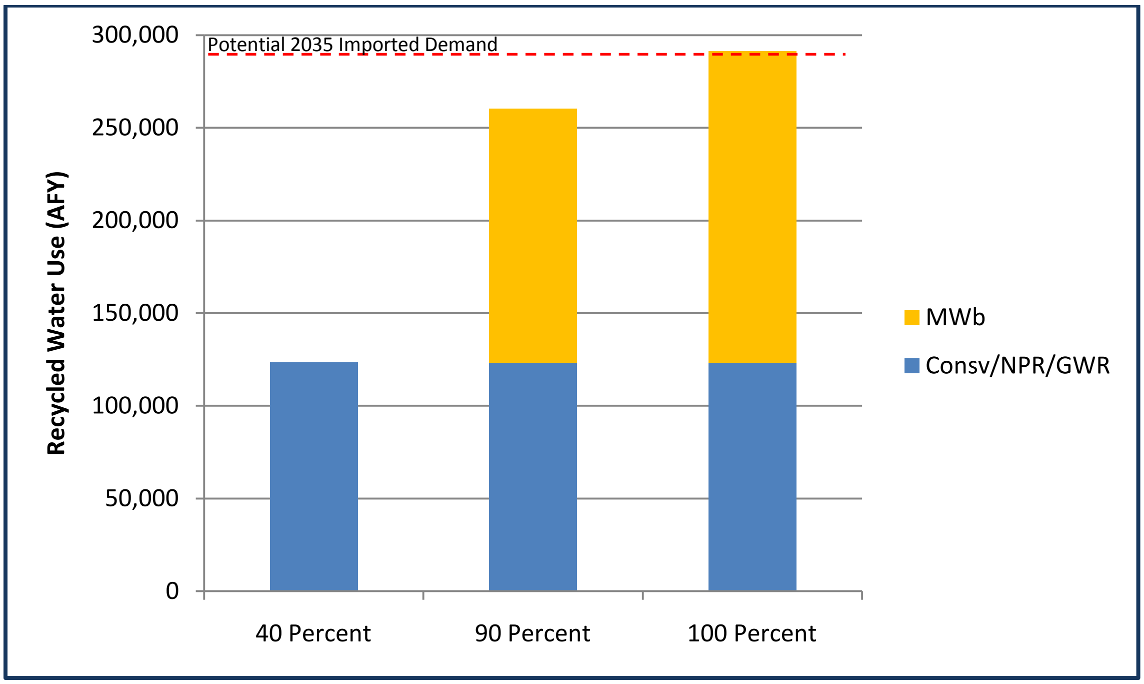
Figure ES-16: Other Agencies Theme/ Scenarios



Maximize Reuse

The Maximize Reuse theme gives priority to project concept MWb (HTP, GWR injected to CB wells [Los Angeles Forebay]), as the highest ranking project with the largest yield. If implemented, MWb would be the only project concept necessary to achieve the 90 percent and 100 percent goals of offsetting imported water. **Figure ES-17** shows the implementation steps of project concept MWb to achieve the 90 percent and 100 percent goals. In addition, if project concept MWb is fully implemented (i.e., all 180,000 AFY), the 100 percent milestone could potentially be exceeded.

Figure ES-17: Max Reuse Theme/ Scenarios



Key Findings and Conclusions

The Long-Term Concepts Report has the following key findings and conclusions:

- Each of the five themes, if implemented individually, could offset 90 percent of potential MWD imported water demands. The Maximize Reuse theme could offset 100 percent or more of potential MWD imported demands.
- Long-term project concept MWa (supply of source water from HTP, GWR to WCB wells) scored the highest from the three HTP project concepts; however, project concept MWb would allow the 100 percent goal to be reached.
- If Valley long-term project concepts Vc (source of supply water from LAGWRP, GWR to San Fernando Basins) or Vd (LAGWRP, GWR outside of San Fernando Basins) are implemented, project concept MWb would produce 168,000 AFY, instead of 180,000 AFY, of recycled water.

Long-term concepts, including the themes discussed above, are presented in this report for discussion purposes only and are intended to encapsulate the potential pathways available to the City given the current regulatory setting. The concepts are intended to maximize the City's recycled water asset after the near-term goal of 59,000 AFY of recycled water is achieved. One thing to note is that the regulatory landscape for potable reuse, which makes up the predominance of opportunity to maximize the recycled water asset, is changing quickly. As new groundwater replenishment (December 2013) and surface water augmentation (December 2016) regulations are promulgated from California Senate Bill 918, and direct potable reuse framework guidelines are established (December 2016), it is envisioned that new opportunities, hopefully with reduced cost and energy implications, will be available to the City.

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

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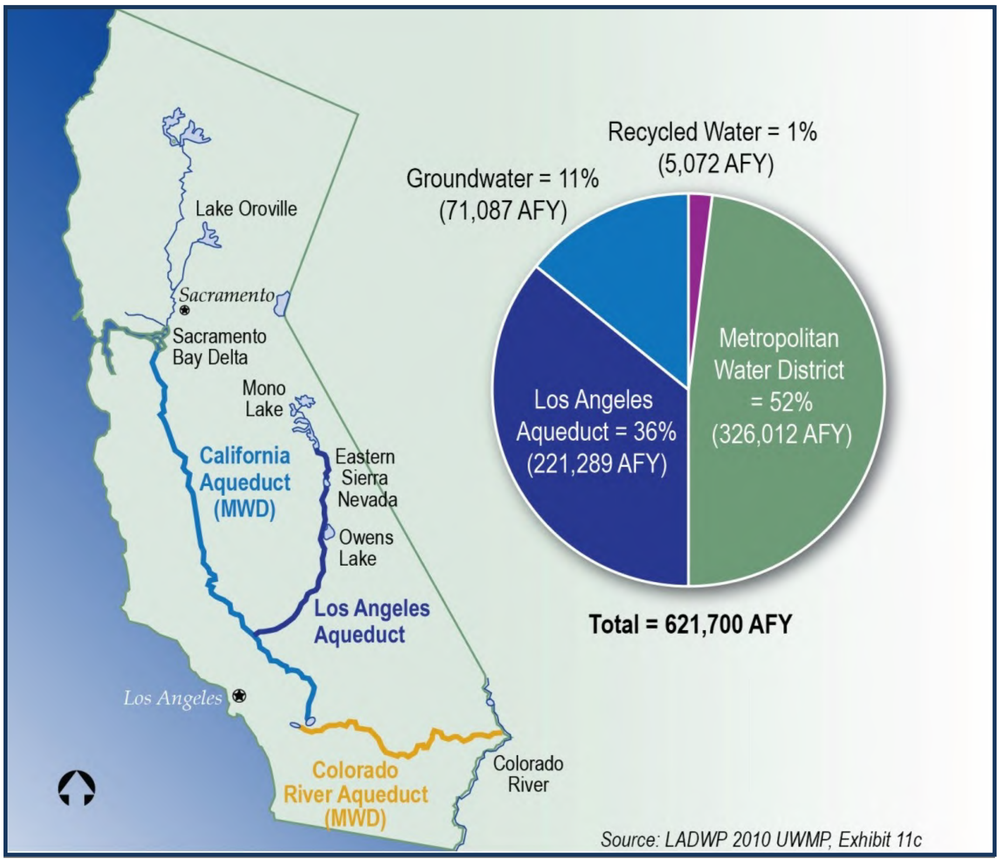
1. Introduction

1.1 Background

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

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



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

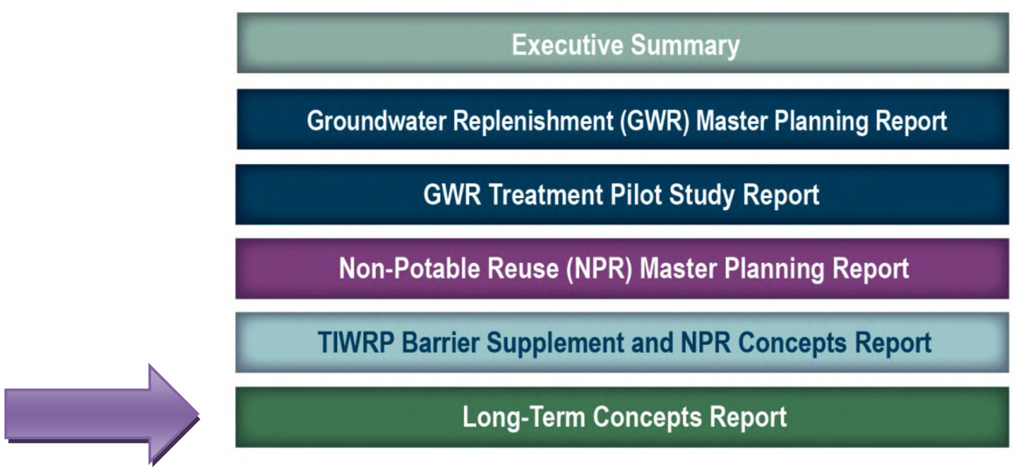
Conservation has helped Angelenos maintain about the same total water use since 1980, despite a population growth of 1 million people. However, conservation alone cannot meet future demands.

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

LADWP, in partnership with the City of Los Angeles Department of Public Works (LADPW), Bureau of Sanitation (BOS) and Bureau of Engineering (BOE), developed the Recycled Water Master Planning (RWMP) documents to outline strategies to offset imported water demand by utilizing recycled water. Specifically, the RWMP process identified projects to significantly increase the City's recycled water use. Originally, the RWMP was to identify groundwater replenishment (GWR) and NPR projects to achieve 50,000 AFY. But after adoption of the 2010 UWMP, the goal of the RWMP was modified to identify, evaluate, and set a course for achieving a total use of 59,000 AFY[6] by 2035, as well as developing a plan to maximize reuse.

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

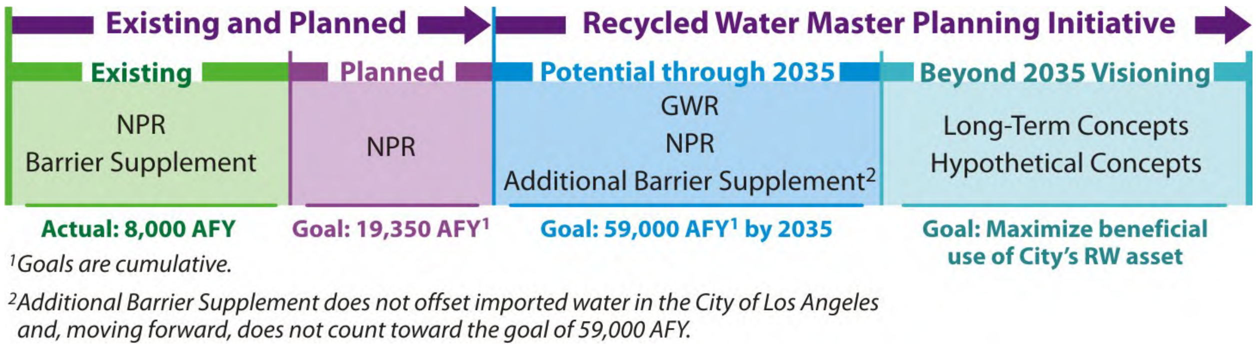
Figure 1-2: RWMP Documentation



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

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

Figure 1-3: Overview of RWMP Components



The purpose of this Long-Term Concepts Report is to develop projects that have the potential to maximize the beneficial reuse of recycled water produced at the City's existing treatment plants, at a potential new satellite plant, and/or at plants operated by outside agencies. The long-term project concepts are intended to expand recycled water reuse beyond the 59,000 AFY goal of the GWR Master Planning Report and the NPR Master Planning Report.

The long-term project concepts were developed to achieve two parallel goals which are essential to a successful long-term recycled water strategy for the City:

- Maximize recycled water reuse from the City's existing treatment plants: Los Angeles-Glendale Water Reclamation Plant (LAGWRP), Hyperion Treatment Plant (HTP), Terminal Island Water Reclamation Plant (TIWRP) and Donald C. Tillman Water Reclamation Plant (DCTWRP).

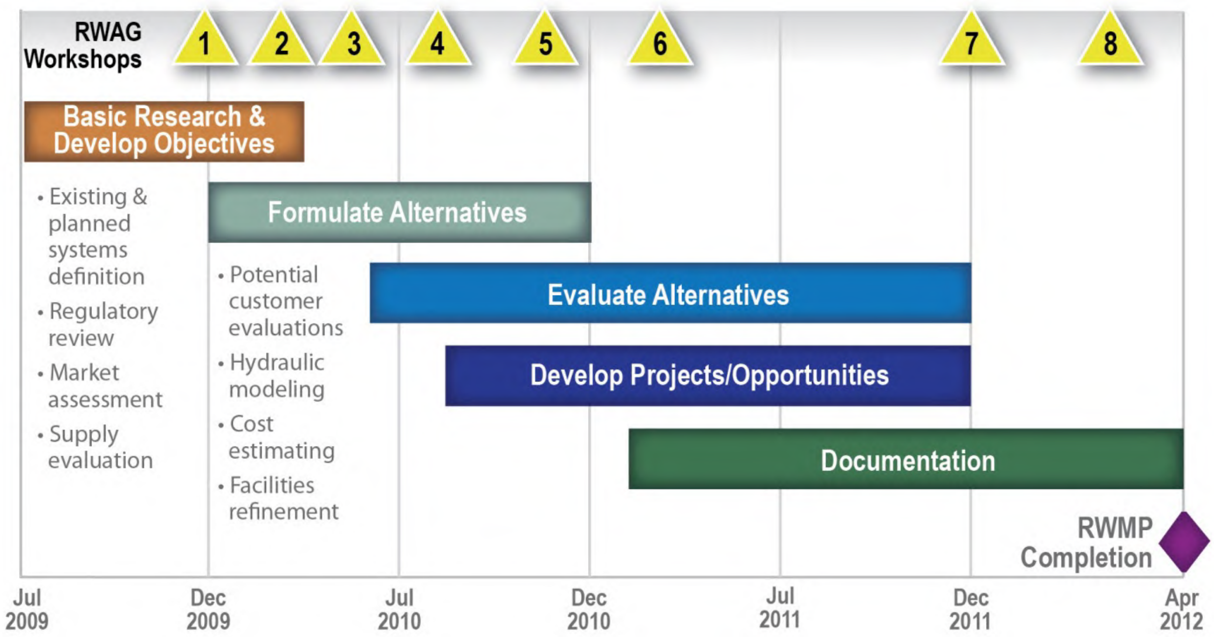
- Maximize the offset of imported Metropolitan Water District (MWD) water, using recycled water from City treatment plants and/or from outside agencies.

The LADWP's 2010 UWMP shows that imported water would be expected to supply approximately 168,027 AFY by 2035. The long-term project concepts are intended to offset MWD supplies to the extent possible (up to 168,027 AFY) by 2085, fifty years after 2035.

1.2 Recycled Water Master Planning Approach

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

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



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

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

1.3 Overview of Long-Term Concepts Report

The purpose of this report is to develop a "menu" of potential long-term concept projects that could be implemented to help maximize LADWP's recycled water deliveries beyond 2035 UWMP goals.

The Long-Term Concepts Report is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Approach
- Section 3 – Project Technical Assessment
- Section 4 – Development of Long-Term Project Concepts
- Section 5 – Evaluation of Long-Term Concepts
- Section 6 - Long-Term Scenarios and Themes
- Section 7 – References
- Appendices

Table 1-1 summarizes the TMs that were developed and used as the basis for this Long-Term Concepts Report. The Revised Draft versions of these TMs are included in **Appendix A** through **Appendix F**.

The long-term concepts effort identified a wide array of potentially feasible wastewater diversion, flow equalization, and treatment expansion and/or upgrade projects that would maximize recycled water production from the existing treatment plants; identified local and regional indirect potable reuse opportunities (including interconnections with neighboring agencies) that could provide a mechanism for beneficial reuse of the maximized recycled water; and identified non-potable reuse projects that could be served by any remaining and expanded recycled water sources, including interagency interconnections.

Table 1-1: Related LTCR TMs

TM Title	Location in Report
Treatment Plant Overview TM	Appendix A
Draft: November 2, 2009	Relevant findings in Section 3.1
The Treatment Plant Overview TM summarizes the infrastructure and operations at three of LADWP's existing plants (HTP, LAGWRP, and TIWRP), including treatment plant flows and quality, current and planned treatment plant infrastructure, under-utilized space at the plant sites, and plant operational issues and trends.	
LAGWRP Opportunities TM	Appendix B
Draft: February 17, 2010	Relevant findings in Section 3.1.1
The LAGWRP Opportunities TM identifies potentially feasible project options that would maximize recycled water production from LAGWRP and estimates the potential recycled water production that could occur at the LAGWRP site. It documents projected influent flows, available areas for recycled water treatment processes at the LAGWRP site, and previous findings with respect to GWR and NPR market demands in the vicinity of LAGWRP. This TM also documents the assumed treatment technologies, appropriate process capacities, and the facilities needed to treat influent flows to a tertiary level and return residuals (i.e., filtration reject/backwash flows) to the collection system to be conveyed and treated at HTP. It includes a discussion of flow equalization needs, and recommended site layouts for treatment facilities. The TM concludes with a discussion of special issues, preliminary conveyance routes, and an order of magnitude cost estimate for maximizing recycled water production.	
HTP Opportunities TM with Addendum	Appendix C
Draft: February 5, 2010; July 23,2010	Relevant findings in Section 3.1.2
The HTP Opportunities TM identifies potentially feasible project options that would maximize recycled water production from HTP and estimates the potential recycled water production that could occur at, and near, the HTP site up to the year 2040. It documents projected influent flows, available areas for recycled water treatment processes at the HTP site, and previous findings with respect to GWR and NPR market demands in the vicinity of HTP. Using a phased approach, this TM also documents the assumed treatment technologies, appropriate process capacities, and the facilities needed to deliver secondary effluent to the recycled water treatment process and return residuals (i.e., brine and filtration reject/backwash flows) to HTP. It includes a discussion of flow equalization needs, and recommended site layouts for treatment facilities, both on and off the HTP property. The TM concludes with a discussion of special issues, preliminary conveyance routes, and an order of magnitude cost estimate.	

TM Title	**Location in Report**
TIWRP Opportunities TM	Appendix D
Draft: February 18, 2010	Relevant findings in Section 3.1.3
The TIWRP Opportunities TM identifies potentially feasible project options that would produce 12.5 mgd of injection barrier or high-quality industrial source water from TIWRP. It documents projected influent flows, available areas for recycled water treatment processes at the TIWRP site, and previous findings with respect to GWR and NPR market demands in the vicinity of TIWRP. This TM also documents the assumed treatment technologies, appropriate process capacities, and the facilities needed to deliver tertiary effluent to the recycled water treatment process and return residuals (i.e., concentrate and filtration reject/backwash flows) to TIWRP. It identifies concentrate management issues and preliminary strategies. It also includes a discussion of flow equalization needs, and recommended site layouts for treatment facilities. The TM concludes with a discussion of special issues (including discharges to the Harbor and operational challenges), preliminary conveyance routes, and an order of magnitude cost estimate for maximizing recycled water production.	
Regional Recycled Water System TM	Appendix E
Draft: October 20, 2009	Relevant findings in Section 3.1.6
This TM documents a series of meetings with neighboring agencies that have some relationship to recycled water to explore the potential for partnerships. The TM includes a summary of: (1) existing and planned recycled water systems; (2) intertie opportunities for supplementing recycled water flows available to LADWP, as well as supplementing adjacent agency/system flows to potentially offset potable water that could be made available to LADWP; and (3) potential opportunities and issues associated with interagency partnerships.	
Regional Groundwater Assessment TM	Appendix F
Draft: November 25, 2009	Relevant findings in Section 3.2.1
This TM summarizes groundwater basin characteristics in the Los Angeles region and provides a description of existing and planned groundwater replenishment projects, including seawater intrusion barriers. The TM also includes estimates of basin replenishment potential for the West Coast Basin, Central Basin, Raymond Basin and the San Gabriel Basin.	

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2. Approach

The long-term goal for the recycled water program is to maximize reuse, and in the process offset additional demands for imported water beyond the 2035 goal of 59,000 AFY. The evaluation includes development of long-term project concepts in the Valley and Metro/Westside service areas for LADWP; technical development and refinement of the project concepts; detailed evaluation and comparison of project concepts; and development of a list of prioritized project concepts that can be used to build various scenarios for maximizing reuse and offsetting imported supplies.

The long-term project concepts evaluation process is presented in **Figure 2-1** and described in detail in the following steps.

Figure 2-1: Long-Term Project Concepts Evaluation Approach

Step 1: Select Conceptual Goal

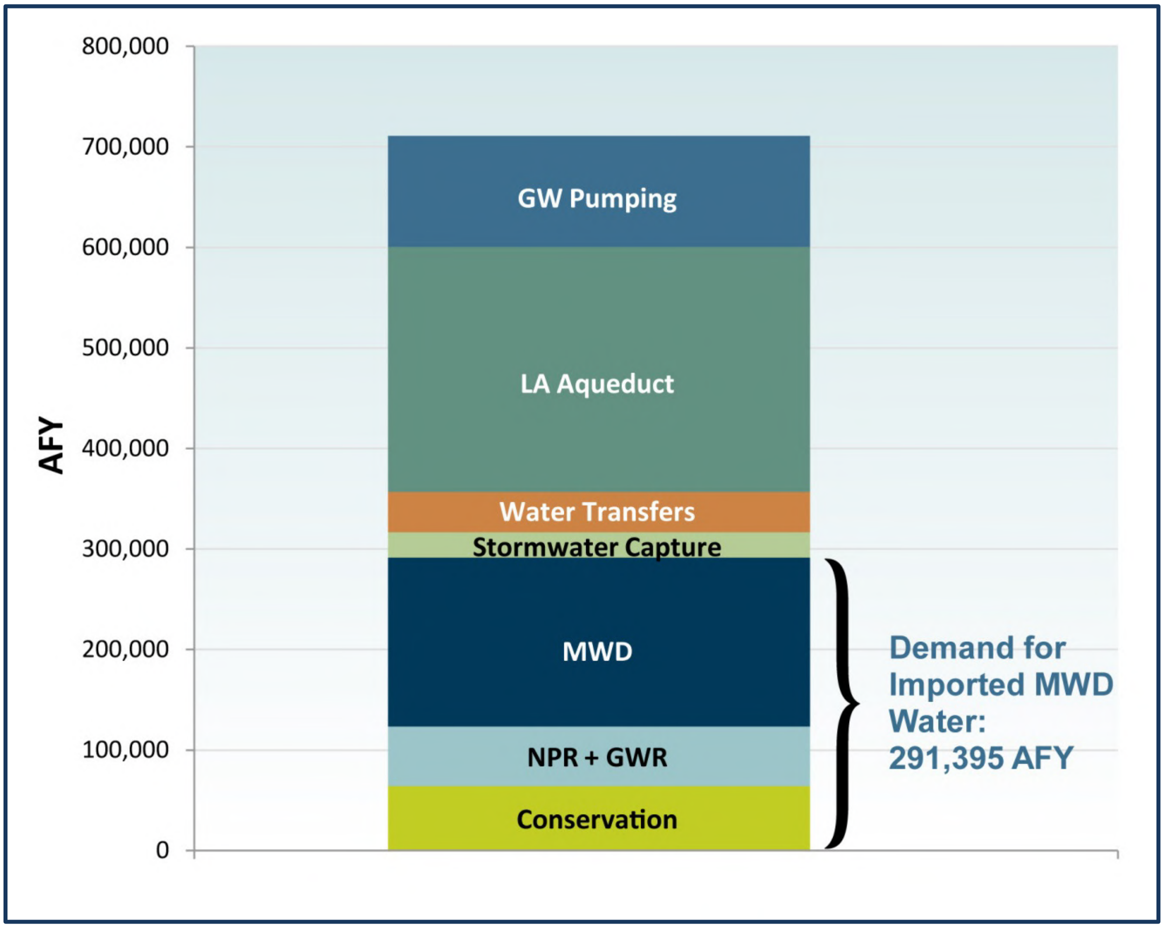
The conceptual goals for the long-term project concepts include offsetting the need for imported water supplies and maximizing reuse. Of the 710,800 AFY of total demand in the year 2035, imported water would be expected to supply 291,395 AFY[7] as shown in Figure 2-2. This number includes 168,027 AFY of anticipated MWD demand. The long-term project conceptual goal is to offset MWD supplies to the extent possible (up to 168,027 AFY) by 2085.

The imported water demand includes 64,368 AFY of conservation and 59,000 AFY of existing and near-term NPR and GWR water demands. These demands would have been supplied with

[7] LADWP 2010 UWMP.

imported water sources if conservation and/or recycled water programs had not been implemented. Water supplied from the Los Angeles Aqueduct (244,000 AFY), water supplied from groundwater (110,405 AFY), stormwater capture (25,000 AFY) and water transfers (40,000 AFY) were also not included in the imported water estimate.

Figure 2-2: 2035 LADWP Potable Water Supplies



Note: AWPF water provided to the DGB is included in "NPR + GWR"

Step 2: Establish Basis for Long-Term Scenarios

Using this conceptual framework, long-term scenarios were developed. The first 123,368 AFY of demand supplied by conservation efforts (64,368 AFY) and non-potable recycled water (59,000 AFY for existing NPR, near-term NPR and GWR) accounts for 40 percent of the 2035 imported MWD water demand (i.e., 123,368 /291,395 is approximately 40 percent). These programs represent 123,368 AFY of water that would have otherwise been imported from MWD in the year 2035.

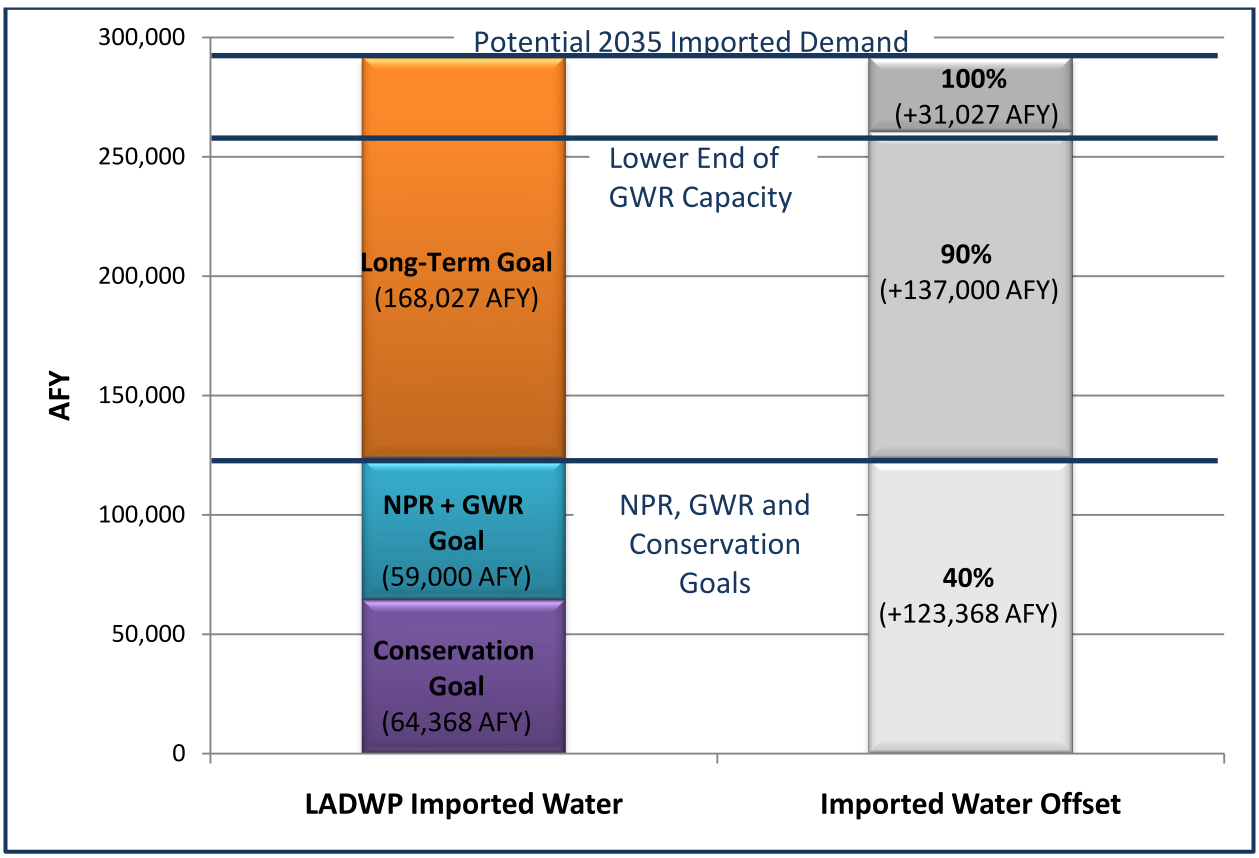
The long-term scenarios build upon that initial 123,368 AFY of conservation plus non-potable recycled water and GWR. They are established based on three different "milestone" amounts of recycled water reuse as described in **Table 2-1.**

Table 2-1: "Milestone" Basis for Long-Term Scenarios

Total Imported Offset (AFY)	Reuse from Long-Term Projects (AFY)	Percent MWD Offset[1]	"Milestone" Basis
123,368	0	40 percent	This is the "baseline" condition prior to implementation of long-term concepts. It represents planned conservation, existing NPR, near-term NPR, and GWR. [2,3]
260,368	+137,000	90 percent	This is the first milestone for long-term concepts. It represents the estimated groundwater recharge potential of San Fernando, Central, West Coast, and Raymond Basins.[3]
291,395	+31,027 (168,027 cumulative)	100 percent	This is the second milestone for long-term concepts. It represents the projected imported MWD supply in 2035.[4]

Notes:
1. Offset percentages are further defined in Section 6.1.
2. Includes 64,368 AFY of conservation and 59,000 AFY of existing, planned and potential NPR and GWR recycled water programs that are expected to be implemented by fiscal year 2034-2035.
3. Draft Regional Groundwater Assessment TM (Appendix F) and Groundwater Replenishment Evaluation TM.
4. LADWP's 2010 UWMP, adopted May 2011

Figure 2-3: "Milestone" Basis for Long-Term Scenarios



Step 3: Identify Project Concepts

Once the long-term scenario numeric targets were established, long-term project concepts were identified in the three primary regions of LADWP's service area: the Valley, Metro/Westside, and Harbor. Ideas from all tasks were considered, and the project concepts were developed based on available build-out flows from the four wastewater treatment plants. Each project concept was defined in terms of the amount of flow that could offset imported water purchases and/or maximize reuse, and project concepts that are mutually exclusive were identified.[8]

Step 4: Develop and Evaluate Project Concepts

After project concepts were identified in Step 3, further technical assumptions and assessment (e.g., facility sizing, energy costs, etc.), were developed. This informed the evaluation criteria and performance measures that were used as the basis of comparison between the different project concepts with respect to the RWMP objectives described in Section 5.1. For each objective, a set of evaluation criteria (or sub-objectives) were established to further define the meaning of the objectives. A performance measure was then defined for each evaluation criterion as a quantitative or qualitative value to determine how well a project concept meets a given evaluation criteria and objective.

After performance measures were assigned to the project concepts, each was ranked with respect to the objective weighting identified earlier in the evaluation process. See Section 5.2 for more details on the decision model process and results.

Step 5: Establish Themes for Long-Term Scenarios

Themes were developed to construct multiple scenarios and help with project concept prioritization within each scenario to move past the "baseline" condition (40 percent) and meet the 90 percent and 100 percent goals. The following themes were established:

- **Valley**: This theme assumes that LADWP decides to pursue Valley project concepts first and gives priority to the highest ranked project concepts in the Valley service area to meet the 90 percent and the 100 percent goals. Once all mutually exclusive project concepts in the Valley were prioritized based on scoring, the highest ranked project concepts from other regions were included.
- **HTP** – This theme assumes that LADWP decides to pursue HTP project concepts first and gives priority to the highest ranked project concept from HTP. Once all mutually exclusive project concepts from HTP were prioritized based on scoring, the highest ranked project concepts from other regions were included.
- **Metro Satellite** – This theme assumes that LADWP decides to pursue the Metro Satellite project concept first and gives priority to the Metro Satellite project concept followed by the next highest ranked project concepts from other regions.
- **Outside Agencies** – This theme assumes that LADWP decides to pursue joint projects with other agencies first. It gives priority to the highest ranked project concepts with supplies from outside agencies. These project concepts include the agencies listed in **Table 3-8**.

[8] Harbor project concepts were originally included in the Long-Term Concepts Report analysis. They were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report and these projects are no longer included in the discussion of Long-Term Concept Projects.

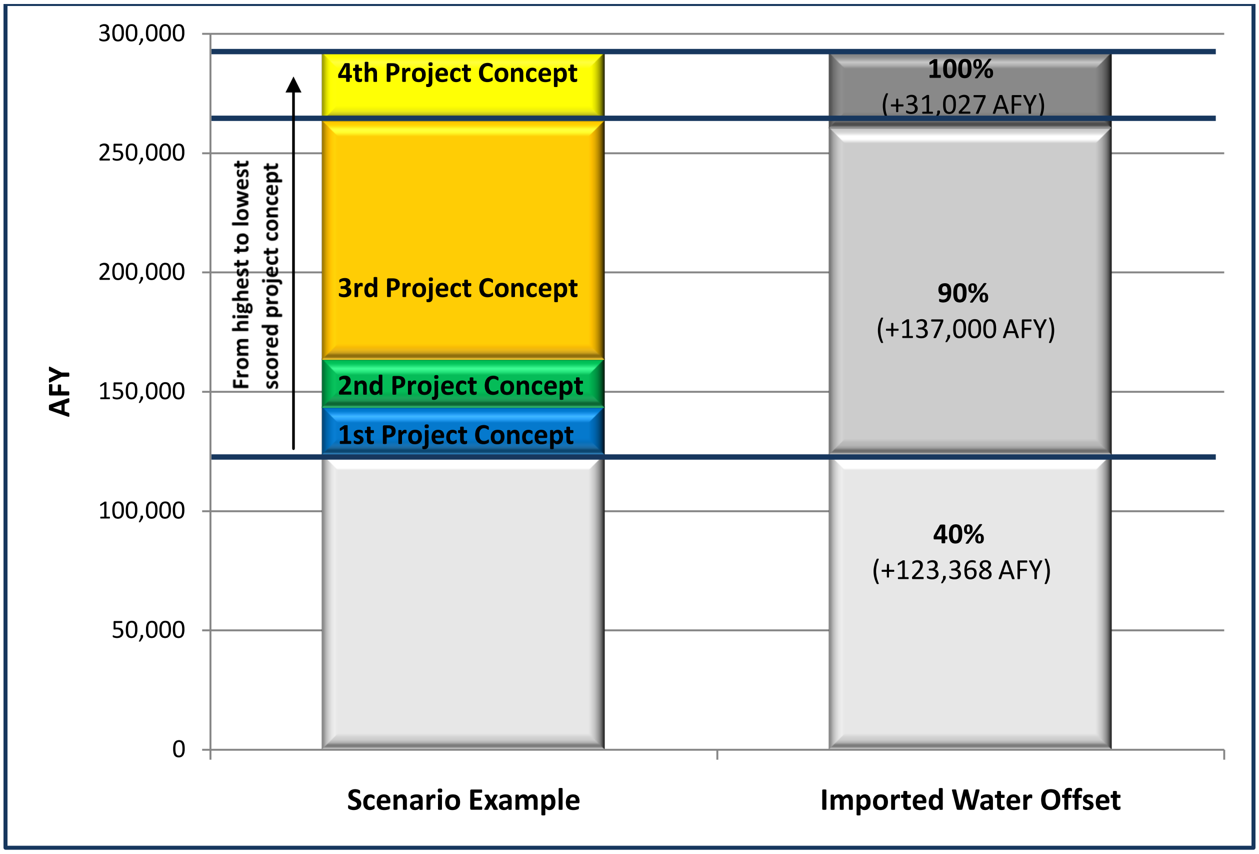
- **Maximize Reuse** - This theme assumes that LADWP decides to pursue project concepts first that meet or exceed the 100 percent milestone. It gives priority to the highest ranked project concept with the largest yield.

Step 6: Use Prioritized Project Concepts and Themes to Develop Long-Term Scenarios

Once the project concepts were ranked, lower-ranking mutually exclusive concepts were eliminated (or reserved for particular future situations). Then a prioritized list was developed. Using the prioritized list and a chosen theme, the highest ranked project concepts could be implemented first, the second highest could be implemented second, and so on. An example of how a long-term scenario was developed is shown in **Figure 2-4** based on a presumed "Metro theme".

Note that this analysis was to develop concepts only. Implementation decisions will be made in the future.

Figure 2-4: Example of Long-Term Scenario Development



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3. Technical Assessments

The Long-Term Concepts Report was a parallel activity to the development of the NPR and GWR Master Planning Reports. Potential opportunities were identified that would increase the City's reuse beyond the 59,000 AFY goal established for near-term NPR and GWR. This effort included opportunities to maximize the beneficial reuse of effluent produced, or potentially produced, at each of the City's existing treatment plants: LAGWRP, HTP, TIWRP[9] and DCTWRP.

This section summarizes the supplies that serve as building blocks for the development of long-term project concepts.

3.1 Recycled Water Supplies

Each project concept has one supply source associated with it, either a City or a regional agency facility. **Table 3-1** summarizes all the City and non-City facilities identified as potential sources to provide recycled water to the City's service areas. These facilities are shown graphically in **Figure 3-1**.

Table 3-1: Potential Long-Term Recycled Water Supplies

WRP[1]	Agency[2]	Current Treatment Level	Average Supply		Available Supply Notes[3]
			MGD	AFY	
Valley Service Area					
DCTWRP	BOS	Nitrified Tertiary	27	30,000	Newly-constructed AWPF by 2022. Most of the flow would be committed for GWR and up to 5,000 AFY for non-potable reuse. Space is available for expanded AWPF facilities that could potentially produce an additional 30,000 AFY (beyond near-term GWR).
LAGWRP	LABOS & GWP	Nitrified Tertiary	20	22,000	Expected to continue treating flows to a tertiary level.
BWRP	BWP	Tertiary	4.5	5,000	Annual supply of 5,000 AFY of tertiary-treated water could be potentially available
TWRF	LVMWD	Nitrified Tertiary	2	2,500	Annual supply of 2,500 AFY of tertiary-treated water could be potentially available.

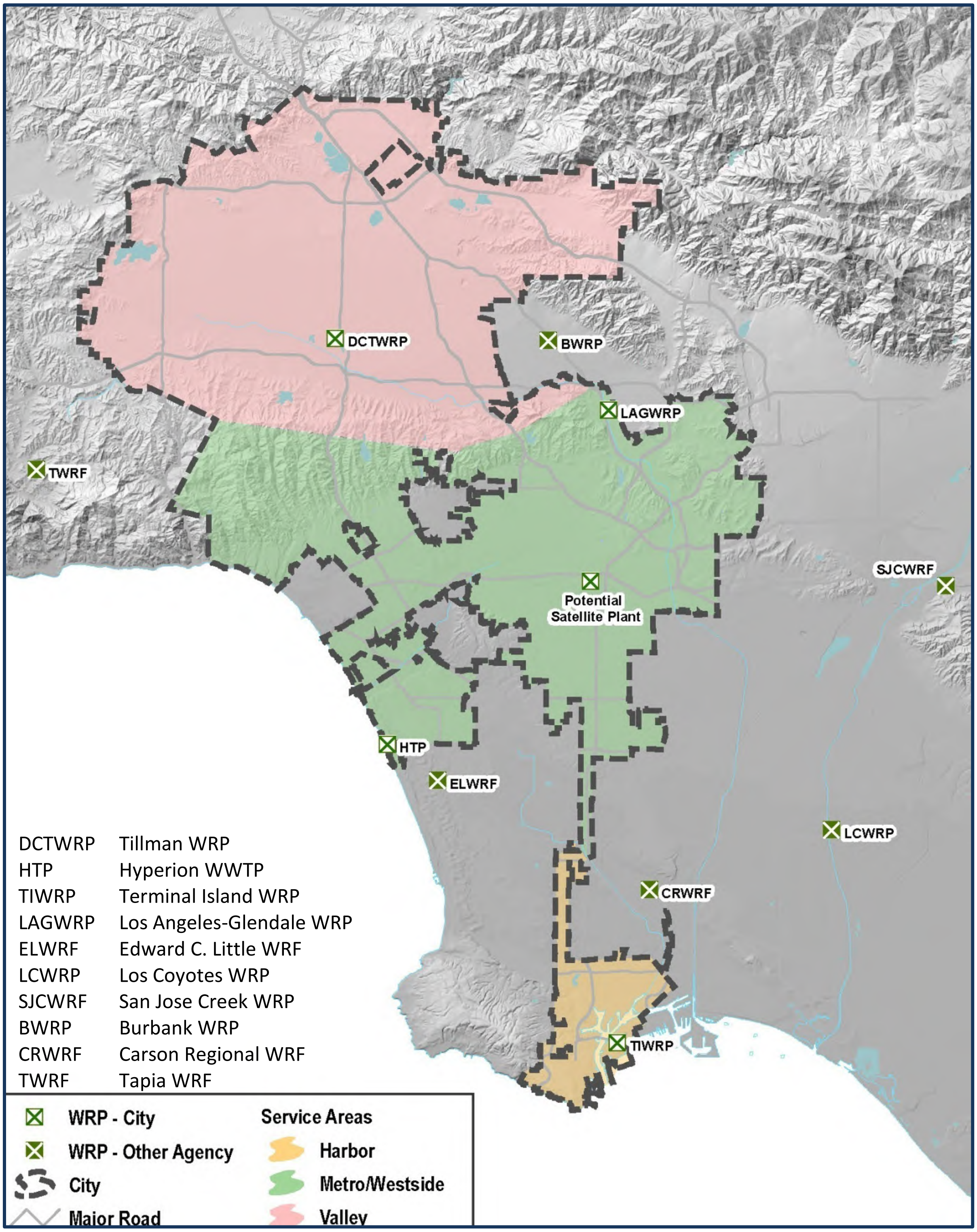
[9] Harbor project concepts were originally included in the Long-Term Concepts Report analysis. They were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report and these projects are no longer included in the discussion of Long-Term Concept Projects. Background research conducted for TIWRP is included in this report for completeness.

WRP[1]	Agency[2]	Current Treatment Level	Average Supply MGD	Average Supply AFY	Available Supply Notes[3]
Metro/Westside Service Area					
HTP	BOS	Pure Oxygen Secondary	160	180,000	Plant currently produces secondary effluent, yet would be possible to construct AWPF in the future. With full buildout, an average supply of 180,000 AFY of purified recycled water could be potentially available.[4]
ELWRF	WBMWD	Tertiary/AWP	9	10,000	The 56-mgd plant has the capability to produce five different levels of advanced treatment. Average supply of 10,000 AFY of purified recycled water could be potentially available.
SJCWRP	LACSD	Nitrified Tertiary	9	10,000	Currently produces 73.5 mgd of tertiary-treated water. CBMWD and WRD purchase tertiary-treated recycled water from LACSD's SJCWRP and could make some of this recycled water available to the City. Average supply of 10,000 AFY of tertiary-treated water could be potentially available between SJCWRP and LCWRP.
LCWRP	LACSD	Nitrified Tertiary	9	10,000	Currently produces 25.8 mgd of tertiary-treated water. CBMWD purchases tertiary-treated recycled water from LACSD's LCWRP and could make some of this recycled water available to the City. Average supply of 10,000 AFY of tertiary-treated water could be potentially available between SJCWRP and LCWRP.[5]
New Metro Satellite Plant	BOS	N/A	45	50,000	New Metro plant would produce purified recycled water if constructed. Average supply of 50,000 AFY of purified recycled water could be potentially available.[6]

Notes:

1. WRPs: Burbank Water Reclamation Plant (BWRP), Tapia Water Recycling Facility (TWRF), Edward C. Little Water Recycling Facility (ELWRF), San Jose Creek Water Reclamation Plant (SJCWRP), Los Coyotes Water Reclamation Plant (LCWRP)
2. Agencies: Glendale Water and Power (GWP), Las Virgenes Municipal Water District (LVMWD), West Basin Municipal Water District (WBMWD), Sanitation Districts of Los Angeles County (LACSD)
3. Agencies: Central Basin Municipal Water District (CBMWD); Water Replenishment District (WRD); Membrane Bioreactor (MBR); Advanced Water Purification Facility (AWPF)
4. Includes 70 mgd of secondary flow to WBMWD.
5. SJCWRP and LCWRP are reported together because CBMWD's system is planned to be looped and flow could be supplied from either plant.
6. RMC/CDM, 2010h

Figure 3-1: Long-Term Supply Locations



3.1.1 Los Angeles-Glendale Water Reclamation Plant

The LAGWRP, operated by the City of Los Angeles, is located approximately 8.5 miles north of downtown Los Angeles, east of Griffith Park. LAGWRP has a permitted capacity of 20 mgd and is currently operating at an average influent flow rate of 19 mgd (September 2008 through July 2009). LAGWRP produces up to 18 mgd tertiary-treated recycled water and currently supplies 2,430 AFY and up to 4.8 mgd to non-potable customers. All wastewater at LAGWRP is treated to a tertiary level, which includes a nitrification/ denitrification (NdN) process, and the tertiary effluent is delivered to LADWP's and the City of Glendale's recycled water distribution systems or discharged to the Los Angeles River.

There are two project options for potential development of recycled water production at LAGWRP (Appendix B - *LAGWRP Opportunities Final Draft TM*). Project Option 1 expands LAGWRP existing influent capacity by 12 mgd (for a total influent capacity of 32 mgd) resulting in an increase of recycled water production of 9 mgd (for a total production of 27 mgd) with equalization. Project Option 2 expands LAGWRP influent capacity by 28 mgd (for a total influent capacity of 48 mgd) resulting in an increase of recycled water production of 22 mgd (for a total production of 40 mgd). The large increase in influent flows under Project Option 2 cannot be achieved until the Glendale Burbank Interceptor Sewer (GBIS) is constructed, which is not scheduled to occur until after 2030. The GBIS would divert upstream flows from the Valley Spring Lane/Foreman Avenue (VSL/FA) sewershed to LAGWRP. Both project options assume that LAGWRP would be expanded with new tertiary facilities including NdN. Proposed facility locations are shown in **Figure 3-2**.[10]

[10] Proposed facility locations are shown in Appendix B - *LAGWRP Opportunities Final Draft TM* (Figures 2-4, 3-5, and 3-6).

Figure 3-2: LAGWRP Expansion Site

The LAGWRP production estimates are based on the following findings and assumptions:

- Maximum 2040 sewer flow in the LAGWRP sewershed as it is currently configured is 32 mgd. If flows from the VSL/FA sewershed were diverted to LAGWRP, the potential 2040 influent flow could be as high as 56 mgd if the planned Glendale-Burbank Interceptor Sewer/Northeast Interceptor Sewer II (GBIS/NEIS II) is operational by that time.
- Treatment capacity is limited to some extent by available area for treatment and equalization facilities. The site has enough area to provide treatment capacity for the 32 mgd of future influent flow from the LAGWRP sewershed, including area set aside for a secondary effluent equalization basin (which allows the plant to operate with constant flow rates to the filters). The site also has enough area for a maximum capacity of 48 mgd without equalization. The LAGWRP site does not have sufficient available space to build treatment capacity for the entire 56 mgd of potential influent flow from the LAGWRP and VSL/FA sewersheds.
- LAGWRP will continue to provide recycled water to LADWP and the City of Glendale under the current LAGWRP agreement. This agreement states that the cities of Los Angeles

and Glendale are each 50 percent owners of LAGWRP, and that each of these two cities is entitled to 50 percent of the plant capacity and product water. The City of Pasadena has purchased the right to 60 percent of Glendale's product water (30 percent of total product water), though this right is not exercised as of 2011.

- The level of treatment would be Title 22 tertiary with NdN and ultraviolet disinfection because the anticipated uses for recycled water from LAGWRP are irrigation and industrial applications. Continued NdN treatment would be required to maintain a failsafe discharge option to the Los Angeles River. Groundwater replenishment projects that may use tertiary effluent from LAGWRP may require additional advanced treatment.
- LAGWRP will not receive flows from the DCTWRP sewershed.
- Upstream flows in the LAGWRP and VSL/FA sewersheds will not be routed to a satellite treatment plant.

Table 3-2 summarizes the two options for LAGWRP.

Table 3-2: LAGWRP Recycled Water Production Potential

LAGWRP	Project Option 1	Project Option 2
Description	**With Equalization** (less space for treat. capacity)	**Without Equalization** (more space for treat. capacity)
Water Quality Produced	Nitrified/Denitrified Disinfected Tertiary	Nitrified/Denitrified Disinfected Tertiary
Source of Influent Flows (sewershed)	LAGWRP	LAGWRP + diversions from VSL/FA
Plant Capacity & Max Hourly Influent Flow, mgd(1)	32	48
Average Daily Influent Flow, mgd(2)	30	44
Average Daily RW Production, mgd(3)	27	40
Total Volume RW Produced, AFY	30,000	45,000
Total Equalization Volume Provided, MG(4)	5	0

Notes:

1. For LAGWRP, max hourly influent flow will not exceed plant capacity (primary/secondary processes are designed for no peaking).
2. LAGWRP runs at plant capacity approximately 18 hours per day. During the remaining six hours, the influent flow dips to match available sewer flows, therefore the average daily influent flow is less than plant capacity.
3. Assumes plant losses of 1 mgd per 10 mgd of average daily influent flow.
4. Equalization of 5 MG is also mentioned in Alternative 2 of the City's 2006 Integrated Resources Plan.

3.1.2 Hyperion Treatment Plant

The HTP, located south of the Los Angeles International Airport, is the largest wastewater treatment plant owned by the City and has a permitted average dry weather capacity of 450 mgd. All wastewater is treated to a secondary level and the majority is discharged through a 5-mile ocean outfall. The following sections provide additional detail on current and projected flows.

The HTP has potential capacity to produce 160 mgd of purified recycled water occurring in four distinct implementation phases based on long-term plans (Appendix C- *HTP Opportunities Final Draft TM*).

These phases in combination provide a production capacity of 128 mgd within the HTP site (Phase 1 through 3) and an additional 32 mgd of production capacity using nearby off-site areas (Phase 4). A phased approach is recommended so that the recycled water production capacity can match incremental increases in recycled water demands up to the year 2040. However, simultaneous construction of any of the phases could potentially be accomplished. Proposed facility locations are shown in **Figure 3-3**.[11]

Figure 3-3: HTP Expansion Sites

These production estimates are based on the following findings and assumptions:

- Influent flows at HTP will not change appreciably between 2009 and 2040 due to the opposing effects of population growth, water conservation measures, and expansion of reuse capacity at the upstream DCTWRP and LAGWRP treatment plants. Consistent with this assumption, the average annual influent flows at HTP are estimated to be 301 mgd between 2009 and 2040. With in-plant consumptive uses totaling 6 mgd, secondary flows of 295 mgd would be available.
- Up to 70 mgd of secondary effluent flow will be delivered at a constant flow rate to West Basin Municipal Water District (WBMWD) in accordance with an agreement signed between LADWP and WBMWD in early 2011.
- Purified recycled water produced will be treated with microfiltration (MF), reverse osmosis (RO), and advanced oxidation processes (AOP), to meet anticipated regulatory requirements for direct injection to a groundwater aquifer.

[11] Proposed facility locations are shown in Appendix C- *HTP Opportunities Final Draft TM* (Figures 2-4 and 3-3).

- The maximum anticipated flow of brine and MF residuals delivered to the outfall, not including WBMWD's contribution, will be approximately 65 mgd for facilities producing 160 mgd of recycled water (Phase 4).

Table 3-3 provides a summary of the phases for HTP.

Table 3-3: HTP Long-Term Recycled Water Production Potential

	Phase 1	Phase 2	Phase 3	Phase 4	Total
Description	**Existing Emergency Storage Basin Area**	**Existing Parking Lot Area**	**Existing Oxygen Reactor No. 9 Area**	**Nearby Off-Site Area**	
Pure Oxygen Secondary Effluent Flow, mgd	295	295	295	295	
Pure Oxygen Secondary Effluent Flow to WBMWD, mgd	70	70	70	70	
Net available	225	225	225	225	
MF/RO Feed Flow Rate, mgd	70	30	80	45	225
Purified RW Production, mgd	50	21	57	32	160
Volume Purified RW Produced, AFY	56,000	23,500	63,900	35,800	179,200
Equalization Volume Provided, MG(1)	9	15	0	6	30

Note:
1. Design considerations dictate that equalization volumes provided for Phases 1 and 2 exceed the actual volumes required for operation.

3.1.3 Terminal Island Water Reclamation Plant

The TIWRP is located on a 22-acre site on Terminal Island in the port area of San Pedro, within the City of Los Angeles, near the entrance to the Los Angeles Harbor.[12] TIWRP has a permitted average dry weather flow (ADWF) tertiary treatment capacity of 30 mgd and is currently operating at an average influent flow rate of 15.4 mgd. The treatment plant discharges undisinfected tertiary effluent on a continuous basis through its permitted harbor outfall into the Los Angeles Harbor, which is hydraulically connected by the harbor entrance to the Pacific Ocean. TIWRP also has a 5.0 mgd capacity Advanced Water Purification Facility (AWPF)[13], which consists of microfiltration

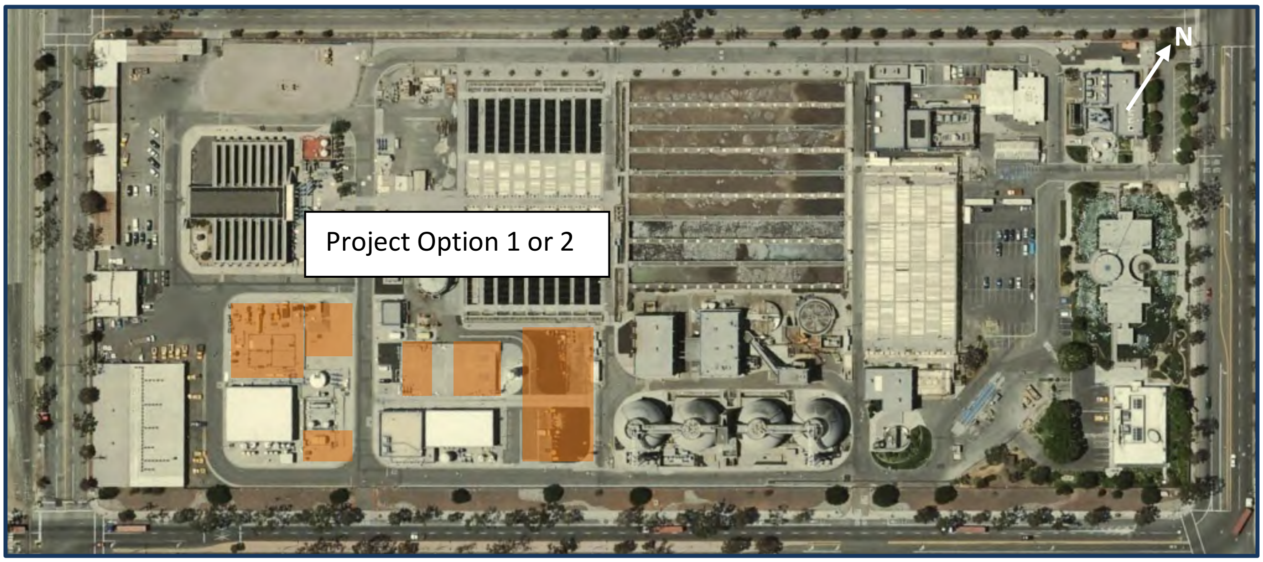
[12] Harbor project concepts were originally included in the Long-Term Concepts Report analysis. They were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report and these projects are no longer included in the discussion of Long-Term Concept Projects. Background research conducted for TIWRP is included in this report for completeness.

[13] The official name of the TIWRP AWPF is the Advanced Water Treatment Facility (AWTF).

membranes (MF), reverse osmosis membranes (RO), and disinfection with sodium hypochlorite. Advanced treated disinfected recycled water from TIWRP is sent to the Dominguez Gap Seawater Intrusion Barrier and Harbor Generating Station, while concentrates and other residuals from the advanced treatment are dechlorinated and then discharged through the Harbor Outfall to San Pedro Bay.

The TIWRP has the potential capacity to produce 12.5 mgd of purified treated recycled water by expanding the influent treatment capacity to 16.2 mgd (Appendix D – *TIWRP Opportunities Final Draft TM*). The two project options include preliminary layouts for facilities with and without 50 percent treatment redundancy, assuming two different scenarios for failsafe discharge of treated effluent as explained below. Proposed facility location is shown in **Figure 3-4**.[14]

Figure 3-4: TIWRP Expansion Sites



The 12.5 mgd purified treated recycled water production estimate is based on the following findings and assumptions:

1. Influent flows at TIWRP will remain relatively constant between 2009 and 2040. Consistent with this assumption, the average annual influent flows at TIWRP are projected to be 16.2 mgd in 2040. Current 2012 flows are less than 16.2 mgd.

2. In-plant uses at TIWRP are non-consumptive (i.e., spray-down water, tank cleaning water, and foam control for the aeration basins) and therefore total consumptive loss is assumed to be negligible. As such, 16.2 mgd would be available for advanced treatment by 2040.

3. Recommended improvements to plant operations will increase the recovery rate to 77 percent, thereby resulting in a purified recycled water production capacity of 12.5 mgd. It should be noted that the plant currently experiences a recovery rate of 71 percent, which would yield a production capacity of 11.5 mgd using an influent flow rate of 16.2 mgd. The existing purified recycled water facilities have a nominal production capacity of 5.0 mgd. The actual production capacity is between 3.8 and 4.0 mgd due to operational issues (See the

[14] Proposed facility locations are shown in Appendix D – *TIWRP Opportunities Final Draft TM* (Figures 2-4 and 3-3).

"TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report" for additional details).

4. Up to 12.5 mgd of recycled water production capacity can be located on-site at TIWRP. Production capacity is limited by influent flows.

5. Purified recycled water will be required to meet regulatory requirements for direct injection to a groundwater aquifer. If also used for specialized industrial uses water quality requirements will also apply. The assumed treatment process involves MF/RO/AOP.

6. Recycled water production capacity will not be limited by concentrate disposal. It is assumed that concentrates and other residuals will be managed using one or more of the following: (1) the existing Harbor outfall, (2) the Los Angeles County Sanitation Districts (LACSD) ocean outfall, (3) a regional concentrate pipeline, or (4) deep well injection using abandoned oil wells on the TIWRP site. Each of these concentrate disposal alternatives has its own unique challenges. The maximum anticipated flow of concentrate and MF residuals would be approximately 3.7 mgd for facilities producing 12.5 mgd of recycled water.

Table 3-4 summarizes the potential recycled water production that could be implemented at TIWRP, assuming different concentrate discharge options and flow equalization.

Table 3-4: TIWRP Summary of Project Options

	Project Option 1	Project Option 2
Description	Continued Use of Harbor Outfall	No discharge to Harbor Outfall
Fail Safe Disposal Method	Harbor Outfall	Recycled Water Users
AWPF Level of Redundancy	Typical	Typical + 50 percent
Concentrate Disposal Option	Harbor Outfall	LACSD outfall, regional concentrate pipeline, or deep well injection
Water Quality Produced	MF/RO/AOP (Purified)	MF/RO/AOP (Purified)
Tertiary Effluent Flow, mgd(1)	16.2	16.2
Total MF/RO Feed Flow Rate, mgd(1)	16.2	16.2
Total Purified RW Production, mgd(2)	12.5	12.5
Total Volume Purified RW Produced, AFY	14,000	14,000
Total Equalization Volume Provided, MG	2	2

Notes:
1. Projected influent flow for 2040 is 16.2 mgd.
2. Current recovery rate is 71 percent but assumed recovery rate with plant improvements is 77 percent.

Additional Analysis on TIWRP

Subsequent to the TIWRP background research effort described above, a more detailed analysis was performed to determine potential expansion improvements that could be made at the plant to maximize reuse in the Harbor area. Harbor project concepts were originally included in the Long-Term Concepts Report analysis, but they were subsequently moved to the TIWRP Barrier

Supplement and Non-Potable Reuse Concepts Report. Background research conducted for TIWRP is included in the Long-Term Concepts Report for completeness.

3.1.4 Donald C. Tillman Water Reclamation Plant

Facilities at DCTWRP are documented in the GWR Master Planning Document, which identified, developed, evaluated, and recommended a GWR project to produce purified recycled water at a new AWPF using water from the DCTWRP for recharge in the San Fernando Basin.

DCTWRP is a tertiary treatment process and includes an NdN treatment step. DCTWRP has the capacity to treat up to 80 mgd, of which approximately 29 mgd is committed to in-plant reuse and nearby lakes and the Los Angeles River. **Table 3-5** summarizes the DCT flows and **Table 3-6** shows the AWPF capacity planning parameters.

Table 3-5: DCTWRP Flows

	Phase 1 (FY 2022)	Phase 2 (FY 2035)
DCTWRP Treatment Capacity	80 mgd	80 mgd
DCTWRP Influent	64 mgd [1,2]	80 mgd [1,3]
DCTWRP Effluent (Nitrified/Denitrified Disinfected RW)	59 mgd [1,2]	73 mgd [1,3]
In-Plant Reuse	2 mgd	2 mgd
Flows to Lakes and LA River [4]	27 mgd	27 mgd
Influent to AWPF [5]	30 mgd [6]	43 mgd

Notes:

1. As noted in Draft DCTWRP Maximum Flow Assessment TM (RMC/CDM, 2009d), the DCTWRP tertiary effluent production capacity is estimated to be approximately 87% of the influent flow rate, based on plant flow data from January 2005 through December 2008. The new cloth media filters, which have fewer losses than the old granular media filters, came on-line in December 2009 so data from December 2009 through August 2011 were analyzed as part of this GWR Master Planning Report. The DCTWRP tertiary effluent production capacity is estimated to be approximately 92% of the influent flow rate. If DCTWRP secondary effluent is used for AWPF influent, a slightly more flow will be available since losses from cloth media filters will be eliminated.
2. Approximate daily total influent and effluent flows, accounting for weekend diurnal curves and existing primary flow equalization capacity.
3. Maximum daily total influent and effluent flows, accounting for weekend diurnal curves and installation of additional primary flow equalization capacity.
4. Assumed minimum flow required to Lakes and LA River, based on 2006 Integrated Resources Plan.
5. For Phase 1 the influent flow rate would be managed to meet the recycled water demands (i.e., in-plant reuse, flows to Lakes and LA River, and influent to AWPF).
6. Some NPR uses may be supplied with tertiary-treated recycled water rather than advanced treated purified water; these uses would take tertiary-treated water upstream from the AWPF and would result in less influent flow to the AWPF.

Table 3-6: DCTWRP AWPF Capacity Phase 2 (FY 2035)

Parameter	Wet Year[2]	Dry Year[3]
AWPF Influent Flow	44.3 mgd	44.3 mgd
AWPF Product Water Capacity [1]	35.0 mgd	35.0 mgd
AWPF Production, Potential [2]	31,000 AFY	35,000 AFY
NPR [4]	5,000 AFY	5,000 AFY
GWR	26,000 AFY	30,000 AFY

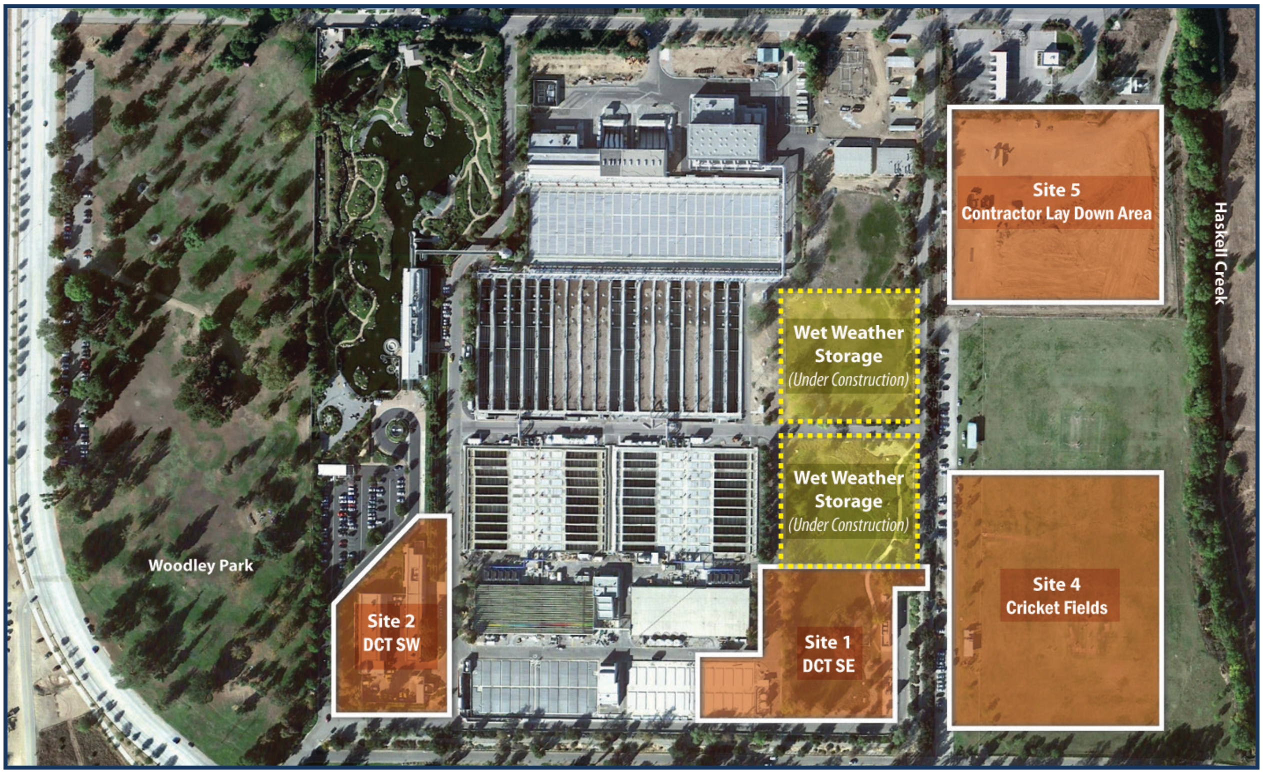
Notes:

1. Assumes overall 79% AWPF recovery (93% MF recovery and 85% RO recovery).
2. Accounts for 92% AWPF online factor, and the maximum number of days HSG (70 days/year) and PSG (30 days/year) are unavailable to receive AWPF product water.
3. Accounts for 92% AWPF online factor, and the assumed minimum number of days HSG (10 days/year) and PSG (5 days/year) are unavailable to receive AWPF product water.
4. Includes existing and planned NPR users only. During wet years, NPR demands would be lower since demands for irrigation water would be lower. Some NPR uses may be supplied with tertiary-treated recycled water.

Five potential sites were examined for the new AWPF: four near DCTWRP and one near Valley Generating Station. After further analysis, the City selected Site 2, DCTWRP Southwest, as the staff-preferred location. Therefore, for the Long-Term Concepts Report, the RWMP team assumed that the AWPF would be located at DCTWRP, within the flood control berm, and in the southwest location. All sites will be evaluated at the same level of detail for environmental impacts as part of environmental documentation. The new AWPF would produce 30,000 AFY of advanced purified recycled water for GWR. Some or all of the 5,000 AFY NPR uses may also receive advanced treated water. This depends on the cost of advanced treatment versus capital improvements for serving both advanced and tertiary recycled water for NPR uses.

Expansions beyond the Phase 2 project would be necessary to provide purified recycled water for long-term project concepts.

Figure 3-5: AWPF Candidate Sites At or near DCTWRP



The AWPF was sized assuming 79 percent overall recovery based on 93 percent MF system recovery and 85 percent RO recovery. These assumptions are explained in Draft Advanced Water Treatment Technology Assessment TM (RMC/CDMa, 2009).

For the Long-Term Concepts Report, it is assumed that expansions beyond Phase 2 would be located at one of the four sites located at or near DCTWRP. Influent flow projections for DCTWRP do not indicate that additional sewage will be available for treatment within the DCTWRP sewershed; however, tertiary recycled water could potentially be pumped from other supply sources (e.g., LAGWRP, TWRF, BWRP) and further treated with advanced water purification (AWP) processes at the AWPF expansion site. Expansion facilities at DCTWRP are assumed to have the same recovery rate and unit costs as the initial 30,000 AFY AWPF.

3.1.5 Metro Satellite

In the Valley and Metro/Westside service areas, a number of potential locations were identified and pre-screened based on zoning and land use to determine the feasibility of locating a satellite treatment plant in that region. Satellite treatment project options are a potential way to reach customers or groundwater recharge opportunities where existing recycled water infrastructure does not reach or to meet demands beyond the existing capacity of the recycled water system.

The Metro area, centered on the Downtown area and east of Los Angeles, had a higher total demand and is located in the proximity of the Los Angeles Forebay (RMC/CDM, 2010c). The Metro area was chosen to site the long-term satellite facility due to its proximity to large available sewer flows and available land to support a full-scale MBR satellite plant. The satellite concepts are considered long-term because of the costs and challenges associated with developing new treatment facilities in urbanized areas of the City.

The Metro area could be served by either raw wastewater or dry weather runoff from the LA River.

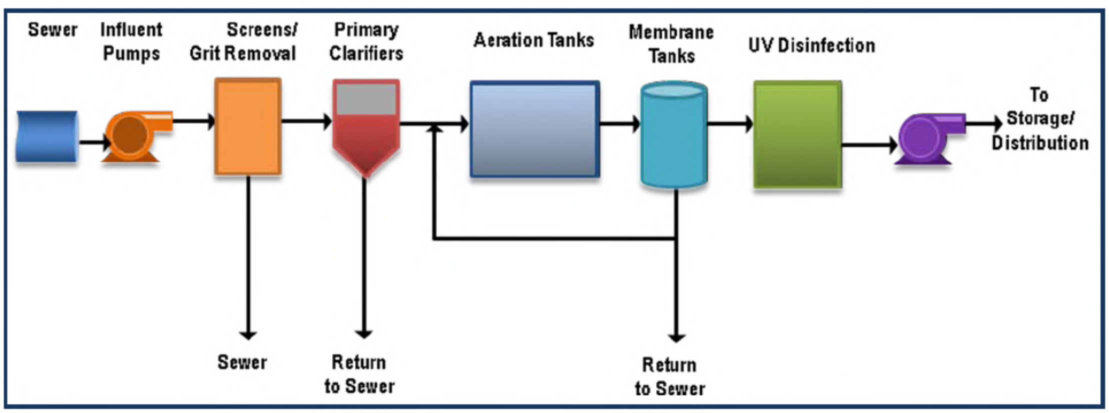
Table 3-7 summarizes the different satellite options that were identified in the Metro area.

Table 3-7: Satellite Flows

	Small Domestic Wastewater	Dry Weather Runoff	Large Domestic Wastewater
Source	Domestic Wastewater	Dry Weather Runoff	Domestic Wastewater
Flow	5.4 mgd (avg); 10.8 mgd (peak)	5.4 mgd (avg); 10.8 mgd (peak)	60.4 mgd (avg); 69 mgd (peak)
Yield	6,000 AFY	6,000 AFY	50,000 AFY
Area	5.1 acres	2.7 acres	54 acres

If raw wastewater is used as the source water for the recycling facility (**Figure 3-6**), the preferred treatment train for a recycling facility serving NPR uses would be an MBR/UV train. The MBR/UV train consists of screening and grit removal at the headworks, followed by primary sedimentation, a membrane bioreactor process, and UV disinfection. The total area needed for this type of facility was determined to be approximately 5.1 acres. RO and AOP facilities were added to this treatment train in the subsequent development of long-term satellite project concepts.

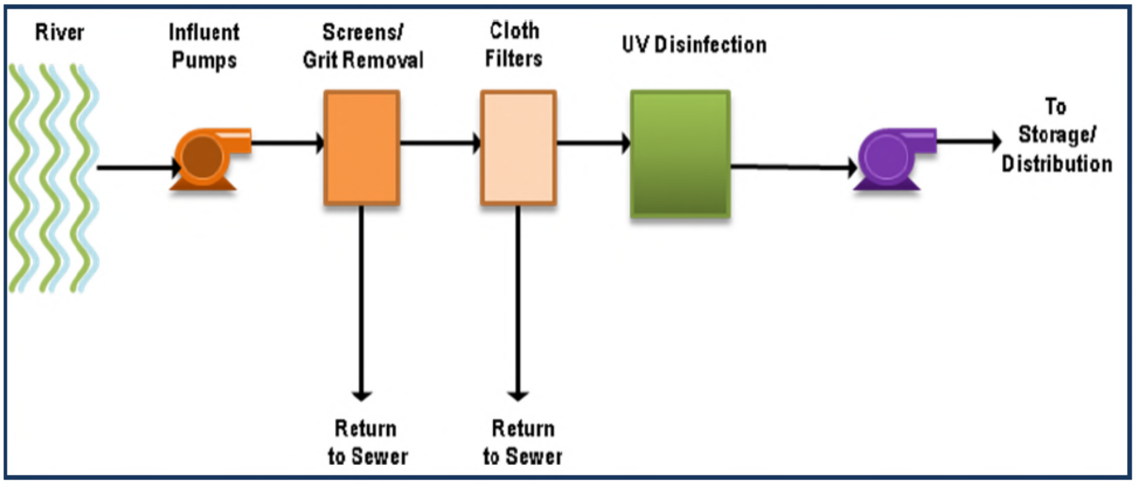
Figure 3-6: Domestic Wastewater Recycling – MBR/UV Treatment Train



Note: RO and AOP facilities were added to this treatment train in the subsequent development of long-term satellite project concepts.

If dry weather runoff was used as the source water for the recycling facility (**Figure 3-7**), the preferred treatment train for a facility serving NPR uses would consist of screening and grit removal at the headworks, followed by filtration with cloth filters, and UV disinfection. The total area needed for this type of facility was determined to be approximately 2.7 acres.

Figure 3-7: Dry Weather Runoff



Preliminary project options for satellite treatment facilities with treatment capacities up to 50,000 AFY were further investigated (RMC/CDM, 2010h). While the yearly production goal is 50,000 AFY, the production levels could vary seasonally.

The 50,000 AFY satellite facility was chosen as a long-term project concept because of its large size and capacity for contributing to the maximizing reuse goal. The 50,000 AFY satellite recycling facility would require a total area of approximately 54 acres.   The 50,000 AFY satellite aims to serve demands for recycled water in the Metro area of the City. Only an outfall sewer would have sufficient flows to provide the source water for this size plant. Information on outfall sewers in the area was collected from TM 5.1.1 Wastewater Collection System. In the Metro area, the East Central Interceptor Sewer (ECIS) is the only outfall sewer with sufficient flows and without maintenance or overloading issues. The ECIS was constructed to relieve pressure on and allow for rehabilitation of the North Outfall Sewer. Treating flow from ECIS will help preserve capacity in the sewer.

Available sites meeting the site identification criteria tend to be to the northeast and southeast of the section of the ECIS between Jefferson & Main and Arlington & Exposition. The average distance between the potential site areas and the sewer was assumed to be 2 miles. Both a force main pipe to supply the influent and a gravity flow pipe to carry the waste flows back to the sewer would be required.

The Metro Satellite project concept involves many challenges. It would require that a large treatment facility be sited in an urbanized area of Los Angeles, and it would require that multiple pipelines and injection wells be sited in the same type of urban environment. It would also require that the project proponents comply with a number of permitting and institutional requirements as detailed in **Appendix J**.

3.1.6 Regional partnerships

Meetings with neighboring agencies were conducted to determine (1) existing and planned recycled water systems; (2) intertie opportunities for supplementing recycled water flows available to LADWP, as well as supplementing adjacent agency/system flows to potentially offset potable water that could be made available to LADWP; and (3) potential opportunities and issues associated with interagency partnerships (Appendix E - *Regional Recycled Water System Final Draft TM*). **Table 3-8** summarizes the relevant potential partnership opportunities for each agency. The current and planned AFY of recycled water reuse are also indicated, as well as whether the agency has identified a supply source.

Table 3-8: Potential Partnerships

Agency	Current RW Reuse (AFY)	Planned RW Reuse (FY)	Identified supply for planned reuse? (Y/N)	Potential Partnerships
BWP	1,975	3,500	Y	• Supply users in LADWP's San Fernando Valley service area with RW from BWRP • Intertie at Griffith Park • Intertie at Equestrian Center • Intertie at Toluca Lake/Lakeside Golf Course Community • Intertie at Woodbury University • Supply RW to PWP from BWRP through GWP distribution system • Supplement LA River flows
CBMWD	5,000	22,000	Y	• Southeast Water Reliability Project (SWRP) intertie to serve LADWP Metro Area users • SWRP intertie to serve CBMWD users in western service area • Connect CBMWD groundwater users to recycled water
LVMWD	6,500	6,500	Y	• LVMWD and LADWP intertie to improve reliability • Supplement LA River flows
PWP	0	7,000	N	• Discuss formation of Regional Recycled Water "working group" • PWP Satellite Plant • Collaborate on planning for water augmentation project in Raymond Basin
WBMWD	35,000	70,000	Y	• Increase recycled water contributions at Dominguez Gap and West Coast Barriers • Collaborate on planning for water augmentation projects in West Coast Basin • Supply recycled water to West Side

3.2 Demands/Reuse Options

Each project concept has a reuse component for the recycled water. This satisfies the long-term objective of maximizing reuse, which can be accomplished with either City or non-City sources. The larger project concepts require GWR to achieve maximum reuse with imported water offset; but some of the smaller project concepts utilize other options. GWR facilities include spreading grounds, injection wells, and/or seawater intrusion barriers. Other options for end use include supply to adjacent agencies outside the City's service area in exchange for access to groundwater or MWD imported potable water supplies.

3.2.1 Central, West Coast and Raymond Basins

The Regional Groundwater Assessment Final Draft TM (Appendix F) summarizes existing and planned groundwater replenishment opportunities, including seawater intrusion barriers, and estimates basin replenishment potential for the following basins:

- West Coast Basin
- Central Basin
- Raymond Basin
- San Gabriel Basin

Information on all the basins is summarized in Appendix F. There are no long-term project concepts being proposed in the San Gabriel Basin.

3.2.2 San Fernando Basin

The GWR Master Planning Report indicates that Hansen Spreading Grounds (HSG) may not support GWR of an additional 30,000 AFY beyond current stormwater recharge operations. The depth of the aquifer near the HSG and the presence of a fault downgradient of HSG (approximately at San Fernando Road) do not allow this volume of water to be transmitted through the aquifer. These hydrogeologic conditions may cause excessive groundwater mounding in the HSG area if GWR flow is increased much above 15,000 AFY. The groundwater mounding also has the potential to adversely impact operations at the nearby Bradley Landfill. Therefore, the use of both the HSG and the Pacoima Spreading Grounds (PSG) is necessary to increase GWR to 30,000 AFY. Due to operational requirements of LACDPW, which include reserving HSG and PSG for storm water, these basins will not be able to recharge the full 30,000 AFY of recycled water in wet years; therefore augmentation with injection wells and potentially Strathern Pit may be necessary.

Further modeling may be needed to assess the maximum GWR potential for HSG, PSG and Tujunga Spreading Grounds (TSG). Modeling was completed for HSG and PSG to demonstrate the ability to meet the GWR target of 30,000 AFY by spreading 15,000 AFY of recycled water each at HSG and PSG in addition to the stormwater recharge (RMC/CDM, 2011a). However, further modeling would be needed to estimate whether greater quantities of recycled water could be recharged. For the purposes of this report, it was assumed the San Fernando Basin (i.e., all spreading basins combined) has the potential for an additional 22,000 AFY of GWR beyond the 30,000 AFY for the AWPF due to supply limitations.

3.2.3 Potential Long-Term Recharge Options

Table 3-9 shows the groundwater recharge basins within and adjacent to the City's service areas. This table indicates both the recharge capacity (i.e., theoretical amount) and the recharge potential (i.e., feasible amount considering supply and other constraints).

Table 3-9: Potential Long-Term Recharge Options

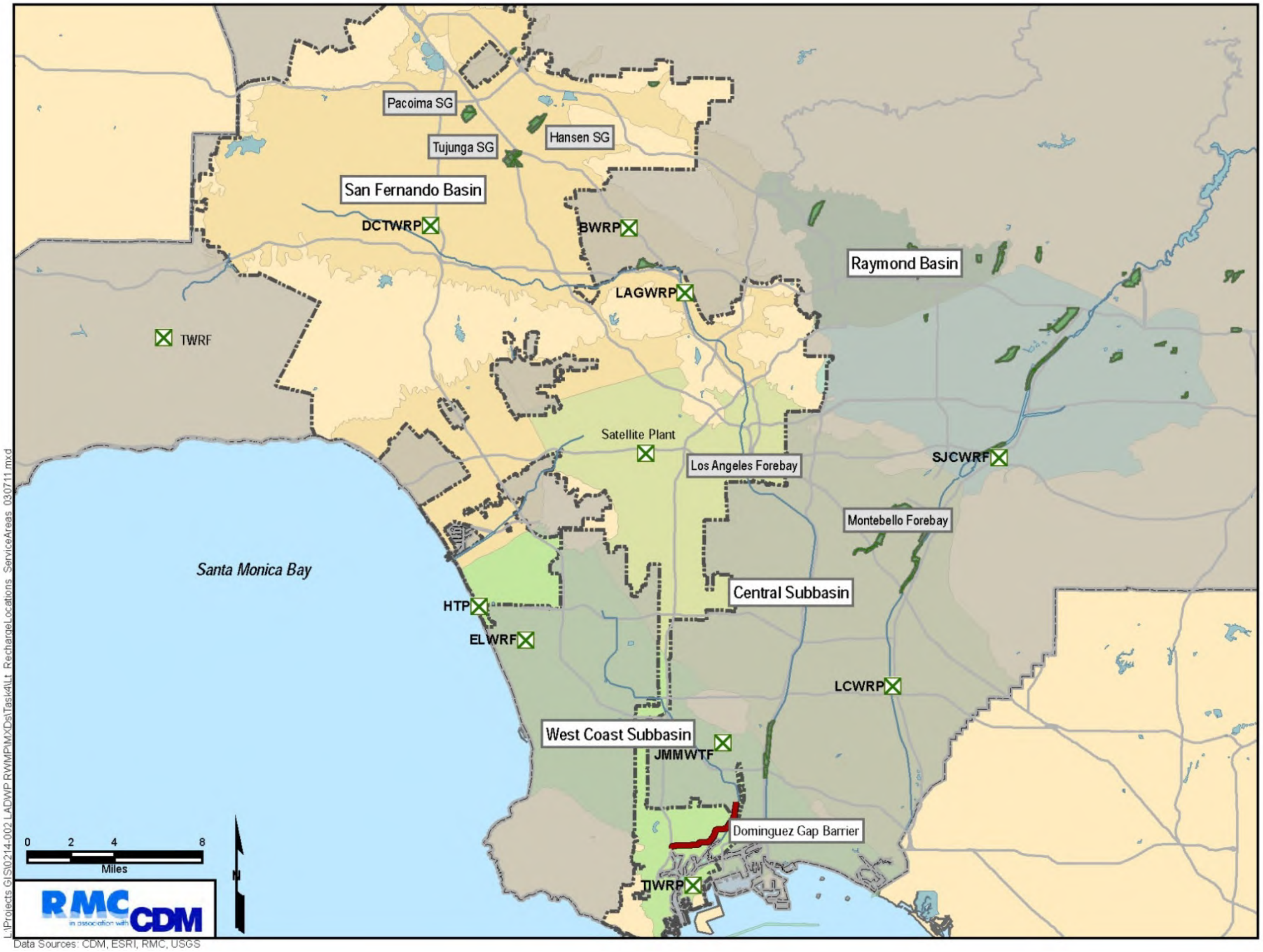
Basin	Type of Recharge	Recharge Capacity	Recharge Potential	TM References
Central				
Los Angeles Forebay	Injection	40,000 AFY	40,000 AFY	Appendix F
Montebello Forebay	Surface/Injection	37,000 AFY	25,000 AFY	
San Fernando				
Tujunga SG	Surface	28,500 AFY[1,2]	52,000 AFY[5]	Developed from RMC/CDM, 2011c (GWR Evaluation)
Pacoima SG		39,300 AFY[3]		
Hansen SG		20,000 AFY[4]		
Raymond	Surface/Injection	5,000-10,000 AFY	*5,000-10,000 AFY*[6]	Appendix F
West Coast	Injection	50,000 AFY	50,000 AFY	Appendix F
Total		**224,800 AFY**	**167,000 AFY**[6]	Appendix F

Notes:

1. Based on potential maximum capacity minus 7,600 AFY of average annual stormwater infiltration.
2. Not currently possible under 2008 Draft regulations. However, proposed November 2011 Draft Regulations may provide future opportunities to recharge recycled water at the TSG. Use of TSG is being included as a possibility for long-term planning purposes after 2035.
3. Based on potential maximum capacity minus 7,800 AFY of average annual stormwater infiltration.
4. Based on potential maximum capacity minus 16,000 AFY of average annual stormwater infiltration and hydrogeologic constraints to limit mounding.
5. The RWMP GWR Evaluation indicates a recharge capacity of 87,800 AFY; however, the recharge potential is supply-limited because only 30,000 AFY are available from DCTWRP and only 22,000 AFY are available from LAGWRP (for a total of 52,000 AFY).
6. It would be possible to substitute project concepts in the Raymond Basin for project concepts in the San Fernando Basin. The total value for recharge potential does not include the Raymond Basin because these projects would be mutually exclusive with projects in the San Fernando Basin.

All identified groundwater recharge opportunities are shown in **Figure 3-8**.

Figure 3-8: Reuse Option Locations



3.3 General Assumptions

Many assumptions are used in the development of the project concepts. **Table 3-10** summarizes the assumptions that are used in the supporting TMs. Specific assumptions for each project concept are described in Section 4.2.

Table 3-10: General Assumptions

Element	Description	Assumed Value(s)
Tertiary Treatment Facilities		
LAGWRP		
Expansion Option 1	Total Nitrified/Denitrified Disinfected Tertiary RW Production	27 mgd (30,000 AFY)
	Additional Influent Capacity	12 mgd
	Additional Production Capacity	7 mgd
	2040 projected flows are within current LAGWRP sewershed.	
Expansion Option 2	Total Nitrified/Denitrified Disinfected Tertiary RW Production	40 mgd (45,000 AFY)
	Additional Influent Capacity	28 mgd
	Additional Production Capacity	20 mgd
	Upstream flows from VSL/FA sewershed are diverted to LAGWRP	
	Additional LAGWRP assumptions are located in Section 3.1.1	
Advanced Water Purification Facilities		
DCTWRP		
Expansion at DCTWRP	Purified RW Production	26.8 mgd (30,000 AFY)
	MF/RO Recovery Rate	78 percent
HTP		
Expansion Phase 1	Purified RW Production	50 mgd (56,000 AFY)
Expansion Phase 2	Purified RW Production (Cumulative)	21 mgd (23,500 AFY)
Expansion Phase 3	Purified RW Production (Cumulative)	57 mgd (63,900 AFY)
Expansion Phase 4	Purified RW Production (Cumulative)	32 mgd (35,800 AFY)
	MF/RO Recovery Rate	71 percent
	Influent flows at HTP (301 mgd) will remain relatively constant between 2009 and 2040.	
	Up to 70 mgd of secondary effluent flow will be delivered at a constant rate to WBMWD.	
	Additional HTP assumptions are located in Section 3.1.2	

Element	Description	Assumed Value(s)
TIWRP		
Expansion Option 1	Purified RW Production	12.5 mgd (14,000 AFY)
Expansion Option 2	Purified RW Production (with 50 percent redundancy)	12.5 mgd (14,000 AFY)
	MF/RO Recovery Rate	77 percent
	Influent flows at TIWRP (16.2 mgd) will remain relatively constant between 2009 and 2040.	
	Production capacity is limited by influent flows, not by concentrate disposal.	
	Additional TIWRP assumptions are located in Section 3.1.3	
Metro Satellite		
	Purified RW Production	45 mgd (50,000 AFY)
	Land Needed	54 acres
	MF/RO Recovery Rate	78 percent
	Additional Satellite assumptions are located in Section 2.2.2	
Conveyance Facilities		
	Trenched Pipelines	6-inch to 60-inch
	Velocity for Sizing Trenched Pipelines	5 feet per second
	Tunneled Pipelines	96-inch diameter and greater
	Velocity for Sizing Tunneled Pipelines	3 feet per second
	Peaking Factor	2 for LAGWRP, LVMWD, BWP flows
Pump Station		
	Head Loss	1 foot for every 1,000 feet
	Pumping Efficiency	0.75
	Land space PS off-site (50,000 AFY or greater)	0.5 acres
	Product Water PS located at WRP	
	Distribution Water PS located at Production Wells	
Groundwater Recharge		
	Capacity of Injection Wells	1,600 AFY/well
	Capacity of Spreading Grounds	365 AFY/acre
	Land space for wells For each well, 100 ft by 50 ft is needed	0.115 acres/well
	Well Redundancy	10 percent (additional capacity)
	Land Purchase needed for injection wells	

Element	Description	Assumed Value(s)
Production		
	Capacity of Production Wells	1,600 AFY/well
	Land space for wells For each well, 100 ft by 50 ft is needed	0.115 acres/well
	Well Redundancy	10 percent (additional capacity)
	Land Purchase needed for production wells	0.115 acre/well
Distribution		
	Pipe Capacity (from production well capacity)	1,600 AFY per pipe
	Lateral Pipeline Length to point of connection	1,000 feet/well

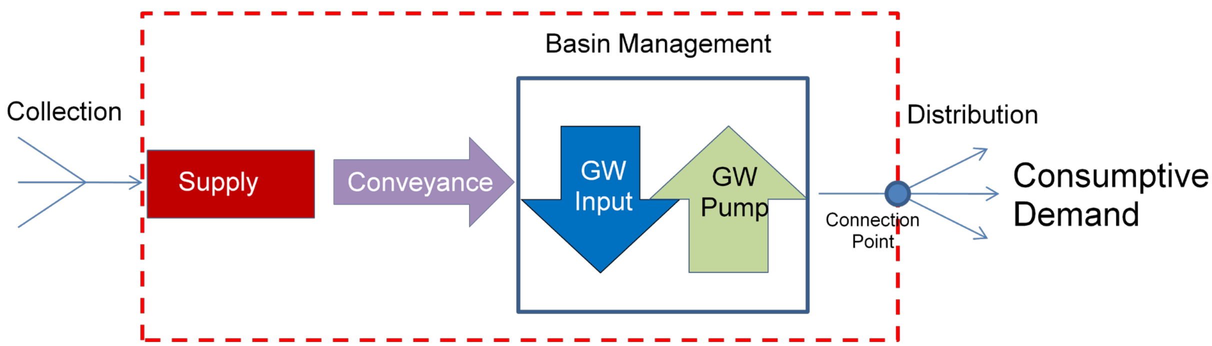
4. Development of Long-Term Project Concepts

This section defines and describes the long-term project concepts.

4.1 Project Concept Development Approach

Each long-term project concept was developed separately and does not depend on another project concept. Some involve components that are mutually exclusive. Each project concept consists of one supply (either owned by the City of Los Angeles or another regional agency), a conveyance pipeline, a GWR facility, a GW extraction facility, and a conveyance pipeline to an LADWP distribution system connection point as shown in **Figure 4-1**. All the project components inside the red dotted line are included in each project concept. To satisfy the long-term objective of reducing reliance on imported water, each project concept begins at the collection system and ends at a connection point to DWP's potable distribution system.

Figure 4-1: Project Concept Development



4.2 Project Concepts

A total of ten project concepts were developed and analyzed throughout the Valley and Metro/Westside. More detailed descriptions of each project concept are included in the following sections. For conceptual design criteria, see **Table 4-1**. For a summary of regulatory and institutional considerations, see **Appendix J**.

4.2.1 Harbor Service Area

Harbor project concepts were originally included in the Long-Term Concepts Report analysis, but they were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report. Some of the projects identified in the TIWRP report support LADWP's goal to increase reuse to 59,000 AFY by 2035 and some of the projects support BOS and BOE goal to maximize reuse from TIWRP.

Background research conducted for TIWRP is included in the Long-Term Concepts Report for completeness.

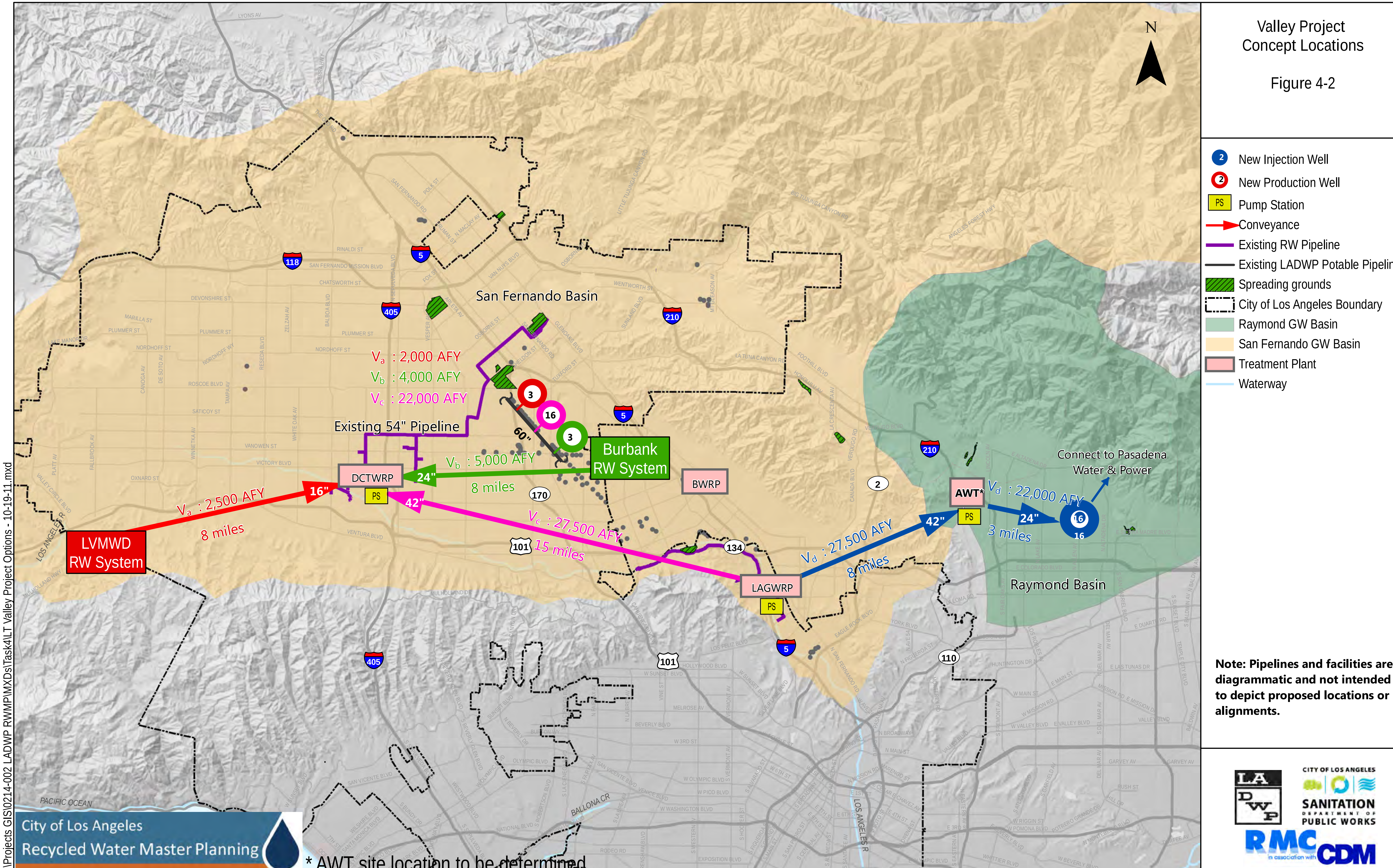
4.2.2 Valley Service Area

In the Valley, four project concepts were developed (**Figure 4-2**). The project concepts utilize nitrified disinfected tertiary-treated recycled water supplies from LVMWD, BWP, or LAGWRP, and treat to purified recycled water quality at either DCTWRP or newly-constructed Pasadena Water and Power facilities. Each project concept also includes conveyance, GWR, recovery via production wells, and connection back to a potable distribution system.

Assumptions for Valley Project Concepts:

The project concepts are based on the following assumptions:

- AWPF/GWR project to treat and recharge 30,000 AFY is already permitted, constructed, and operating at DCTWRP, HSG and PSG.
- The existing 54-inch pipeline from DCTWRP to HSG has sufficient remaining capacity for additional flows up to 23,500 AFY:
  - Assuming a velocity of 5 feet per second (fps), the total capacity in the existing 54-inch pipeline is approximately 57,500 AFY. This analysis assumes that purified recycled water facilities will be constructed at DCTWRP to produce 30,000 AFY of advanced treated water that will subsequently be pumped through the 54-inch pipeline to HSG. The 54-inch pipeline could also supply up to approximately 4,000 AFY of purified recycled water to existing and near-term NPR customers served directly from the pipeline. Therefore, there would be approximately 23,500 AFY of capacity available in the pipeline at 5 fps.
  - For pipe diameter sizing, a velocity of 5 fps was assumed. However, flows up to a maximum of 8 fps are acceptable. During peak flows in the winter period, flows may reach a velocity of 5.8 fps if multiple projects are implemented. Therefore, the existing 54-inch pipeline will have capacity for up to 67,000 AFY (30,300 AFY in the near term and 36,700 AFY in the long-term) during peak flow periods at 5.8 fps.
- Each project will include new production wells and other supporting infrastructure to recover recharged water and make it available to the potable water supply distribution system. It is assumed that existing wells are not sufficient for additional production capacity.



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Data Sources: USGS, LADWP, ESRI

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- The existing HSG, PSG, and TSG have sufficient percolation capacity for Valley project concepts; and potential impacts to water table elevations at well fields, landfills, ongoing remediation projects, and spreading grounds can be mitigated with proper production well placement and other groundwater management practices.
- Flows from other WRPs are available over a six month period only:
    - Available flows from LVMWD, BWP and LAGWRP occur generally over a 6-month period in winter. During this time, irrigation demands are lowest and therefore more flow is available for AWP and GWR. For projects using these supplies, a peak factor of 2 is used to determine facilities sizing and capacities.
- Diluent water will not be required for long-term concept projects that include GWR. It is assumed that previous GWR projects will have already demonstrated the acceptability of recharge with a 100 percent recycled water contribution (RWC).
- An imported water offset or transfer can be arranged between Pasadena Water and Power (PWP) and LADWP. GWR followed by extraction of potable water from the Raymond Basin would constitute PWP's supply, while LADWP would gain access to Pasadena's MWD imported water supply in exchange.

Project Concept Va: LVMWD to DCTWRP to San Fernando Basin

Project concept Va uses tertiary treated recycled water from LVMWD and provides advanced treatment at newly constructed DCTWRP facilities, combined with recharge at existing spreading grounds and subsequent recovery via production wells. The project, as conceived, would produce and reuse 2,000 AFY of recycled water.

Recycled water supply from LVMWD would primarily be available over a six month period during the winter season when irrigation demands within the LVMWD service area are low. It is assumed there would be sufficient pressure at the LVMWD connection to convey flows to DCTWRP. Purified recycled water facilities at DCTWRP would be expanded to treat the additional tertiary water, and the existing pump station would be expanded to pump advanced-treated water through the existing 54-inch pipeline to HSG, TSG, and PSG. The project concept also includes new production wells east of the 170 Freeway, along with laterals from the wells connecting to the existing potable distribution system, a 60 inch potable pipeline located west of the production wells and east of the 170 Freeway.

Project Concept Vb: BWP to DCTWRP to San Fernando Basin

Project concept Vb uses tertiary treated recycled water from BWP and provides advanced treatment at newly constructed DCTWRP facilities, combined with recharge at existing spreading grounds and subsequent recovery via production wells. The project, as conceived, would produce and reuse 5,000 AFY of recycled water.

Recycled water supply from BWP would primarily be available over a six month period during the winter season when recycled water demands within the BWP service area are low. It is assumed there would be sufficient pressure at the BWP connection to convey flows to DCTWRP. Purified recycled water facilities at DCTWRP would be expanded to treat the additional tertiary water, and the existing pump station would be expanded to pump advanced-treated water through the existing 54-inch pipeline to HSG, TSG, and PSG. The project concept also includes new production wells near the existing 60-inch potable pipeline west of the 170 Freeway, along with laterals from the wells connecting to the existing potable distribution system, a 60 inch potable pipeline located west of the production wells and east of the 170 Freeway.

Project Concept Vc: LAGWRP to DCTWRP to San Fernando Basin

Project concept Vc uses tertiary treated recycled water from LAGWRP and provides advanced treatment at newly-constructed DCTWRP facilities, combined with recharge at existing spreading grounds and subsequent recovery via production wells. The project would produce and reuse 22,000 AFY of recycled water.

Recycled water supply from LAGWRP expanded facilities would primarily be available year round; flows from existing facilities would be available over a six month period during the winter season when existing recycled water demands within the LAGWRP service area are low. A pipeline for peak flows would be constructed from LAGWRP to DCTWRP. Purified recycled water facilities at DCTWRP would be expanded to treat the additional tertiary water, and the existing pump station would be expanded to pump advanced-treated water through the existing 54-inch pipeline to HSG, TSG, and PSG. The project concept also includes new production wells near the existing 60-inch potable pipeline west of the 170 Freeway, along with laterals from the wells connecting to the existing potable distribution system, a 60 inch potable pipeline located west of the production wells and east of the 170 Freeway.

Project Concept Vd: LAGWRP to DCTWRP to Raymond Basin

Project concept Vd uses tertiary treated recycled water from LAGWRP and provides advanced treatment at a new AWPF site in Pasadena, followed by GWR in the Raymond Basin. The project, as conceived, would produce and reuse 22,000 AFY of recycled water. Recycled water supply from LAGWRP expanded facilities would primarily be available year round; flows from existing facilities would be available over six month period during the winter season when existing recycled water demands within the LAGWRP service area are low. A pipeline with the capacity for peak flows would be constructed from LAGWRP to the Pasadena AWPF site. The location for the Pasadena Water and Power (PWP) AWPF has not been determined. A new pump station, pipeline and injection wells would be constructed in addition to the AWPF. The project concept also includes new production wells and laterals connecting to the PWP's existing potable distribution system. Potable water would be supplied to PWP and an exchange or transfer of MWD imported water supply would be provided to LADWP.

Project concept Vd involves many challenges. It would require that a pipeline be constructed across multiple city boundaries and would also require that the project proponents comply with a number of permitting and institutional requirements as detailed in **Appendix J**.

Table 4-1: Valley Project Concepts Sizing and Facilities Information

Description	Va	Vb	Vc	Vd
Treatment Facilities				
Source of Supply	LVMWD	BWP	LAGWRP	LAGWRP
Type of Recycled Water Produced	Nitrified/Denitrified Disinfected Tertiary	Nitrified/Denitrified Disinfected Tertiary	Nitrified/Denitrified Disinfected Tertiary	Nitrified/Denitrified Disinfected Tertiary
Avg Flow (afy)	2,500	5,000	27,500	27,500
Peak Flow (afy)	5,000	10,000	32,500	32,500
AWPF Site	DCTWRP	DCTWRP	DCTWRP	Pasadena
Avg AWP Flow (afy)	2,000	4,000	22,000	22,000
Peak AWP Flow (afy)	4,000	8,000	25,000	25,000
Conveyance Facilities				
From supply to AWPF				
Diameter (inches)	16	24	42	42
Length (miles/feet)	8 (42,240)	8 (42,240)	15 (79,200)	8 (42,240)
From AWPF to GWR				
Diameter (inches)	--[1]	--[1]	--[1]	24
Length (miles/feet)	--[1]	--[1]	--[1]	3 (15,840)
Pump Station				
At Supply Source				
Peak Hour Flow Rate (gpm)	--[2]	--[2]	20,150	20,150
Peak Flow TDH (ft)	--[2]	--[2]	390	530
At AWPF Site				
Peak Hour Flow Rate (gpm)	2,480	4,960	15,500	15,500
Peak Flow TDH (ft)	350	350	350	120
GWR				
GWR Type (wells/SG)	HSG & PSG	HSG & PSG	HSG & PSG	Inj Wells
No. Injection Wells	--[3]	--[3]	--[3]	18

Description	Va	Vb	Vc	Vd
Land Purchase (acres)	--[3]	--[3]	--[3]	2.1
Production Wells				
No. Production Wells	2	3	16	16
Land Purchase (acres)	0.2	0.3	1.8	1.8
Distribution				
Laterals				
Diameter (inches)	10	10	10	10
Length (miles/feet)	0.4 (2,000)	0.5 (3,000)	3.0 (16,000)	3.0 (16,000)

Notes:

1. The existing 54-inch pipeline from DCTWRP to HSG, TSG, and PSG has sufficient remaining capacity.
2. Assumed sufficient pressure at the LVMWD and BWP connection to convey flows to DCTWRP.
3. HSG and PSG are owned and operated by LADWP and do not require additional land purchase.
4. Costs for these facilities may be found in the Long-Term Project Concepts Costs Details (**Appendix H**).

4.2.3 Metro/Westside Service Area

In the Metro/Westside, six project concepts were developed (**Figure 4-3**). The project concepts utilize purified recycled water produced at HTP, WBMWD or at a newly constructed Satellite Plant along with GWR in the West Coast Basin and Central Basin. Each project concept also includes conveyance, recovery via production wells, and connection back to a potable distribution system.

Assumptions for Metro/Westside Project Concepts:

The project concepts are based on the following assumptions:

- West Coast Basin and Central Basin have sufficient capacity to accept flows from water augmentation projects.
- Rio Hondo Spreading Grounds has sufficient percolation capacity. Based on MWD's Groundwater Assessment Study (MWD, 2007), the available percolation capacity of the Rio Hondo Spreading Grounds is approximately 290,000 AFY. It is assumed that 100,000 AFY of capacity would be available for recharge projects implemented by LADWP and other project partners if groundwater pumping is conducted in such a manner as to manage the resulting groundwater mound. Further investigation into the percolation capacity will be required.
- Each project will include new production facilities to recover recharged water and convey it to the potable water supply distribution system.
- Large-scale Metro/Westside injection well project concepts (above 50,000 AFY) will depend on new production well fields to increase the GWR potential in the Central Basin beyond the capacities developed in the 4.1.3 TM. It will be necessary to verify this assumption with hydrogeological field testing, groundwater modeling, and pilot testing. Project yields which are greater than basin recharge potentials are possible only if these "recharge and recovery" type projects are implemented.
- The HTP treatment upgrades consist of EQ, MF, RO, AOP and a post-stabilization step intended to raise the pH of the recycled water product water to within acceptable limits. This process will meet the regulatory requirements for direct injection to a groundwater aquifer. The facilities would be constructed in a four phase approach for a total recycled water production capacity of 160 mgd. The EQ allows the MF/RO/AOP facility to continue producing recycled water at full capacity during the nighttime hours, when the drop in diurnal flow, combined with the outflow of secondary effluent to WBMWD, decreases the instantaneous supply of secondary effluent available. EQ also improves the process performance of the membranes by avoiding steep flow turndowns through the MF/RO/AOP facility and preventing the need to take individual membrane trains out of service on a frequent basis.
- The satellite treatment consists of MBR, AWT, EQ, land purchase, influent pump station and brine line. The location of the satellite plant has not yet been determined but will be near downtown Los Angeles. Per the Draft Long-Term Satellite Concept Report, available sites meeting the site identification criteria tended to be to the northeast and southeast of the section of the East Central Interceptor Sewer between Jefferson & Main and Arlington & Exposition (RMC/CDM, 2011x).

- Available secondary flows from HTP include diversion of 70 mgd of secondary effluent to WBMWD. WBMWD's 2009 CIP Master Plan for Recycled Water Systems indicates that WBMWD is considering a long-range planning option to take up to 73.4 mgd (82,275 AFY) of secondary effluent from HTP by 2035; however the Master Plan also mentions other supply options (WBMWD, 2009). This TM assumes that 70 mgd is the sustained delivery rate of HTP secondary effluent to WBMWD. This is a simplification for planning purposes and is consistent with the assumption that the project phases could be implemented at any time up through 2040.
- Approximately 10,000 AFY could be purchased from WBMWD to implement a recharge project. This is based on WBMWD's 2009 RWMP and assumes that this approximate amount could be made available for a joint project based on the agency's plans to serve up to 70,000 AFY of recycled water to customers by 2020 and to potentially expand beyond this volume in subsequent years (WBMWD, 2009).
- Approximately 6,500 AFY could be purchased from CBMWD to implement a recharge project. This is based on the contracted flow amounts that CBMWD has with LACSD from the SJCWRP and LCWRP (approximately 23,000 AFY) versus the anticipated demands on the CBMWD system in the next few years (approximately 11,000 AFY). This available amount of recycled water could be reduced if other projects are implemented, such as the Groundwater Reliability Improvement Program.

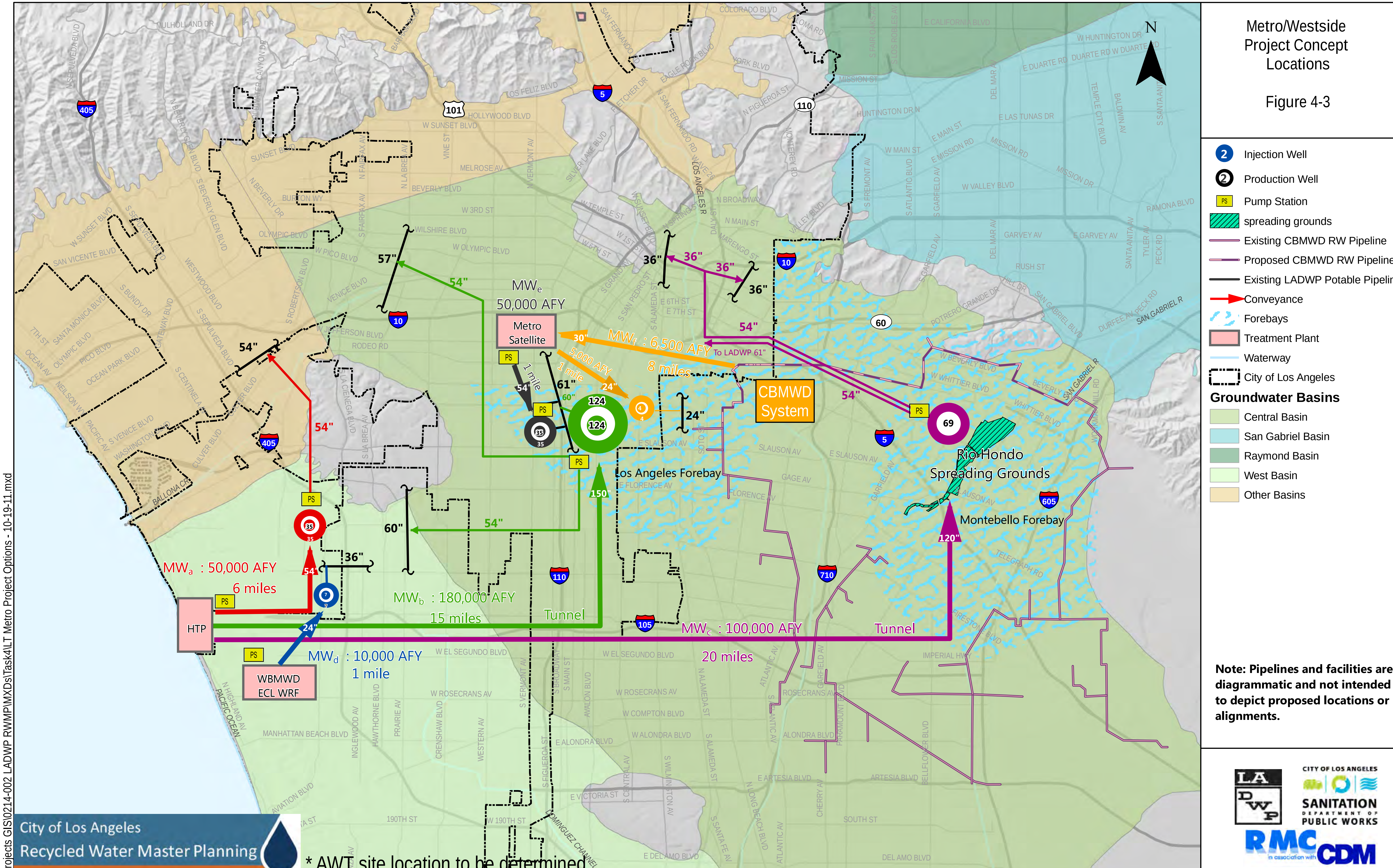
Project Concept MWa: HTP to WCB Wells

Project concept MWa consists of newly constructed advanced treatment facilities at HTP, combined with recharge in the West Coast Basin and subsequent recovery via production wells. The project would produce and reuse 50,000 AFY of recycled water. Secondary effluent feed flows from HTP would be available continuously during the year. Advanced treatment facilities, a pump station and a new pipeline from HTP would be constructed to provide recycled water for injection into the West Coast Basin. The project concept also includes new production wells west of the 405 Freeway and south of the 91 Freeway, along with laterals from the wells connecting to the existing potable distribution system further north. One potential connection point on the existing potable distribution system was identified.

Project Concept MWb: HTP to CB Wells (Los Angeles Forebay)

Project concept MWb consists of newly constructed advanced treatment facilities at HTP, combined with recharge in the Central Basin (Los Angeles Forebay) and subsequent recovery via production wells. The project would produce and reuse 180,000 AFY of recycled water.[15] Secondary effluent feed flows from HTP would be available continuously during the year. Advanced treatment facilities, a pump station and a tunnel from HTP would be constructed to provide recycled water for injection into the Central Basin. The project concept also includes new production wells east of the 110 Freeway and south of the 5 Freeway, along with laterals from the wells connecting to the existing potable distribution system. Due to the large production flows, three potential connection points on the existing potable distribution system were identified.

[15] A purified recycled water production capacity of 180,000 AFY at HTP relies on the assumption that no sewer flows are diverted to LAGWRP (for project concept Vc or Vd) and reused upstream in the HTP sewershed. If flows are diverted upstream, the production capacity at HTP would be reduced to168,000 AFY of purified recycled water.



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Data Sources: USGS, LADWP, ESRI

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Project Concept MWc: HTP to CB Spreading Grounds (Rio Hondo Spreading Grounds in Montebello Forebay)

Project concept MWc consists of newly constructed advanced treatment facilities at HTP, combined with recharge using existing capacity in the Rio Hondo Spreading Grounds and subsequent recovery via production wells. The project would produce and reuse 100,000 AFY of recycled water. Secondary effluent feed flows from HTP would be available continuously during the year. Advanced treatment facilities, a pump station and a tunnel from HTP would be constructed to provide recycled water for GWR at the existing Rio Hondo Spreading Grounds in Central Basin. The project concept also includes new production wells east of the 5 Freeway and south of the 60 Freeway, along with laterals from the wells connecting to the existing potable distribution system further northwest. Due to the large production flows, three potential connection points on the existing potable distribution system were identified.

Project Concept MWd: WBMWD to WCB Wells

Project concept MWd consists of newly constructed advanced treatment facilities at WBMWD ECL WRF, combined with recharge in the West Coast Basin and subsequent recovery via production wells. The project, as conceived, would produce and reuse 10,000 AFY of recycled water.

WBMWD ECL WRF receives secondary effluent flows from HTP continuously during the year. Advanced treatment facilities, a pump station and a pipeline from WBMWD ECL WRF would be constructed to provide recycled water for injection into the West Coast Basin. The project concept also includes production wells west of the 405 Freeway and north of the 105 Freeway, along with laterals from the wells connecting to the existing potable distribution system further north. One potential connection point on the existing potable distribution system was identified.

Project Concept MWe: Metro Satellite to CB Wells

Project concept MWe consists of a newly constructed advanced treatment satellite plant, near downtown Los Angeles, combined with recharge in the Central Basin and subsequent recovery via production wells. The project would produce and reuse 50,000 AFY of recycled water. The new satellite plant will divert flows from an existing City trunk sewer in the Metro area and produce recycled water throughout the year. Advanced treatment facilities, a pump station and a pipeline from the satellite plant would be constructed to provide recycled water for injection in the Central Basin. The project concept also includes new production wells west of the 110 Freeway and south of the 10 Freeway, along with laterals from the wells connecting to the existing potable distribution system further east. One potential connection point on the existing potable distribution system was identified.

Project Concept MWf: CBMWD to AWP to CB Wells

Project concept MWf uses tertiary treated recycled water from CBMWD and provides advanced treatment at a newly constructed satellite plant near downtown Los Angeles, combined with recharge in the Central Basin and subsequent recovery via production wells. The project, as conceived, would produce and reuse 6,500 AFY of recycled water.

Recycled water supply from CBMWD would be available year-round. It is assumed there would be sufficient pressure at the CBMWD connection point to convey flows to the AWP satellite plant.

Advanced treatment facilities, a pump station and a pipeline from the satellite plant would be constructed to provide recycled water for injection into the Central Basin. The project concept also includes new production wells east of the 110 Freeway and south of the 10 Freeway, along with laterals from the wells connecting to the existing potable distribution system further east. One potential connection point on the existing potable distribution system was identified.

Table 4-2: Metro/Westside Project Concepts Sizing and Facilities Information

Description	MWa	MWb	MWc	MWd	MWe	MWf
Treatment Facilities						
Source of Supply	HTP	HTP	HTP	WBMWD distribution	New satellite WRP	CBMWD distribution
Quality of Recycled Water Produced	Purified	Purified	Purified	Purified	Purified	Purified
Avg Feed Flow (afy)	--	--	--	10,000	61,000	6,500
AWP Site	HTP	HTP	HTP	WBMWD ECL WRP	MBR/RO/AOP Satellite Plant	MBR/RO/AOP Satellite Plant
Avg AWP Flow (afy)	50,000	180,000	100,000	--	50,000	5,000
Peak AWP Flow (afy)	50,000	180,000	100,000	--	50,000	10,000
Conveyance Facilities						
From tertiary supply to AWT						
Diameter (inches)	--	--	--	--	--	30
Length (miles/feet)	--	--	--	--	--	8 (42,240)
From AWP to GWR						
Pipeline Type	Trenched	Tunneled	Tunneled	Trenched	Trenched	Trenched
Diameter (inches)	54	150	120	24	54	24
Length (miles/feet)	6 (31,680)	15 (79,200)	20 (105,600)	1 (5,280)	3 (15,840)	1 (5,280)
Pump Station						
At AWP Site						
Peak Hour Flow Rate (gpm)	31,000	111,590	62,000	6,200	30,998	6,200
Peak Flow TDH (ft)	80	230	230	10	0	10
At Production Well Site						
Peak Hour Flow Rate (gpm)	31,000	111,590	62,000	--	30,998	--
Peak Flow TDH (ft)	770	550	500	--	770	--
Land Purchase (ft)	0.5	0.5	0.5	--	0.5	--
GWR						
GWR Type	Inj Wells	Inj Wells	Ex. S.G.	Inj Wells	Inj Wells	Inj Wells
No. Injection Wells	35	124	--	7	35	7
Land Purchase (acres)	4.0	14.3	--	0.8	4.0	0.8

Description	MWa	MWb	MWc	MWd	MWe	MWf
Production Wells						
No. Production Wells	35	124	69	7	35	4
Land Purchase (acres)	4.0	14.3	7.9	0.8	4.0	0.5
Distribution						
Laterals						
Diameter (inches)	10	10	10	10	10	10
Length (miles/feet)	6.6 (35,000)	23.5 (124,000)	13.1 (69,000)	1.3 (7,000)	6.6 (35,000)	0.8 (4,000)
Trunk						
Diameter (inches)	54	54, 60	36, 54	--[2]	54	-[2]-
Length (miles/feet)	4 (21,000)	9 (47, 500), 1 (5,300)	2 (10,560), 21 (110,880)	--	1.0 (5,280)	--
Greenhouse Emissions						
CO2e Emissions (metric ton/yr)	-36,100	-143,700	-76,000	-10,700	-11,300	-5,100
Annual Yield (AFY)	50,000	180,000	100,000	10,000	50,000	5,000
CO2e Emissions (metric ton/AF)	-0.722	-0.798	-0.798	-1.070	-0.226	-1.020

Notes:

1. Assumed sufficient pressure at the CBMWD connection to convey flows to Metro Satellite.
2. MWd and MWf do not include distribution trunk lines because the production wells are located close to existing potable distribution lines.
3. Costs for these facilities may be found in the Long-Term Project Concepts Costs Details (**Appendix H**).

5. Evaluation of Long-Term Concepts

A detailed evaluation process was developed to enable the comparison of multiple project concepts using multiple criteria. This section outlines the overall approach for the analysis starting with a review of the RWMP objectives that guide the evaluation process. This section also describes the framework used for the detailed evaluation, including the decision model process.

5.1 Recycled Water Master Planning Objectives

Six overall objectives and two threshold objectives were established for the RWMP at the beginning of the planning process. These objectives support the goals of the RWMP and establish criteria by which project concepts can be compared. The NPR supply evaluation and the near-term Integrated Alternatives Analysis (IAA) evaluation use these same objectives, but with some variations in weighting, evaluation criteria and performance measures.

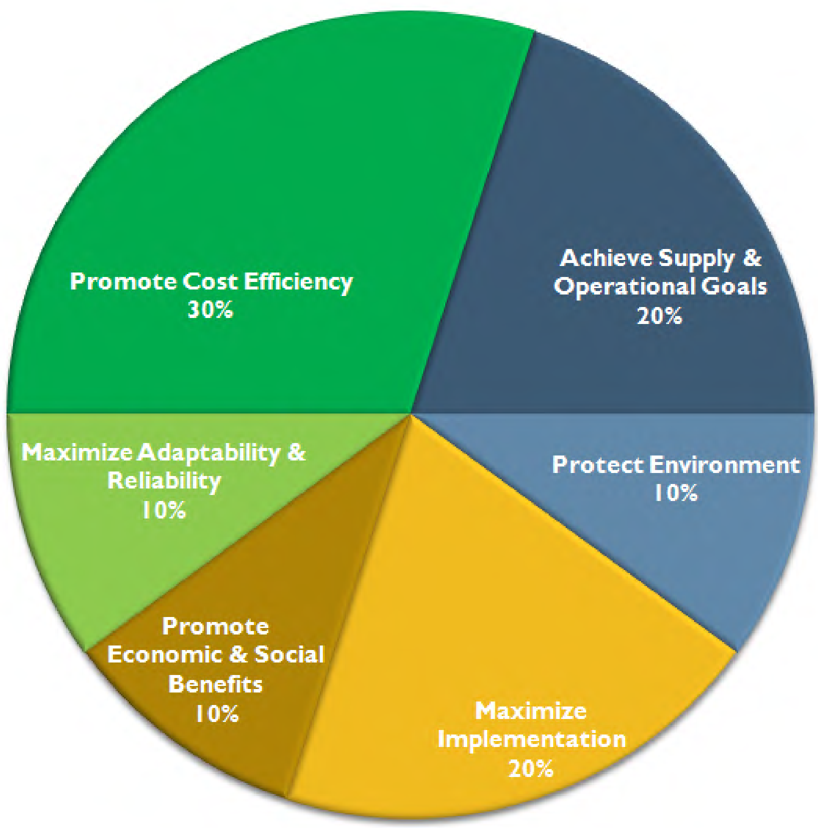
Several guidelines were used to establish objectives. The objectives were designed to be easy to understand; non-redundant; measureable with performance measures; and, concise in numbers (generally no more than five to eight objectives). It is also important to note that objectives are not solutions. Solutions (i.e., project concepts) represent how these objectives could be achieved.

The following objectives were developed and used for the RWMP evaluations:

- **Threshold Objective 1** – Meet all water quality regulations and health & safety requirements, and use proven technologies. The long-term concept projects meet regulations to the extent possible, but this report acknowledges that changes to regulations may be necessary to implement some of the more innovative projects.
- **Threshold Objective 2** – Provide effective communication and education on recycled water program.
- **Objective 1 - Promote Cost Efficiency**: Meet the goals of the recycled water program in a cost-effective manner, considering both City and recycled water customer costs.
- **Objective 2 – Achieve Supply and Operational Goals**: Meet or exceed water supply targets and operational goals established by the City. The primary supply goal (LADWP) is to offset as much imported water as possible. The primary operational goal (BOS) is to reuse as much recycled water as possible from City-owned treatment facilities.
- **Objective 3 – Protect Environment**: Develop projects that not only protect the environment, but also provide opportunities to enhance it.
- **Objective 4 - Maximize Implementation**: Maximize implementation by minimizing typical hurdles including institutional complexity, minimizing permitting challenges, and maximizing customer acceptance.
- **Objective 5 - Promote Economic and Social Benefits**: Provide economic and social benefits in the implementation and operation of recycled water projects.
- **Objective 6 – Maximize Adaptability and Reliability:** Maximize adaptability and reliability to be able to adapt to uncertainties and to maximize reliability of operations once projects are implemented.

Different weightings were assigned to each objective. To determine the relative weights, the RWMP team established preliminary weightings for each RWMP task (NPR and IAA). The objective weightings for the long-term project concepts are presented graphically in **Figure 5-1**. The two threshold criteria are not included in this chart because all project concepts need to meet the threshold criteria in order to be considered.

Figure 5-1: Objectives Weighting for the Long-Term Integrated Alternatives Analysis



In addition, the City also conducted a weighting exercise with the members of the RWAG at their first meeting in December 2009. The RWAG is a group of Los Angeles residents who represent specific community groups and their interests. They provided feedback about the RWMP throughout the planning process.

5.1.1 Objective 1 – Promote Cost Efficiency

Two evaluation criteria are used for Objective 1 – Promote Cost Efficiency:

- Total Lifecycle Cost; and,
- Unit Lifecycle Cost.

The long-term project concepts have a planning period of 50 years and the base year is 2036, which follows the implementation of NPR and GWR facilities that are expected to be completed by 2035. A 30 percent contingency cost and a 30 percent implementation cost were applied to the construction costs. The calculations assume a construction cost escalator of 3.0 percent, a water purchase escalator of 4.0 percent, a 5.5 percent interest rate over a 25 year payback period and a discount rate of 5.5 percent. The cost estimating procedures for the RWMP are documented in the Final Draft Cost Estimating Basis TM (**Appendix F**).

The following sections briefly discuss the assumptions for the total lifecycle cost and unit lifecycle costs for the long-term project concepts.

Total Lifecycle Cost (50-year)

The total lifecycle cost for each project concept considered in this evaluation is the present value (PV) of the 50-year lifecycle cost.

The costs included in the lifecycle cost estimate are:

- Capital construction cost of new supplies (e.g., expansion of existing water reclamation plants, additional levels of treatment, and/or new satellite plants) and new conveyance, pump stations, GWR, and production facilities, etc.;
- Post-construction O&M costs for the WRPs, pump stations, conveyance, GWR and production facilities; and
- Recycled water purchase costs, where applicable.

These costs were evaluated without the lifecycle cost of GW purification, which includes the capital and O&M cost of GW purification treatment facilities.

Over the 50-year life of the project, process equipment, such as pumps, are assumed to have a 20-year life and to require replacement every 20 years, while structures, such as buildings and buried pipelines, are assumed to have a 50-year life. Each long-term project concept component was split accordingly between these two broad categories of "equipment" with 20-year life and "permanent structures" with 50-year life. The capital cost of initial facilities construction and subsequent equipment replacement were applied accordingly in the lifecycle cost estimate. Equipment salvage values were included in the cost estimate for those items that do not reach the end of their lifespan by the end of the lifecycle period.

The post-construction O&M cost includes labor, chemicals, routine equipment replacement (e.g., filters, membranes, UV lamps), and power for the AWTF, pump stations and GWR and production facilities.

Detailed lifecycle cost estimates for each long-term project concept are found in **Appendix F**.

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Table 5-1: Objectives, Evaluation Criteria, Performance Measures, and Scores for Long-Term Project Concepts

Threshold Objective: Meet All Water Quality Regulations and Health & Safety Requirements, and Use Proven Technologies								Va	Vb	Vc	Vd	MWa	MWb	MWc	MWd	MWe	MWf	
								seasonal	seasonal	partly seasonal	partly seasonal						seasonal	
							GWR	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	
							NPR											
							Water Supply Source	LVMWD	BWP	LAGWRP	LAGWRP	HTP	HTP	HTP	WBMWD	Metro Sat.	CBMWD	
							Treatment (Production-AFY)	4,000	8,000	25,000	25,000	50,000	180,000	100,000	10,000	50,000	10,000	
							Storage (MG)	-	-	-	-	-	-	-	-	-	-	
							Conveyance (mi)	8	5	15	11	6	15	20	1	3	9	
							Pump Station Flow (gpm)	2,500	5,000	15,500	15,500	31,000	111,600	62,000	6,200	31,000		
							GWR Spreading Grnds (acres)	-	-	-		-	-	-	-		-	
							GWR Injection Wells (No.)	-	-	-	18	35	124	-	7	-	7	
							Production Wells (No.)	2	3	16	16	35	124	69	7	35	4	
Objective	Weight	Evaluation Criteria	Sub-Weight	Overall Weight	Performance Measure	Unit	*Distribution Connection (mi)*	1	1	3	3	4	23	13	1	7	1	Notes
							Differentiator?											
Promote Cost Efficiency	30%	Total Lifecycle Cost with GW Purification Cost	50%	15.0%	Total Lifecycle Cost (50-Year from 2035 to 2085)	$ million	Yes	$97.0	$124.0	$782.0	$806.0	$1,130.0	$4,371.0	$2,632.0	$405.0	$2,746.0	$268.0	1
		Unit Lifecycle Cost with GW Purification Cost	50%	15.0%	Unit Lifecycle Cost (50-Year from 2035 to 2085)	$/AF	Yes	$970	$620	$710	$730	$450	$490	$530	$810	$1,100	$1,070	2
Achieve Supply & Operational Goals	20%	Reduction in Imported Water	70%	14.0%	Reduction in volume of imported water purchases	AFY	Yes	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	3
		Overall Wastewater System Benefits	30%	6.0%	HTP service area collection system benefits	AFY	Yes	500	1,000	-22,000	-22,000	0	0	0	0	-50,000	1,500	4
Protect Environment	10%	Groundwater Quality	33%	3.3%	Improves groundwater quality	AFY	Yes	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	5
		Habitat Benefits	33%	3.3%	Benefits to LA River	AFY	Yes	10000	5000	5000	5000	10000	10000	10000	10000	10000	10000	6
		Greenhouse Gas Emissions	33%	3.3%	Greenhouse gas emissions	metric tons of CO_2 eq. / AF	Yes	-0.7	-0.6	-0.3	-0.1	-0.7	-0.8	-0.8	-1.1	-0.2	-1.0	7

Notes:
1. 50-year lifecycle for permanent structures (bldgs and pipelines), and 20-year lifecycle for equipment.
2. Unit lifecycle cost. Yield assumes 100% RW (i.e., no blend) starting operation in 2035.
3. AFY number is assigned according to how much imported water would be offset for LADWP. Assumes that for "Vd" a transfer of MWD water can be made with PWP.
4. Reducing wastewater flow in HTP service area collection system; AFY number is assigned according to how much flow would be added or subtracted from HTP sewershed; lower number is better. Assumes no brine pipelines.
5. Recharging with AWT water will improve GW quality; project concepts with no GWR component score "0".
6. Measures benefits by amount of AFY that continues to be discharged to LA River beyond the current flows from DCT. "No Project" flows for Long-Term Concept Projects are assumed to be: DCT = 0 AFY, Burbank WRP = 5,000 AFY, LAG = 5,000 AFY
7. GHG emissions based on power consumption; include GHG reduction related to reduced pumping for MWD water

Table 5-1: Objectives, Evaluation Criteria, Performance Measures, and Scores for Long-Term Project Concepts (cont.)

Threshold Objective: Meet All Water Quality Regulations and Health & Safety Requirements, and Use Proven Technologies								**Va**	**Vb**	**Vc**	**Vd**	**MWa**	**MWb**	**MWc**	**MWd**	**MWe**	**MWf**	
								seasonal	seasonal	partly seasonal	partly seasonal						seasonal	
							GWR	2,000	4,000	22,000	22,000	50,000	180,000	100,000	10,000	50,000	5,000	
							NPR											
							Water Supply Source	LVMWD	BWP	LAGWRP	LAGWRP	HTP	HTP	HTP	WBMWD	Metro Sat.	CBMWD	
							Treatment (Production-AFY)	4,000	8,000	25,000	25,000	50,000	180,000	100,000	10,000	50,000	10,000	
							Storage (MG)	-	-	-	-	-	-	-	-	-	-	
							Conveyance (mi)	8	5	15	11	6	15	20	1	3	9	
							Pump Station Flow (gpm)	2,500	5,000	15,500	15,500	31,000	111,600	62,000	6,200	31,000		
							GWR Spreading Grnds (acres)	-	-	-		-	-	-	-		-	
							GWR Injection Wells (No.)	-	-	-	18	35	124	-	7	-	7	
							Production Wells (No.)	2	3	16	16	35	124	69	7	35	4	
Objective	**Weight**	**Evaluation Criteria**	**Sub-Weight**	**Overall Weight**	**Performance Measure**	**Unit**	***Distribution Connection (mi)***	1	1	3	3	4	23	13	1	7	1	**Notes**
							Differentiator?											
Maximize Implementation	20%	Public Acceptance	25%	5.0%	Impacts to Public from permanent facilities	Score	No	4	3	3	3	2	2	2	3	1	1	8
		Institutional Complexity	70%	14.0%	Complexity of implement./operation	Score	Yes	4	4	4	1	3	2	2	2	3	2	9
		Impacts to Community Amenity	5%	1.0%	Temporary traffic/noise/odor/dust impacts due to construction	Score	Yes	3	4	4	2	4	4	2	4	4	4	10
Promote Economic & Social Benefits	10%	Permanent job creation	50%	5.0%	Permanent job creation	Number of jobs	Yes	3	7	75	37	85	611	170	17	170	0	11
		Environmental Justice	50%	5.0%	Permanent above-ground facilities in low-income or minority tract in census data	Score	Yes	3	3	3	3	5	1	3	3	1	1	12
Maximize Adaptability & Reliability	10%	Foregone Opportunities	100%	10.0%	RW recharged outside SFB	Yes/No	Yes	N	N	N	Y	Y	Y	Y	Y	Y	Y	13

Notes:

8. Score 1 = new WRP at new site; 2 = PS at new site; 3 = new WRP/PS at existing site; 4 = minor exp. at existing site or wells only; 5 = few to no impacts
9. 1 - many agreements required, complex, 2 - many agreements, less complex, 3 - moderate number of agreements, 4 - few agreements, lower complexity, 5 - project would require few or no agreements (see scoring spreadsheet)
10. Based on miles of open-trench and other surface construction. Score 1 = 20+ miles, 2 = 15-20, 3 = 10-15, 4 = 5-10, 5 = 0-5 miles; Tunneling projects receive a +1
11. Assumes 1.9 employees per mgd of AWT treatment; also assumes 1.9 employees per mgd of tertiary; projects that have tertiary and AWT expansions are counted double
12. Permanent facilities: Above-ground facilities in low-income and minority communities. Scoring: 5 - little/no impacts, 3 - wells only, 1 - treatment facilities.
13. RW recharged outside of City will keep GW storage capacity inside City open for future use. "Yes" is better.

Unit Lifecycle Cost (50-year)

The unit lifecycle cost for each project concept considered in this evaluation is the PV of the 50-year lifecycle cost divided by the total volume of potable water offset by recycled water (including GWR or recycled water exchange), represented in $/AF:

$$\text{Unit lifecycle cost (\$/AF)} = \frac{\text{PV of 50-year lifecycle cost}}{\text{Total volume of potable offset}}$$

Estimated capital and operation and maintenance costs for the RWMP are based on the cost criteria and unit costs defined in the *Cost Estimating Basis for Recycled Water Master Planning TM* (**Appendix F**).

Construction and O&M Unit Cost Basis

Figure 5-2 shows the project components that are included in each project concept cost. Detailed cost estimates of each project concept are located in **Appendix H**.

Figure 5-2: Project Concept Development

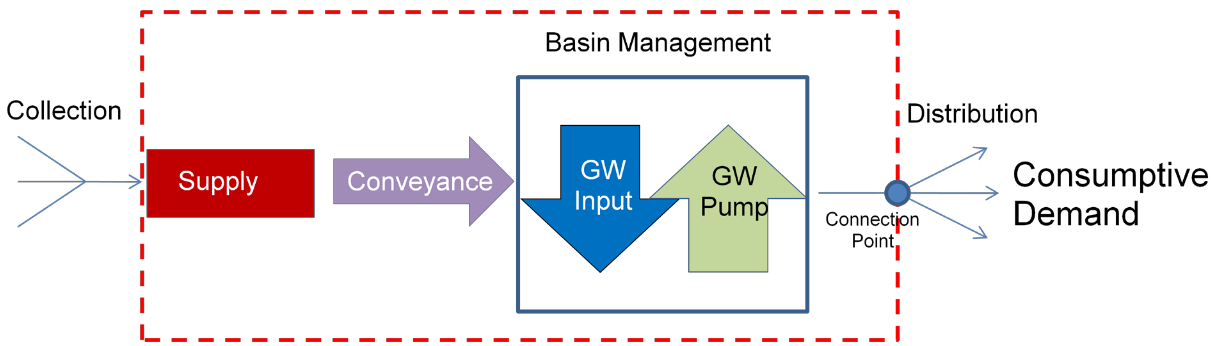


Table 5-2: Project Concepts Costs

Project Concept	Annual Average Production (AFY)	Capital Cost ($M)	Annual O&M Cost ($M/yr)	RW Purchase Cost ($M)	50-year PV($M)	50-Year Yield (start 2031) (af)	Unit Lifecycle Cost ($/af)
Va	2,000	$63	$1.5	$1.25	$97	100,000	$970
Vb	4,000	$106	$3.2	--	$124	200,000	$620
Vc [2]	22,000	$539	$25.2	--	$782	1,100,000	$710
Vd [2]	22,000	$580	$24.6	--	$806	1,100,000	$730
MWa	50,000	$836	$33.1	--	$1,130	2,500,000	$450
MWb	180,000	$3,463	$121.2	--	$4,371	9,000,000	$490
MWc	100,000	$2,213	$71.6	--	$2,632	5,000,000	$530
MWd	10,000	$142	$4.1	$10.0	$405	500,000	$810
MWe	50,000	$1,412	$108.5	--	$2,746	2,500,000	$1,100
MWf	5,000	$205	$3.3	$3.25	$268	250,000	$1,070

Note:

1. Interest rate is 5.5%; Payback period is 25 years; Discount rate is 5.5%.
2. The construction and operational costs of the GBIS/NEIS II connection are not included

Costs of GBIS/NEIS II

GBIS/NEIS II is a planned 84-inch diameter interceptor sewer designed to convey 190 mgd. This sewer could maintain significant flows to LAGWRP throughout the diurnal cycle. It is a deep tunneling operation that will be located in the vicinity of the Griffith Park Golf Courses, across Interstate-5 from the plant. At this time, it is not known whether GBIS/NEIS II would be operational by 2040.The estimated cost to construct GBIS/NEIS II is approximately $750M (BOS, 2010).

One significant issue with GBIS/NEIS II is that a connection to LAGWRP would be challenging. The sewer alignment could be over a mile away from the plant; and the sewer itself will be approximately 80 feet deep, requiring a pump station with a large pumping head capacity (BOS, 2009). The construction and operational costs of this connection are not included in the cost basis for LAGWRP long-term projects.

5.1.2 Objective 2 – Achieve Supply & Operational Goals

Two evaluation criteria are used for Objective 2 – Achieve Supply & Operational Goals:

- Reduction in imported water (measured in AFY of imported water); and,
- Overall wastewater system benefits.

Reduction in Imported Water

Since reducing dependence on potable water (or imported water) supplies is an ongoing City goal, long-term project concepts are ranked by the total volume of potable water offset that they provide. All long-term project concepts achieve various amounts of recycled water reuse, ranging from 2,000 to 180,000 AFY. These supply values are assumed to constitute the potable demand offset, or reduction in imported water reliance.

Overall Wastewater System Benefits

This performance measure ranks project concepts based on how well they reduce wastewater flows in the HTP service area, thereby reducing stress on the collection system. This performance measure applies to the project concepts which convey or divert wastewater flows in the HTP service collection system. Project concepts Vc, Vd and MWe reduce wastewater flows to the HTP collection system and therefore the wastewater flows are expressed as negative. [16] It is assumed that the project concepts have no dedicated brine line. Project concept Vd does not generate brine that discharges to the LA sewer system. On the other hand, project concepts Va, Vb, Vc, and MWf increase brine flow to the HTP collection system, which increases the loading on the HTP service collection system. For this performance measure, lower values are considered better than higher values because more flows are removed from the HTP sewershed.

An analysis was conducted to estimate the potential impacts of brine-concentrate discharges from the various advanced purification options on downstream operations at HTP and WBMWD. To assess these potential impacts, a spreadsheet model was developed to calculate

[16] A portion of the flow removed from the HTP sewershed by project concept Vc is returned to the sewer system as brine flow.

the flows and total dissolved solids (TDS) concentrations for the various long-term options being considered. A description of the model and an analysis of the framework and results are further described in Appendix K.

5.1.3 Objective 3 – Protect Environment

Three evaluation criteria are used for Objective 3 – Protect Environment:

- Groundwater quality;
- Habitat benefits; and,
- Greenhouse gas emissions.

Groundwater Quality

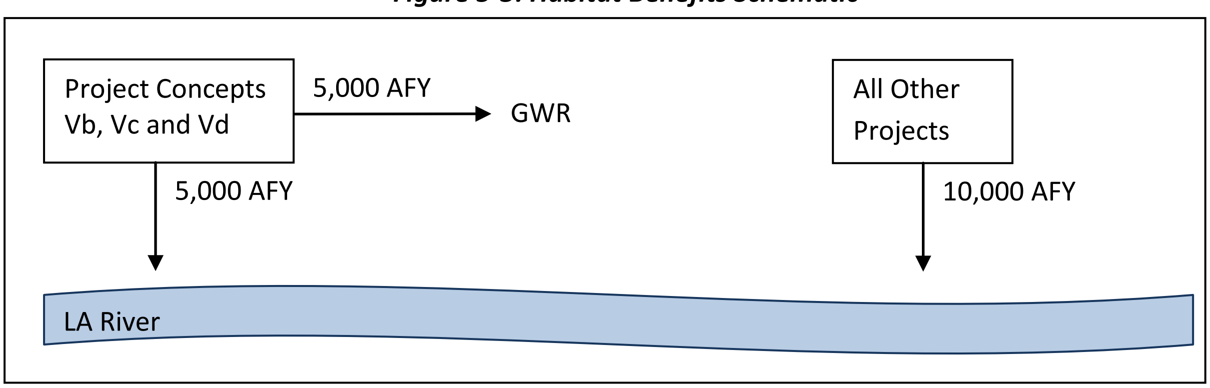
This evaluation criterion ranks project concepts based on how well they improve the existing groundwater quality. Existing groundwater basins located within the City of Los Angeles typically have higher TDS than the AWPF product water used for GWR. By recharging the groundwater with AWPF product water, the groundwater quality will be improved (i.e., TDS and other contaminants already in the aquifer will be lowered in concentration by dilution). Therefore, project concepts with higher amounts of GWR are assumed to improve groundwater quality.

Habitat Benefits

This evaluation criterion ranks project concepts based on the discharge flows to the LA River. In general, additional flow discharged into the LA River, beyond the current flows discharged from DCTWRP through Lake Balboa, Wildlife Lake and the Japanese Garden, is considered to provide some beneficial support to downstream LA River habitats. If no long-term project concepts are implemented (i.e., the current baseline condition), 10,000 AFY would be discharged into the LA River, (approximately 5,000 AFY from the Burbank WRP and 5,000 AFY from LAGWRP).

Most of the projects would not change this 10,000 AFY amount that is discharged to the river from Burbank WRP, and LAGWRP. However, Project concepts Vb, Vc, and Vd would reuse some of that river discharge for upstream beneficial uses and would result in only 5,000 AFY being discharged into the LA River, from these sources as shown in **Figure 5-3**.

Figure 5-3: Habitat Benefits Schematic



Greenhouse Gas Emissions

This evaluation criterion ranks project concepts based on the amount of greenhouse gas (GHG) emitted by the treatment, GWR and NPR facilities in each project concept. The GHG emissions that result from the operation of the treatment, GWR and the NPR facilities are calculated based on the electricity demand of these systems. The GHG emissions, carbon dioxide, methane, and nitrous oxide, were calculated and converted to metric tons of carbon dioxide equivalents. This evaluation criterion also takes into consideration the reduction in GHG emissions that would be realized by potable water offset (i.e., less pumping and treatment of imported water). Therefore, some of the GHG emissions values for this evaluation criterion are negative (i.e., GHG emissions reduction from imported water offset outweigh the GHG emissions from treatment, GWR and NPR facilities).

5.1.4 Objective 4 – Maximize Implementation

Three evaluation criteria are used for Objective 4 – Maximize Implementation:

- Public acceptance;
- Institutional complexity; and,
- Impacts to community amenity.

Public Acceptance

This evaluation criterion assesses impacts to the public based on construction of permanent facilities. Public acceptance is more difficult if new facilities are constructed in developed areas. A score of 1 signifies that a new WRP is constructed at a new site, while a score of 5 signifies little to no impact (no new construction). Some project concepts consist of an expansion of AWTP and pump station at an existing site, and receive a score of 3. **Table 5-3** summarizes the scoring criteria for public acceptance.

Table 5-3: Scoring of Public Acceptance

Score	Public Acceptance
1	New WRP at new site
2	New PS at new site
3	Expansion of WRP and PS at existing site
4	Minor exposure at existing site or wells only
5	Few to no exposure impacts

Regulatory, Permitting and Institutional Requirements

This evaluation criterion ranks project concepts based on the complexity of operating relationships with outside agencies. These operating relationships include finalized agreements regarding simple customer connections, sales agreements, technical assistance, water transfers and basin adjudications. The institutional complexity can affect the implementation of a project concept. Project concepts with a higher number of operating contracts/agreements with multiple outside agencies score the lowest. **Table 5-4** shows the interpretation of each of the scores in the range from 1 to 5.

Table 5-4: Interpretation of Scoring for Institutional Complexity

Score	Institutional Complexity
1	Many agreements required, complex
2	Many agreements, less complex
3	Moderate number of agreements
4	Fewer agreements, lower complexity
5	Project would require few or no agreements

Regulatory, permitting, and institutional information about long-term project concept is based on the following assumptions:

- The California Department of Public Health (CDPH) will adopt groundwater recharge (GWR) regulations by December 31, 2013 per California Water Code (CWC) section 13562(a)(1) and any amendments thereto;
- Long-term project concepts must comply with the Regional Water Quality Control Board (RWQCB) Basin Plan and any other relevant State Plans and Policies (State regulations); and
- Estimated water volumes for the proposed options are assumed to be viable for this initial assessment based on the supposition that a project will utilize suitable water management strategies that balance the recharge of recycled water (RW) with the extraction of groundwater.

A table is included in **Appendix J** that summarizes the regulatory, permitting, and institutional requirements for long-term project concepts. The table lists the concept projects, permitting agencies, a description of the permit, the responsible agency, institutional arrangements, technical memoranda that explain regulatory and institutional requirements in more detail. Section 5 shows the relative scoring of regulatory/institutional complexity that is used in the Criterium Decision Plus evaluation.

The table indicates the regulatory and permitting requirements for each project concept that must be met before the project concept can be implemented. The most complex regulatory project concept in the Valley is Vd since many agreements are required (Glendale, PWP and MWD). In the Metro/Westside, MWd and MWf are the most complex regulatory project concept since many agreements are required.

Given the long time period before the long-term project concepts could be implemented, the information about permitting requirements is speculative and based on the current regulatory system.

Wastewater and Recycled Water Rights

The City of Los Angeles wastewater treatment plants receive some sewage flows that do not originate within the City itself. There are over twenty cities, water districts, county sanitation districts, and other entities that contract with the City for wastewater treatment services, as listed below:

- Las Virgenes Municipal Water District
- Triunfo Sanitation District
- City of San Fernando
- Karl Holton Camp
- Universal City
- City of Burbank
- City of Glendale
- City of Crescenta Valley
- City of La Canada
- County Sanitation District No. 4
- County Sanitation District No. 5
- County Sanitation District No. 9
- County Sanitation District No. 16
- County Sanitation District No. 27
- City of Beverly Hills
- Veterans Administration
- Federal Office Building
- City of El Segundo
- Western Los Angeles County Council (WLACC)
- Aneta Street
- Culver City
- City of Marina Del Rey
- City of Santa Monica
- Port of Long Beach

Services are provided under a standard wastewater services agreement between the City and the contracting agency. These standard agreements set forth rights to available recycled water flows from the plants based on the proportion of flow discharged into the sewerage system for the latest complete flow year. The agreements also include terms for the use of available but un-utilized recycled water. Additional detail on recycled water terms and conditions may be found in Section II.B.4 of the standard wastewater services agreement.

Rights to utilize recycled water will need to be reviewed as part of institutional arrangements for the planning, design, construction, and operation of long-term concept projects.

Impacts to Community Amenity

This evaluation criterion ranks project concepts based on the amount of construction impacts to the surrounding areas. Construction impacts include impacts from increased traffic, noise, odor, and dust. Pipeline construction is used as a proxy for overall construction impacts because it impacts the community directly due to traffic, dust and noise.

Project concepts that involve pipeline construction for lengths of over 20 miles score lowest while projects with five miles or less of pipeline construction score highest. Tunneling is considered to impose fewer construction impacts compared to open-trench methods, since a boring and jack shaft is constructed only every three miles. Concept projects that use tunneling are awarded an extra score point for this reason. **Table 5-5** summarizes the scoring criteria for community amenity impacts.

Table 5-5: Scoring of Community Amenity Impacts

Score	Community Amenity Impacts	
	Open-Trench	Tunnel
1	20 miles or more	--
2	15-20 miles	20 miles or more
3	10-15 miles	15-20 miles
4	5-10 miles	10-15 miles
5	0-5 miles	5-10 miles

5.1.5 Objective 5 – Promote Economic & Social Benefits

Two evaluation criteria are used for Objective 5 – Promote Economic & Social Benefits:

- Permanent job creation; and
- Environmental justice

Permanent Job Creation

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

It was assumed that 1.9 full-time employment positions would be required per mgd of recycled water (AWP or tertiary) produced. This factor is estimated by analyzing the personnel required to operate similar AWPFs. The three AWPFs listed in **Table 5-6** are similar to the proposed AWPF in that they receive secondary or tertiary effluent from a neighboring wastewater treatment plant. As a result, some of the personnel used to staff the AWPFs are shared with the wastewater treatment plant. Also, the capacities of these facilities are comparable to the capacity of the proposed AWPF. The average number of personnel required per mgd of the AWPF production capacity is approximately 1.9. Project concepts that have tertiary and AWP expansions are counted twice, once for each level of treatment.

Table 5-6: Personnel Requirements at Similar AWTP Facilities

Facility	Source Water	Flow (mgd)	# of Personnel	# of Personnel/mgd
TIWRP AWTP	Tertiary Effluent from TIWRP	5	9.18	1.8
ELWRF	Secondary Effluent from HTP	22	40	1.8
Miami-Dade Water and Sewer Department	Tertiary Effluent from the South District Wastewater Treatment Plant	21	40.8	1.9

Environmental Justice

This evaluation criterion ranks project concepts based on the environmental justice impacts of the new permanent above-grade facilities, such as pump stations and wells, included in AWP and GWR facilities. Below-grade piping projects are not considered because their temporary effects are assessed by the Impacts to Community Amenity evaluation criterion. The environmental justice impacts are determined by counting the number of census tracts designated as low-income and/or minority community parcels/tracts where new permanent above-grade facilities for AWP and GWR facilities would be located.

Table 5-7 summarizes the scoring criteria for environmental justice effect.

Table 5-7: Scoring of Environmental Justice Effects

Score	Environmental Justice Effects
1	Treatment facilities
2	-
3	Well facilities
4	-
5	No new facilities

5.1.6 Objective 6 – Maximize Adaptability & Reliability

This evaluation criterion ranks project concepts based on the extent to which GWR projects forego opportunities outside the City boundaries. Recycled water recharge outside the City is desirable because it will keep the groundwater storage capacity inside the City boundaries available for future GWR opportunities. This criteria is scored on a "yes" and "no" basis, with "yes" signifying an opportunity to recharge outside the San Fernando Basin, and therefore, preserve future GWR opportunities inside a City-controlled basin. This criterion assumes that opportunities for GWR outside the City could be missed if the City does not pursue projects sooner rather than later.

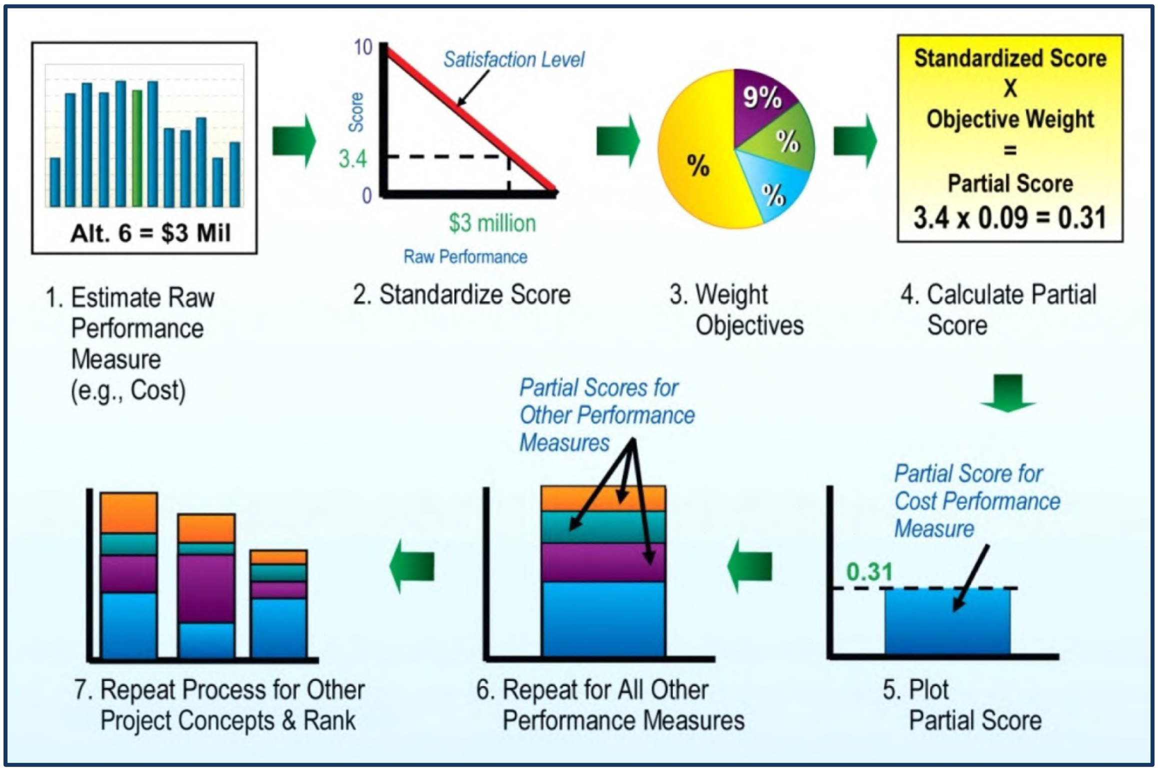
5.2 Decision Model

A decision model based on a multi-attribute rating methodology was developed to characterize project concepts. The objectives, evaluation criteria, and performance measures for each project concept were used as inputs to the decision model. Developing such a decision model is helpful when there are multiple project concepts that can be measured differently against multiple criteria, and when no single project concept clearly performs the best in all areas. In these cases, systematizing the decision process by explicitly defining and weighting criteria and then giving scores to the project concepts for those criteria can make future consideration easier and more objective.

5.2.1 Process

The decision model based on the multi-attribute rating methodology was developed using the commercial software Criterium® DecisionPlus® (CDP). This software was developed by Infoharvest Inc., and was selected to rank the project concepts because of its sophistication, ease of understanding and use, and its ability to conduct sensitivity analyses, if needed. There are seven basic steps of the multi-attribute rating technique, which are shown in **Figure 5-4**.

Figure 5-4: Multi-Attribute Rating Technique for Evaluating Project Concepts



Descriptions of the seven procedures in Figure 5-4 are as follows:

1. Estimate Raw Performance Measure

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

2. Standardize Score

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

3. Weight Objectives

The criteria were weighted in terms of their importance to the overall RWMP objectives as described in Section 3.1.

4. Calculate Partial Score

A standardized score was multiplied by its relative weight of importance in order to get a partial score for a particular project concept.

5. Plot Partial Score

The partial score was then plotted on a graph for the project concept.

6. Repeat for All Other Performance Measures

This procedure was repeated for all of the other criteria for the project concept until a total score for the project concept was calculated.

7. Repeat Process for Other Project Concepts & Rank

Finally, the total score for the project concept was compared to the total scores of the other project concepts in order to establish prioritization for implementation.

5.2.2 Results

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

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

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

Valley Service Area Results

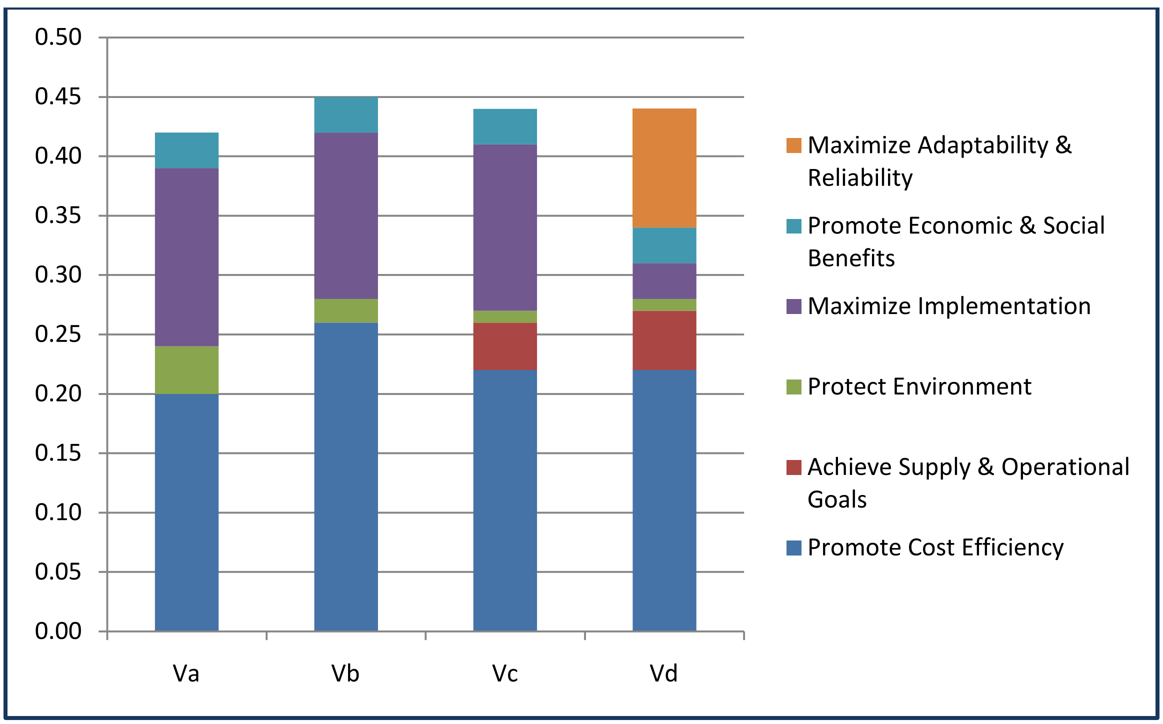
Figure 5-5 shows graphical results for the CDP model analysis for the Valley service area. The following results were observed:

- Project concept Vb scored relatively high in cost efficiency while Va, Vc, and Vd scored lower. Va, Vc, and Vd also scored in a similar range for cost efficiency.

- Project concept Vd and Vc both scored high in achieving supply and operational goals since both project concepts achieve larger reductions in wastewater flow in the HTP service area collection system.
- Project concept Va scored the highest in protecting the environment since it does not decrease any flows to the Los Angeles River.
- Project concept Va scored highest in maximizing implementation since it has a higher public acceptance due to fewer construction impacts.
- Project concept Vc scored highest for economic and social benefits because it creates the most permanent jobs.
- Project concept Vd scored highest in the maximize adaptability and reliability because it recharges groundwater outside the San Fernando Basin.

Overall, project concept Vb scored the highest, followed by project concepts Vc, Vd and Va. Because some concept projects are mutually exclusive, only project concepts Vc or Vd could be recommended for potential implementation. Based on the CDP results, Vc has a higher score than Vd and therefore would have priority in being implemented relative to the other long-term projects in the Valley Service Area.

Figure 5-5: CDP Model Results – Valley Service Area



Metro Service Area Results

Figure 5-6 shows graphical results for the CDP model analysis for the Metro/Westside service area. The following results were observed:

- Project concept MWa scored best in cost efficiency while MWe scored the worst due to its high unit costs.
- Project concept MWb scored highest in achieving supply and operational goals since it offsets a large amount of imported water demand.
- With the large amount of purified recycled water recharged to the underlying basin, project concept MWb improves groundwater quality the most and therefore scored the highest in protecting the environment.
- Project concept MWa scored highest in maximizing implementation since it has the least number of agreements needed to implement the project.
- Project concept MWb scored highest for economic and social benefits since the project creates lots of permanent jobs.
- All project concepts scored the same in the maximize adaptability and reliability since they will recharge outside the City, keeping groundwater storage capacity inside the City open for future uses.

Overall, project concept MWa scored the highest, followed by project concepts MWb, MWc, MWd, MWe and MWf. Because some project concepts are mutually exclusive, only project concepts MWa, MWb or MWc could be recommended for potential implementation. Based on the CDP results, MWa scored highest and therefore would have priority in being implemented.

Figure 5-6: CDP Model Results – Metro/Westside Service Area

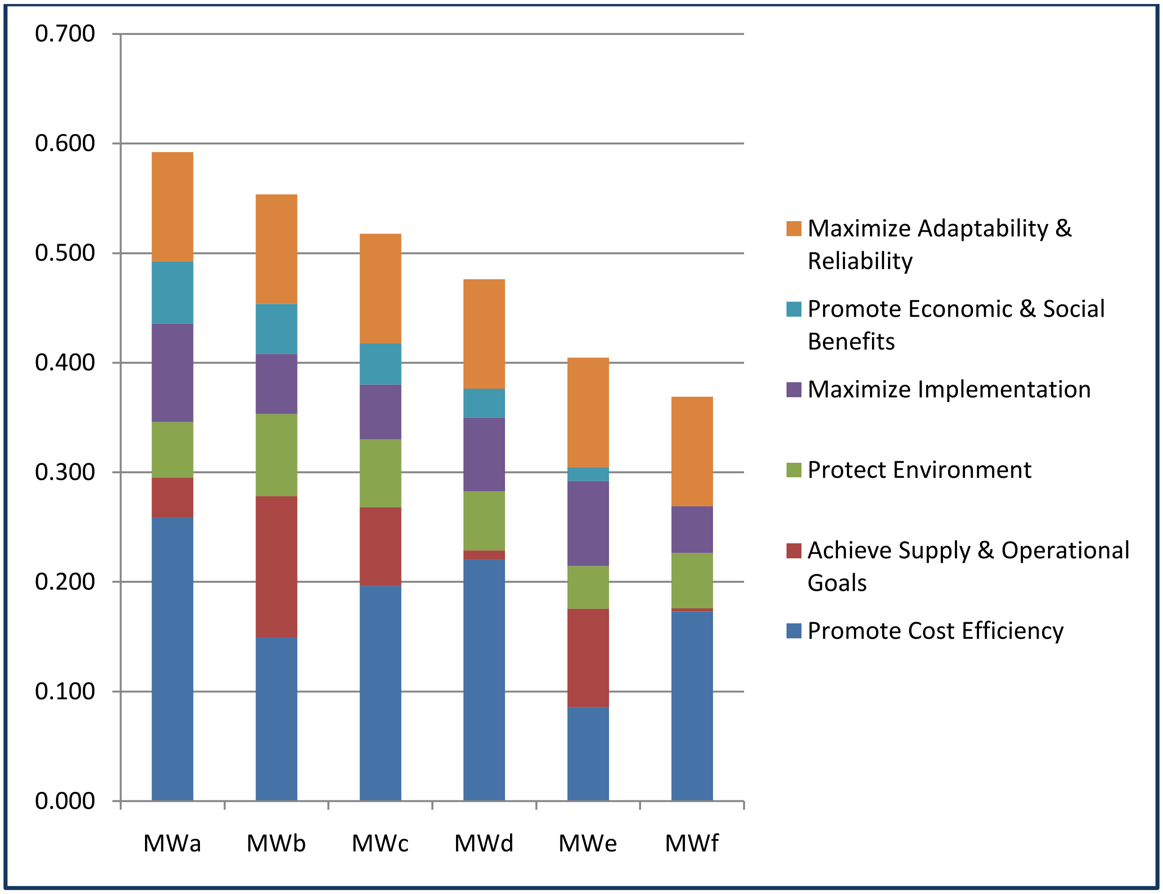
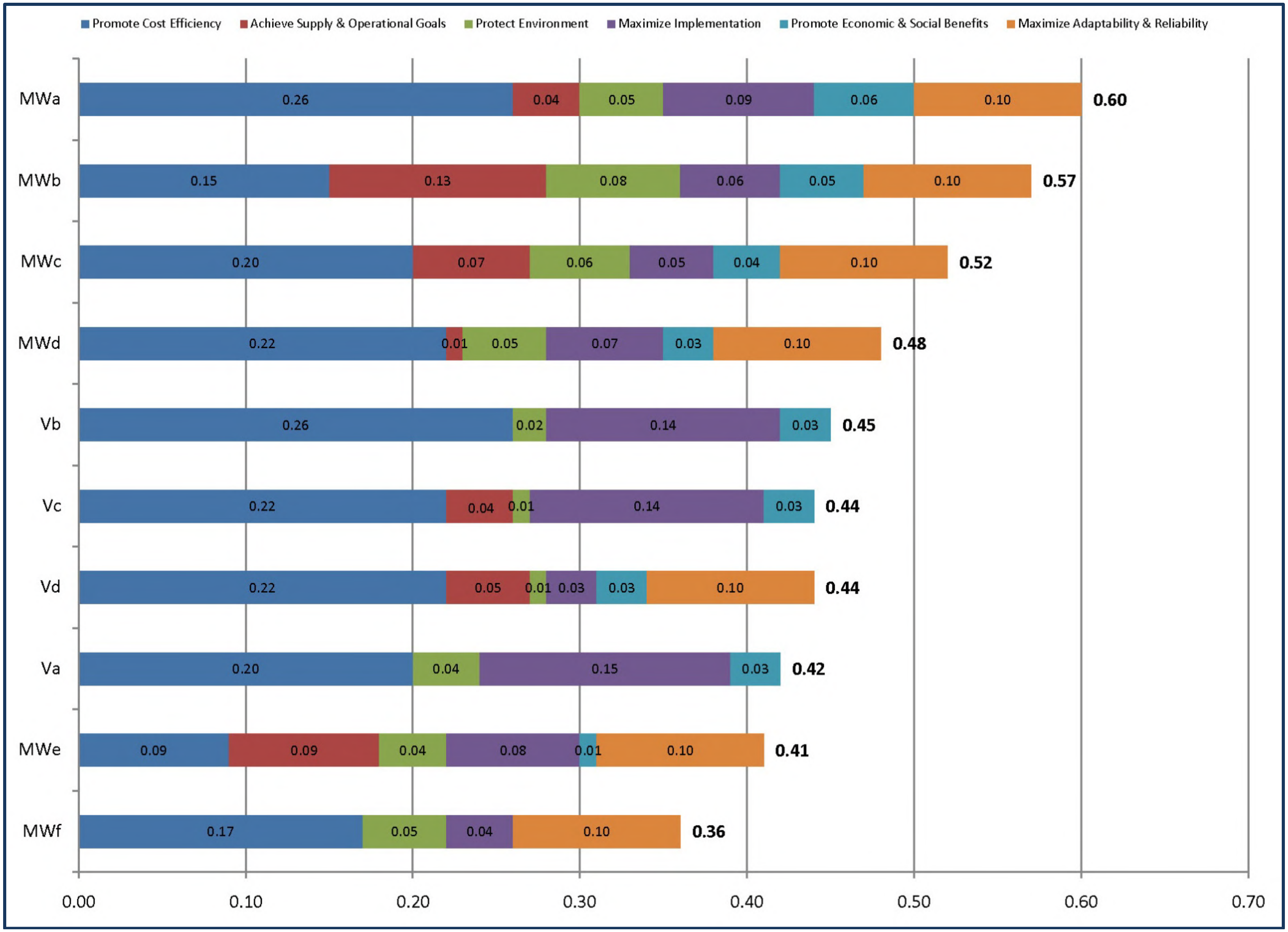


Figure 5-7 shows graphical results for the CDP model analysis.

Figure 5-7: Long-Term Project Concepts Scoring (in Order of Ranking)



5.2.3 Sensitivity Analysis

Sensitivity analyses were conducted for near-term project alternatives to verify the robustness of the initial long-term project concepts rankings. Sensitivity analyses were also provided for long-term projects, but are only included for informational purposes and are not used to evaluate the long-term project concepts. A total of six sensitivity runs were conducted and are further described in Appendix I. The variations in objectives weightings for the sensitivity runs were developed based on input from the RWAG and the City. The sensitivity analysis results are also located in Appendix I.

Evaluation criteria and performance measures were defined to rank the long-term project options. This section describes the evaluation criteria and the associated performance measures. The threshold criteria do not have any evaluation criteria or performance measures because they must be met by all project concepts in order to be considered further.

Table 5-1 summarizes the evaluation criteria, performance measures, and scores for the long-term project concepts (i.e., inputs and outputs). As shown in this table, the performance measures were measured both qualitatively (i.e., relative score of 1 to 5) and quantitatively (i.e., unit capital cost, temporary job creation, etc.). When a qualitative score was used, a score of 5 was “better” and a score of 1 was “worse”.

Table 5-8 summarizes the results of all CDP runs. It indicates the number of times that each project concept was computed to be the highest ranked project concept. The ideal situation would include findings that the sensitivity runs have little effect on the highest ranked project concept(s), signifying that the choice of the project concept(s) was not sensitive to different weightings applied to the evaluation criteria. Key findings from the CDP results are summarized below:

- Project Concepts MWa and MWb consistently rank highest among all project concepts evaluated. MWb ranked highest on 4 of the 6 decision model runs, whereas MWa ranked highest on 3 of the 6 runs. Both of these Project Concepts had an average ranking of less than 2.0 (low is best), and had the best rankings in all model runs. Project Concepts MWa and MWb consistently rank high because they have high cost efficiency, high environmental protection and large supply benefits. The sensitivity analysis demonstrates that these project concepts rank high under all six weighting scenarios.
- Project Concepts Vb, Va and MWf consistently rank lowest among all project concepts evaluated. All three had an average ranking higher than 8.0 (high is worst). These three Project Concepts consistently rank the lowest because they have very low supply benefits, economic and social benefits and low cost efficiency. The sensitivity analysis demonstrates that these project concepts rank poorly under all six weighting scenarios.

Table 5-8: Summary of Long-Term Project Concepts for the Base Run and Sensitivity Runs

CDP Rankings without Groundwater Purification Cost										
	MWa	MWb	MWc	MWd	MWe	MWf	Va	Vb	Vc	Vd
0 Base	1	2	3	4	9	10	8	6	5	7
1 RWAG Average Weights	1	2	3	4	8	10	9	6	5	7
2 RWAG Environmental Emphasis	4	1	2	5	3	6	7	10	8	9
3 RWAG Social Emphasis	2	1	3	4	5	9	6	10	8	7
4 RWAG Cost Emphasis	1	3	2	4	10	8	9	6	7	5
5 Equal Weights	2	1	3	4	5	7	8	10	9	6
6 No Cost	2	1	3	5	4	7	9	10	8	6
Average Ranking	**1.9**	**1.6**	**2.7**	**4.3**	**6.3**	**8.1**	**8.0**	**8.3**	**7.1**	**6.7**
Total Number of Times Ranked No.1	3	4	0	0	0	0	0	0	0	0

Color Coding of Rankings:

1	2	3	4	5	6	7	8	9	10

Highest Ranked → → Lowest Ranked

6. Long-Term Scenarios and Themes

Long-term scenarios and themes were developed to provide potential implementation strategies for long-term concept projects. They are included here for discussion purposes only and are not intended to represent recommendations; nor do they include all possible strategies that could be implemented.

6.1 Establish Long-Term Scenarios

The following three scenarios were developed as an implementation framework for the long-term concept projects. They represent stages/percentages of MWD imported water offset for LADWP:

- **40 Percent:** The 40 percent scenario represents the amount of MWD offset that can be achieved through conservation (64,368 AFY), existing NPR, near-term NPR, and GWR (59,000 AFY), for a total of 123,368 AFY. This scenario represents the baseline condition for long-term concept projects (i.e., before long-term concept projects are implemented).
- **90 Percent**: The 90 percent scenario represents the MWD offset based on the estimated recharge potential in the Los Angeles area. Based on the Regional Groundwater Assessment TM (Appendix F) and the Groundwater Replenishment Evaluation TM, 167,000 AFY is the estimated combined recharge potential of San Fernando, Central, and West Coast Basins (Raymond Basin is not included because projects are mutually exclusive with San Fernando Basin). This recharge potential is based on both the recharge capacities of the groundwater basins as well as supply and other limitations. Accounting for the planned 30,000 AFY GWR project, this leaves approximately 137,000 AFY of recharge potential for the remaining basins. This would increase reuse by an additional 137,000 AFY for a total imported offset of 260,368 AFY.
- **100 Percent:** The 100 percent scenario represents the total MWD offset in 2035 (291,395 AFY) as reported in the 2010 UWMP. This scenario increases reuse by an additional 31,027 AFY. Based on LADWP's 2010 UWMP, 291,395 AFY is the total projected amount of imported water LADWP would receive from MWD in 2035, if no conservation or NPR/GWR projects were implemented (existing and future).

Table 6-1: "Milestone" Basis for Long-Term Scenarios

Scenario (Percent MWD Offset)	Total Imported Offset (AFY)	Reuse from Long-Term Projects (AFY)	"Milestone" Basis
40 percent	123,368	0	This is the "baseline" condition prior to implementation of long-term concepts. It represents existing and planned conservation, existing NPR, near-term NPR, and GWR. [1,2]
90 percent	260,368	+137,000	This is the first milestone for long-term concepts. It represents the estimated groundwater recharge potential of San Fernando, Central, West Coast, and Raymond Basins.[2]
100 percent	291,395	+31,027 (168,027 cumulative)	This is the second milestone for long-term concepts. It represents the projected imported MWD supply in 2035.[3]

Notes:

1. Includes 64,368 AFY of conservation and 59,000 AFY of existing, planned and potential NPR and GWR recycled water programs that are expected to be implemented by fiscal year 2034-2035.
2. Draft Regional Groundwater Assessment TM (Appendix F) and Groundwater Replenishment Evaluation TM.
3. LADWP's 2010 UWMP, adopted May 2011

6.2 Develop Implementation Themes

This section develops themes to prioritize the build-out of the long-term projects and combines them with the IAA results to dictate which projects to implement first. The overall goal of the long-term project concepts is to replace 168,027 AFY of potable water supplies with recycled water. This would allow the City to increase the percentage of 2035 MWD demand offset from 40 percent to 100 percent.

The following themes were developed:

- **Valley –** This theme assumes that LADWP decides to pursue Valley project concepts first and gives priority to the highest ranked project concepts in the Valley service area to meet the 90 percent and 100 percent goals. Once all mutually exclusive project concepts in the Valley are chosen based on scores, the highest ranked project concepts from other regions are included.
- **HTP** – This theme assumes that LADWP decides to pursue HTP project concepts first and gives priority to the highest ranked project concepts for HTP. Once all mutually exclusive project concepts for HTP are chosen based on scores, the highest ranked project concepts from other regions are included.
- **Metro Satellite** – This theme assumes that LADWP decides to pursue the Metro Satellite project concept first and gives priority to the Metro Satellite project concept followed by the highest ranked project concepts from other regions.

- **Outside Agencies** – This theme assumes that LADWP decides to pursue joint projects with other agencies first. It gives priority to the highest ranked project concepts with supplies from outside agencies, followed by the highest ranked projects with other regions.
- **Maximize Reuse** - This theme assumes that LADWP decides to pursue project concepts first that meet or exceed the 100 percent milestone. It gives priority to the highest ranked project concept with the largest yield.

The baseline rating was used to rank all the project concepts. Once the project concepts were ranked, lower-ranking mutually exclusive concepts were eliminated (or reserved for particular future situations). Then a prioritized list was developed. Using the prioritized list and a chosen theme, the highest ranked project concepts can be implemented first, the second highest can be implemented second, and so on.

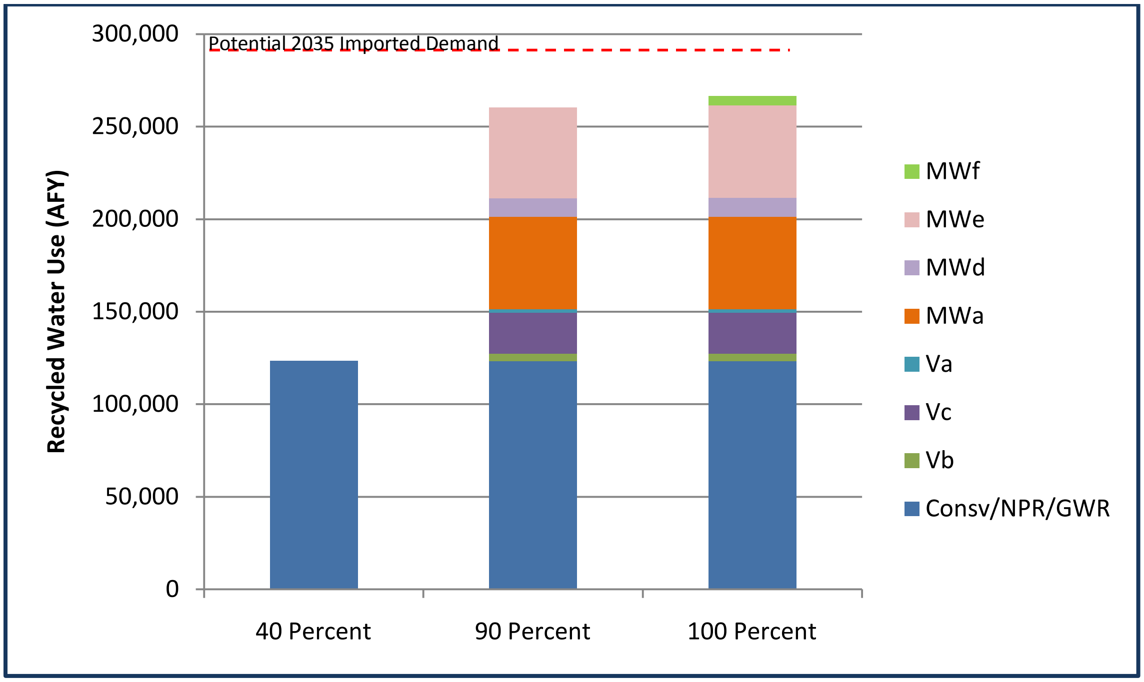
6.2.1 Harbor

As discussed previously, Harbor project concepts were originally included in the Long-Term Concepts Report analysis, but they were subsequently moved to the TIWRP Barrier Supplement and Non-Potable Reuse Concepts Report. Background research conducted for TIWRP is included in the Long-Term Concepts Report for completeness.

6.2.2 Valley

The Valley theme gives priority to the highest ranked project concepts in the Valley service area to meet the 90 percent and 100 percent goals. Based on the CDP results, the highest to lowest ranked Valley project concepts are: Vb, Vc, Va, and Vd. Since the project concepts Vc and Vd are mutually exclusive, project concept Vc takes precedence over project concept Vd. Project concept Vc would divert sewer flows to LAGWRP that would otherwise be treated at HTP, thereby reducing the influent flows at HTP. However, the influent flow reduction does not impact MWa, which is the highest scoring MW project concept. **Figure 6-1** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

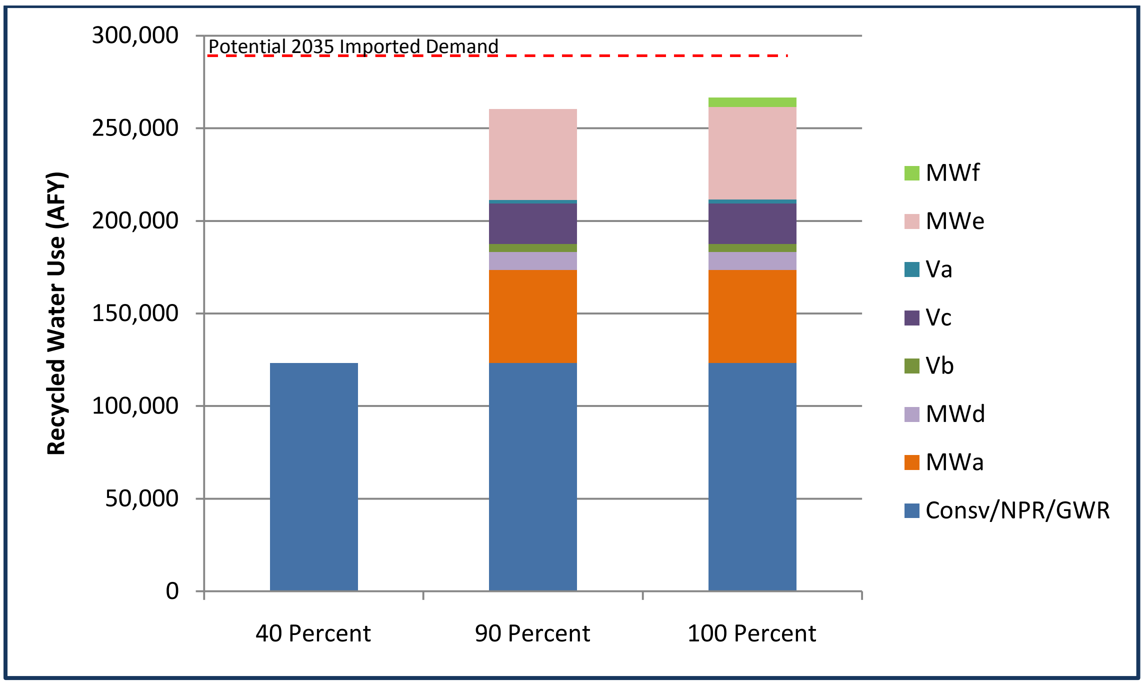
Figure 6-1: Valley Theme/ Scenarios



6.2.3 HTP

The HTP theme gives priority to the highest-ranked project concepts for HTP to meet the 90 percent and 100 percent goals. Based on the CDP results, the highest to lowest ranked HTP project concepts are: MWa, MWb and MWc. Since all three of these projects are mutually exclusive, project concept MWa will take precedence over the other HTP project concepts. **Figure 6-2** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

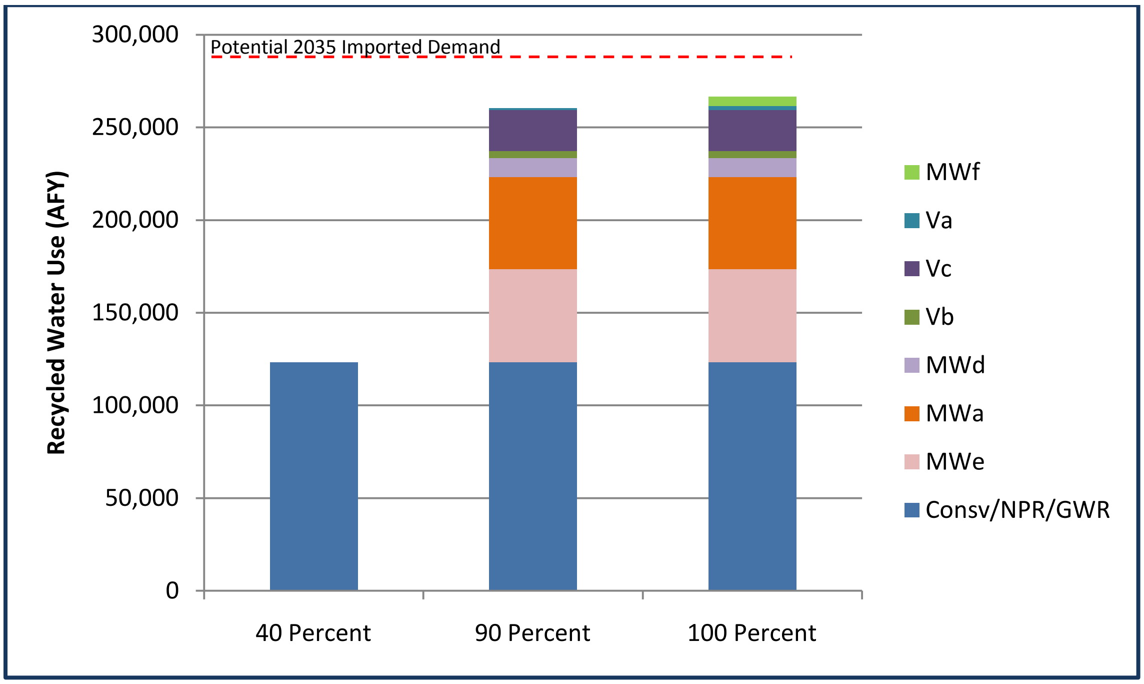
Figure 6-2: HTP Theme/ Scenarios



6.2.4 Metro Satellite

The Metro Satellite theme gives priority to the satellite project concept to meet the 90 percent and 100 percent goals. Therefore, project concept MWe would be the first implemented, followed by the other highest scored project concepts. **Figure 6-3** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

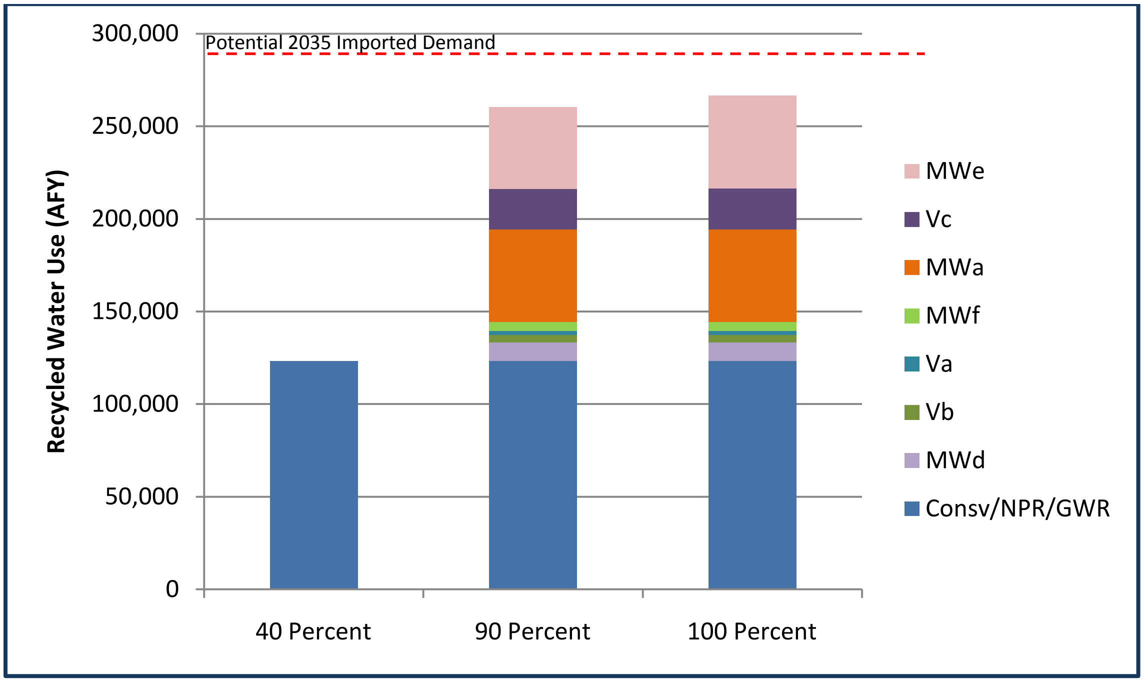
Figure 6-3: Metro Satellite Theme/ Scenarios



6.2.5 Outside Agencies

The Outside Agencies theme gives priority to the project concepts supplied from outside agencies. Based on the CDP results, MWd would be the first implemented, followed by Vb, Va and MWf. To achieve the 90 percent and 100 percent goals, the next highest project concepts are chosen after that. **Figure 6-4** shows the order of project concepts to achieve the 90 percent goal. The 100 percent goal is not reached in this scenario due to implementation of more cost-effective project concepts with lower yields.

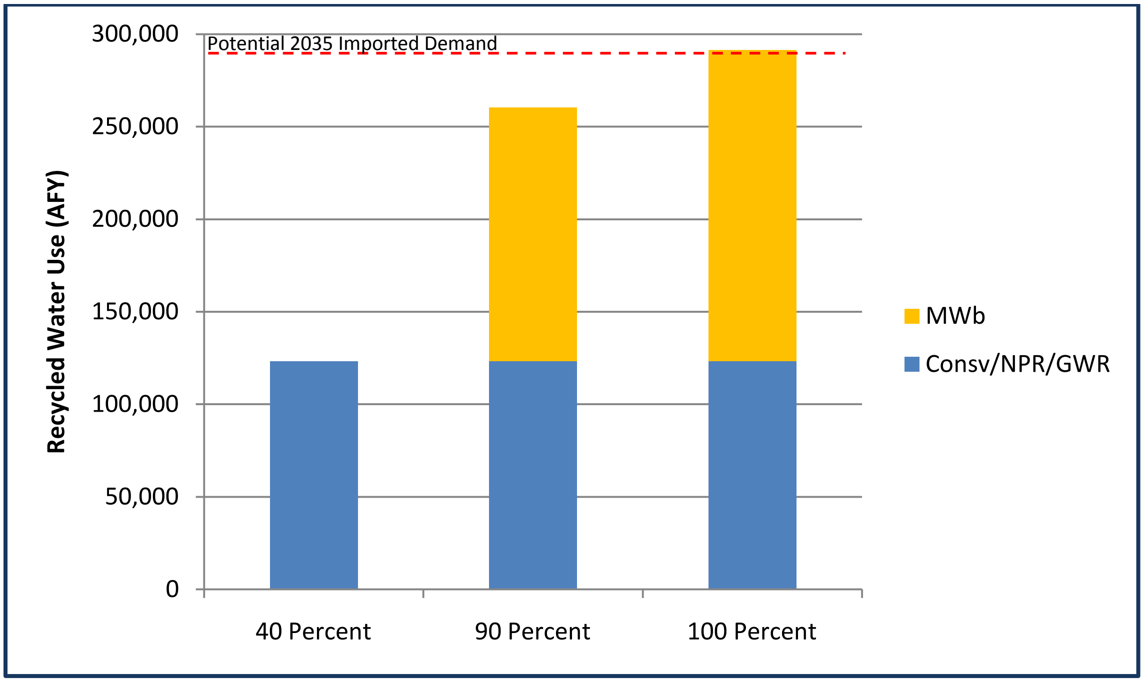
Figure 6-4: Other Agencies Theme/ Scenarios



6.2.6 Maximize Reuse

The Maximize Reuse theme gives priority to project concept MWb, as the highest ranking project with the largest yield. If implemented, MWb would be the only project concept necessary to achieve the 90 percent and 100 percent goals of offsetting imported water. **Figure ES-17** shows the implementation steps of project concept MWb to achieve the 90 percent and 100 percent goals. In addition, if project pg concept MWb is fully implemented (i.e., all 180,000 AFY), the 100 percent milestone could potentially be exceeded.

Figure 6-5: Max Reuse Theme/ Scenarios



6.3 Key Findings and Conclusions

The Long-Term Concepts Report has the following key findings and conclusions. Each of the five themes, if implemented individually, could offset 90 percent of potential MWD imported water demands, and the Maximize Reuse theme could offset 100 percent or higher. Since MWa scored the highest from the three HTP project concepts, it was selected in the first four themes and project concept MWb (the second highest ranked MW project concept) was excluded. Alternately, project concept MWb could be implemented in place of MWa, which would allow the City to offset 100 percent of the imported water demand. This is reflected in the Maximizing Reuse theme. If project concepts Vc or Vd are implemented, the production capacity for project concept MWb would be reduced to 168,000 AFY Figfrom 180,000 AFY due to diversion of influent sewer flows from HTP.

Long term concepts, including the themes discussed above, are presented in this report for discussion purposes only and are intended to encapsulate the potential pathways available to the City given the current regulatory setting. The concepts are intended to maximize the City's recycled water asset after the near-term goal of 59,000 AFY of recycled water is achieved. One thing to note is that the regulatory landscape for potable reuse, which makes up the predominance of opportunity to maximize the recycled water asset, is changing quickly. As new groundwater replenishment (December 2013) and surface water augmentation (December 2016) regulations are promulgated from California Senate Bill 918, and direct potable reuse framework guidelines are established (December 2016), it is envisioned that new opportunities, hopefully with reduced cost and energy implications, will be available to the City.

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