PALMDALE RECYCLED WATER AUTHORITY

RECYCLED WATER FACILITIES MASTER PLAN

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Abbreviation	Description
afy	Acre-feet per year
AVEK	Antelope Valley Eastern Kern Water Agency
Basin Plan	Water Quality Control Plan for the Lahontan Region
Carollo	Carollo Engineers, Inc.
California Department for Public Health	California Department of Public Health
CEC	Constituent of Emerging Concern
CEQA	California Environmental Quality Act
cf	Cubic feet
cfs	Cubic Feet per Second
City	City of Palmdale
CIP	Capital Improvement Program
DWR	Department of Water Resources
ETo	Evapotranspiration
F	Fahrenheit
FAT	Full Advanced Treatment
ft	Feet
ft-msl	feet above sea level
GIS	Geographic Information Systems
Gpcd	Gallons per capita dat
gpd/ac	Gallons per day per acre
HCF	Hundred cubic feet
IS/MND	Initial Study/Mitigated Negative Declaration
IWMP	Integrated Water Master Plan
LACSD	Los Angeles County Sanitation District
LWRP	Lancaster Water Reclamation Plant
MCL	Maximum Contamination Limit
MG	Million gallons
mg/L	Milligrams per liter
mgd	Million gallons per day
mi	Mile
Min.	Minimum
megawatts	Mega Watt
N/A	Not applicable
NEPA	National Environmental Policy Act
NL	Notification Level
PRWA	Palmdale Recycled Water Authority
psi	Pounds per square inch
PWD	Palmdale Water District
PWRP	Palmdale Water Reclamation Plant
RO	Reverse Osmosis
Recycled Water Backbone System	Recycled Water Backbone System

Abbreviation	Description
Regional Water Quality Control Board	Regional Water Quality Control Board
RWC	Recycled Water Contribution
SNMP	Salt Nutrient Management Plan
SWP	State Water Project
SWRCB	State Water Resource Control Board
TDS	Total Dissolved Solids
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
Waterworks No. 40	Los Angeles County Waterworks District No. 40
μg/L	Micrograms per liter

Chapter 1

INTRODUCTION

Over the past five years, both the City of Palmdale (City) and the Palmdale Water District (PWD) have been involved in planning for the use of recycled water within and around the city boundaries and the PWD's service area. They helped develop the Antelope Valley Regional Recycled Water Plan with Los Angeles County Waterworks District No. 40 (Waterworks No. 40) and other regional partners. Both the City and the PWD have produced their own recycled water facility master plans, the PWD's 2010 Recycled Water Facilities Plan (PWD, 2010), and the City's 2009 Recycled Water Facilities Plan (COP, 2009). In addition, the PWD prepared a draft Initial Study/Mitigated Negative Declaration (IS/MND) that provided an environmental review and impact analysis of projects in their facilities master plan. As both recycled water master plans were being adopted, the City and PWD entered into litigation against each other over the right to distribute recycled water within the City.

In the fall of 2012, a mutual agreement was reached wherein the Palmdale Recycled Water Authority (PRWA) was established in order to manage recycled water that is generated and used within the Palmdale area. The PRWA manages all aspects of recycled water use, including the agreements to obtain recycled water from the Sanitation Districts, planning for, designing and constructing supporting facilities, and financing these efforts. At its first meeting in January 2013, the Authority Board of Directors directed staff to proceed with updating and consolidating the master planning documents and to prepare a cost of service study to identify how development of a recycled water system can be economically financed. It also directed staff to identify different potential funding sources for both planning and construction to help offset the local costs.

1.1 REPORT ORGANIZATION

The Master Plan contains five chapters, followed by appendices that provide supporting documentation for the information presented in the report. The chapters are briefly described below:

Chapter 1 - Introduction. This chapter presents the purpose of this Master Plan, describes the efforts of the various stakeholders to coordinate the preparation of the Master Plan, and discusses the organization and scope of the report.

Chapter 2 – Project Setting. This chapter outlines the PRWA service area, the existing and planned facilities for the area, describes the groundwater adjudication process currently taking place, and recaps the findings of the region's Salt and Nutrient Management Plan. Finally, groundwater recharge regulations are reviewed.

Chapter 3 – Market Assessment. This chapter updates the assessment for recycled water based on current potable water use.

Chapter 4 – Project Alternatives and Analysis. This chapter identifies the alternatives most effective in recycled water use and offers an analysis based on unit cost for recycled water and implementability. Projects are also analyzed based on their ability to meet the requirements of the State Water Resource Control Board (SWRCB) and the United States Bureau of Reclamation (USBR) for their facility plans/feasibility studies, and for environmental review (California Environmental Quality Act/National Environmental Policy Act (CEQA/NEPA)). Updated models are used to confirm system hydraulics.

Chapter 5 – Project Recommendations and Conclusions. This chapter summarizes the necessary capital facilities based on hydraulic analysis of the recommended system. This chapter will then provide an implementation plan based on a primary capital phasing.

PROJECT SETTING

The PRWA desires to use recycled water to offset potable water demand and diversify the region's water supply options. The PRWA's service area receives approximately 45 percent of its potable supply from imported surface water, 40 percent from groundwater, and 15 percent from Littlerock Reservoir.

Given Palmdale's high desert location and anticipate future growth, water supply reliability is a significant concern. In addition, the Antelope Valley Groundwater Basin is currently in the process of adjudication, which will limit pumping of available groundwater. Furthermore, the reliability of the State Water Project (SWP) is also in question due to many ongoing issues with the Bay-Delta.

Developing recycled water use in the PRWA's service area would accomplish a number of benefits. These include:

- Reduce dependence on the SWP and groundwater supplies
- Improve water supply reliability
- Preserve potable water supplies
- Provide a potential source of supply for groundwater recharge

2.1 FACILITIES AND DISTRIBUTION

Figure 1 provides an overview of the existing and designed facilities providing recycled water to the PRWA service area. Wastewater collection and treatment in and around the PRWA service area is provided by Los Angeles County Sanitation District (LACSD), Nos. 14 and 20. The two districts serve a combined wastewater service area of approximately 76 square miles and more than 310,000 people. Collection is provided through a network of 104 miles of trunk sewers, which are designed to provide wastewater conveyance via gravity flow.

The Antelope Valley is a closed basin without an outlet to the ocean so treated wastewater either evaporates, is reused, or infiltrates into the Antelope Valley Groundwater Basin.

2.1.1 Palmdale and Lancaster Water Reclamation Plants

The Palmdale Water Reclamation Plant (PWRP) is located in the City of Palmdale and currently provides tertiary treatment for, on average, 9 mgd of wastewater generated in and around the City of Palmdale. The PWRP is operated by the LACSD District No. 20. Currently, the tertiary treated effluent water is provided by the LACSD for irrigation of fodder crops on land leased by the LACSD from the City of Los Angeles Department of Airports through a pipeline located primarily in Avenue N between 30th Street East and 120th Street East.

The Lancaster Water Reclamation Plant (LWRP) is located in the City of Lancaster and currently provides tertiary treatment for, on average, 12 mgd of wastewater generated in both the Cities of Lancaster and Palmdale. Similar to the PWRP, tertiary treated effluent water is provided for irrigation of fodder crops through a pipeline located primarily in Avenue E between Sierra Highway and 90th Street East. Additional water is also used to maintain 200 acres of wetland wildlife refuge, as well as maintain the water level at the Apollo Lakes Regional Park.

2.1.2 Recycled Water System

A Recycled Water Backbone System has been proposed for the Antelope Valley that would connect the LWRP and PWRP, allowing recycled water from both plants to be used throughout the region. Portions of the Recycled Water Backbone System have already been constructed by the City of Lancaster, City of Palmdale, and Los Angeles County Waterworks District No. 40 (Waterworks). Additionally the City of Palmdale has partnered with Waterworks to design and construct a portion of the Recycled Water Backbone System that will complete the connection of the LWRP and PWRP and serve the proposed Palmdale Hybrid Power Plant, the Antelope Valley Country Club, and the Desert Aire Golf Course. The portions of the Recycled Water Backbone System that have been designed or constructed are all located outside of the service area of the PRWA. The primary benefit to the PWRA of these portions is the potential ability to move recycled water between the LWRP and PWRP. However, the majority of the tertiary treated water that will be used in the PWRA service area will originate at PWRP.

Prior to the agreement to create PRWA, the City constructed a recycled water transmission line to deliver recycled water from PWRP to McAdam’s Park for irrigation. The City has an existing agreement with the LACSD for 2,000-acre feet per year (afy) of recycled water to provide to customers throughout the PRWA service area.

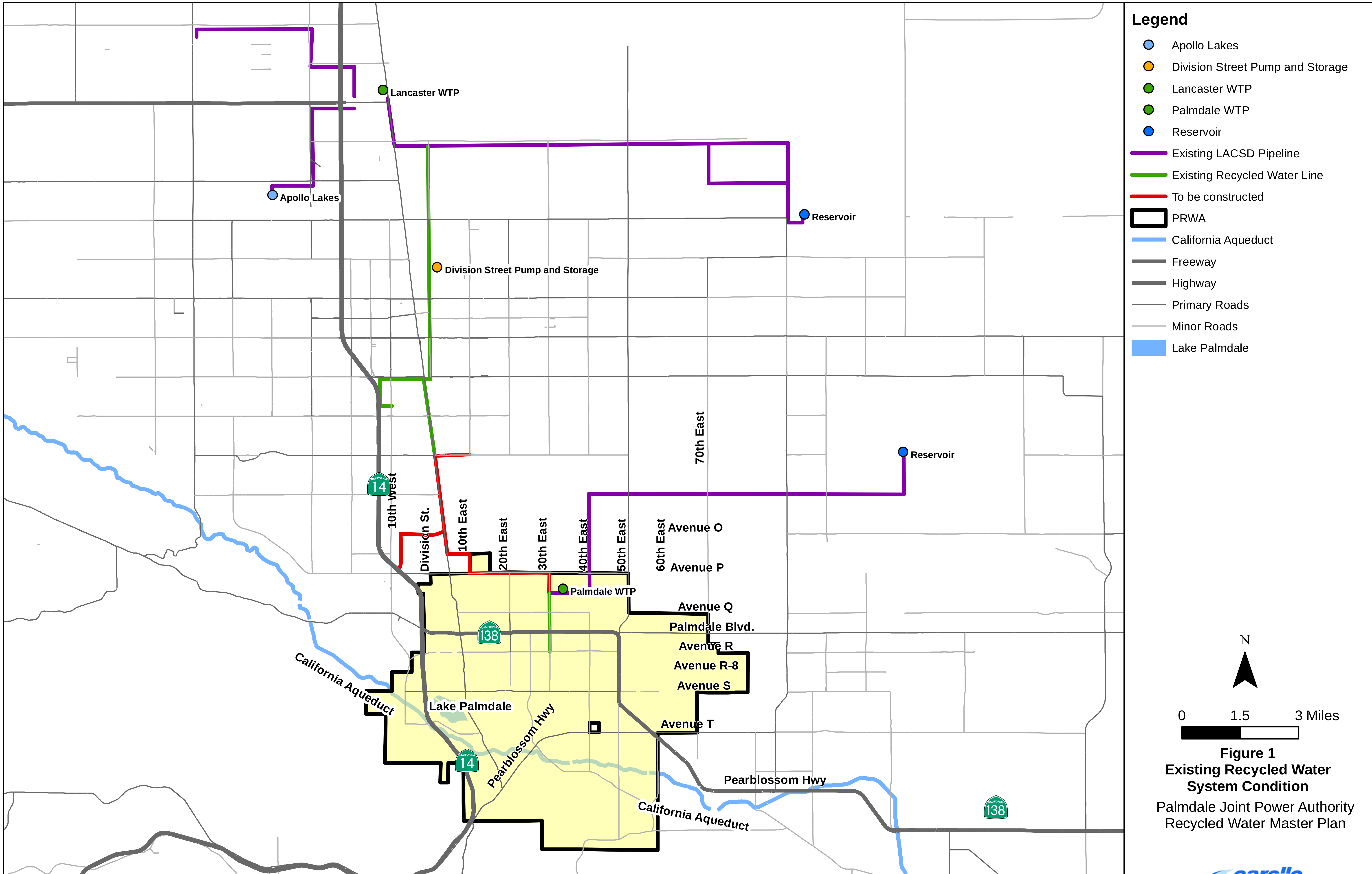

Figure 1
Existing Recycled Water System Condition
Palmdale Joint Power Authority
Recycled Water Master Plan

2.2 ANTELOPE VALLEY GROUNDWATER BASIN ADJUDICATION

Although the Antelope Valley groundwater basin is not currently adjudicated, an adjudication process is underway. There are no existing restrictions on groundwater pumping. However, pumping may be altered or reduced as part of the adjudication process. The adjudication aims to provide clarity for the groundwater users regarding management of groundwater resources.

After adjudication, it is anticipated that the PWD will see a decrease in the volume of the native groundwater they will be allowed to pump because the safe yield of the basin will be set lower than what is currently being pumped from the basin. When this occurs, PWD will need to utilize a replacement water source to make up for the loss of groundwater. The most likely replacement water source will be imported water from the SWP, but recycled water is also an alternative to offset at least some of the reduced supply. Furthermore, the adjudication will likely establish a court-appointed watermaster for the groundwater basin. The watermaster will oversee groundwater recharge activities and any recharge with recycled water will need to be done in coordination with the watermaster.

2.3 ANTELOPE VALLEY SALT AND NUTRIENT MANAGEMENT PLAN

Per the California Recycled Water Policy established by the State Water Resources Control Board, the Antelope Region has drafted a Salt and Nutrient Management Plant (SNMP). The SNMP for the Antelope Valley details groundwater quality in the region, the salt and nutrient loading throughout the region, and methods for monitoring and managing salt and nutrient levels . The recommended groundwater monitoring program was developed based on the anticipated use of recycled water in the Antelope Valley.

The SNMP is currently in draft form, and pending approval by the Antelope Valley Regional Water Management Group, stakeholders will seek adoption of the SNMP by the Lahontan Regional Water Quality Control Board (Regional Water Quality Control Board). Stakeholders will collaborate as necessary with the Regional Water Quality Control Board staff to prepare the SNMP for adoption into the Water Quality Control Plan for the Lahontan Region (Basin Plan). The process may include a public hearing process, an environmental analysis, presentation of SNMP to the Lahontan Regional Water Quality Control Board, and other related activities.

2.4 WATER QUALITY

As described in the SNMP, groundwater quality in the region is excellent within the upper (principal) groundwater aquifer but degrades toward the northern portion of the dry lake areas. Considered to be generally suitable for domestic, agricultural, and industrial uses, the water in the principal aquifer has a total dissolved solids (TDS) concentration ranging from 200 to 800 milligrams per liter (mg/L). The deeper aquifers typically have higher TDS levels. Hardness levels range from 50 to 200 mg/L and high fluoride, boron, and nitrates concentrations have been measured in some areas of the basin. Arsenic is emerging as a constituent of concern in the region and has been observed in some water purveyor supply wells. Research conducted by Waterworks and USGS has shown the problem to reside primarily in the deep aquifer. It is not anticipated that the existing arsenic concentrations will lead to future loss of groundwater as a water supply resource for the region. In addition, portions of the Basin have experienced nitrate levels above the maximum contamination limit (MCL) of 10 mg/L.The water quality objectives for the groundwater basins proposed by the SNMP stakeholder group are shown below in Table 1.

Table 1 Antelope Valley SNMP Water Quality Objectives
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

	Units	Groundwater Quality Objectives[1]	Reference
TDS	mg/L	500	SECONDARY MAXIMUM CONTAMINANT LEVELS in 22 CCR 64449
Chloride	mg/L	250	SECONDARY MAXIMUM CONTAMINANT LEVELS in 22 CCR 64431
Nitrate	mg/L as NO_3	45	MCL in 22 CCR 64431
Nitrite	mg/L as N	1	MCL in 22 CCR 64431
Nitrate + Nitrite	mg/L as N	10	MCL in 22 CCR 64431

Note:
(1) Water quality objectives taken from page 55 of the Draft SNMP for the Antelope Valley

As shown in Table 1, the objectives recommended for the groundwater basin by the stakeholders in the region are based on the primary maximum contaminant levels (MCL) and secondary maximum contaminant levels for drinking water in order to protect the primary beneficial use of the groundwater basin. In Table 2, these objectives are compared to the baseline water quality data for the Lancaster subbasin and the average water quality levels measured in the effluent from the Palmdale WRP.

Table 2 Lancaster Subbasin Water Quality Baselines and Assimilative Capacity Recycled Water Facilities Master Plan Palmdale Recycled Water Authority

	Units	Groundwater Quality Objectives(1)	Baseline	Palmdale WRP Average Concentration(2)
TDS	mg/L	500	323	463
Chloride	mg/L	250	38	149
Nitrate	mg/L as NO_3	45	1.62	2.41
Nitrite	mg/L as N	1	0.037	0.17
Nitrate + Nitrite	mg/L as N	10	1.62	-

Notes:

(1) Water quality objectives taken from page 55 of the Draft SNMP for the Antelope Valley
(2) Average 2012 water quality for tertiary treatment at the Palmdale WRP

As shown in Table 2, the baseline and discharge levels meet all the water quality objectives recommended in the SNMP.

2.4.1 Monitoring

Per the Recycled Water Policy, the SNMP establishes a basin wide program to monitor the levels of salts and nutrients throughout the groundwater basin in relationship to the baseline levels and objectives established by the SNMP. The approach to this monitoring program for the SNMP was to select existing wells were feasible and appropriate in proximity to the areas where recycled water will be used. When projects that use recycled water are implemented, the responsible agency will designate a groundwater well (existing or new), as appropriate, to be included in the SNMP monitoring program. Source waters to the region, such as imported and recycled waters are monitored at the applicable treatment plant.

Per the SNMP, existing raw imported water, treated potable water, groundwater, and recycled water monitoring programs provide the basis for the SNMP monitoring program. The appropriate agency or well owner is responsible for monitoring and reporting water quality. For example, PWD will be responsible for monitoring raw imported water and groundwater in their service area whereas the Sanitation Districts will monitor the recycled water that they produce.

For the purposes of the SNMP, the monitored and reported constituents include:

- Total dissolved solids
- Nitrogen species (ammonia, nitrate, and nitrite)
- Chloride

- Arsenic
- Chromium
- Fluoride
- Boron
- Constituents of Emerging Concern (CECs)

Recycled water implementation will primarily entail close monitoring of TDS, chloride, and nitrogen species. Further information on the presence and source of these contaminants can be found in Section 3 of the SNMP. Monitoring will be consistent with the actions by the State Water Resources Control Board (State Board) taken pursuant to the Recycled Water Policy.

Specific CEC monitoring requirements prescribed in the Recycled Water Policy pertain to the production and use of recycled water for groundwater recharge by surface and subsurface application methods. Prior to the implementation of any proposed groundwater recharge project using with recycled water, the appropriate agency (or agencies) will monitor the water for CECs as prescribed in the Recycled Water Policy, as applicable, unless an alternative monitoring plan is proposed and approved by the Regional Water Quality Control Board.

The RWMG may take on the responsibility for reporting monitoring results to the SWRCB or the reporting responsibilities could potentially be another duty of the eventual watermaster for the Antelope Valley groundwater basin.

2.5 CURRENT SUPPLY AND USE OF RECYCLED WATER

The Antelope Valley SNMP provides the most up-to-date accounting of the volume of recycled water available in the region and the potential customers for the recycled water. The total annual volumes of recycled water anticipated to be available from the PWRP in the SNMP are listed in Table 3.

Table 3 PWRP Upgrade and Expansion Effluent Flows
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

	2010 (acre feet)	2015 (acre feet)	2020 (acre feet)	2025 (acre feet)	2030 (acre feet)	2035 (acre feet)
Palmdale WRP Upgrade and Expansion	-	15,000	16,500	18,000	19,500	21,000

Note:
(1) Volumes taken from page 54 of the Draft SNMP for the Antelope Valley

As shown in Table 3, flows were projected to be approximately 15,000 afy in 2015 and increase to 21,000 afy by 2035.

Existing recycled water customers served by the PWRP are listed below in Table 4. As shown in Table 4, the largest existing consumer of recycled water from the PWRP is Antelope Valley Farms, the agricultural customers working closely with LACSD to dispose of plant effluent via agriculture.

Table 4 PWRP Existing Customers
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Customers	July 2013 Demand[1] (MGD)
Harrington Farms	0.15
Antelope Valley Farms[2]	10.18
City of Palmdale	0.14
Total	**10.47**

Notes:

(1) July 2013 PWRP Monitoring Report

(2) Antelope Valley Farms represent the growers who lease land from LACSD for the purpose of effluent disposal via alfalfa crops

As shown in the following table, four projects that will potentially be served by the PWRP are at various stages of completion. These projects were identified in the SNMP and are discussed in more detail below.

2.5.1 City of Palmdale Hybrid Power Plant Project (2015)

This project involves the construction of a 570-megawatt electricity generating facility. The power plant will be a hybrid design, utilizing natural gas combined cycle technology and solar thermal technology. The power plant is projected to use approximately 3,200 AFY of recycled water and discharge waste to on-site evaporation ponds. This project will be served by the portion of the Recycled Water Backbone System currently being designed by the City of Palmdale and Waterworks.

2.5.2 PRWA Service Area Customers

A portion of the “North LA/Kern County Regional Recycled Water Project,” (or the Recycled Water Backbone System) identified in the SNMP are customers located within the PRWA service area that were proposed to be served by the PRWA recycled water system. The anticipated use by these customers is analyzed in Chapter 3.

Table 5	PRWA Planned Projects Recycled Water Facilities Master Plan Palmdale Recycled Water Authority					
	2010 (acre feet)	**2015 (acre feet)**	**2020 (acre feet)**	**2025 (acre feet)**	**2030 (acre feet)**	**2035 (acre feet)**
Palmdale WRP Upgrade and Expansion	**-**	**15,000**	**16,500**	**18,000**	**19,500**	**21,000**
Palmdale Hybrid Power Plant Project	-	3,200	3,200	3,200	3,200	3,200
PRWA Service Area Customers	TBD	TBD	TBD	TBD	TBD	TBD
Palmdale Water District Groundwater Recharge	-	-	-	-	3,000	6,000
Palmdale WRP Agricultural Site	8,500	9,500	10,500	11,500	12,500	13,500

Notes:

(1) Volumes taken from page 54 of the Draft SNMP for the Antelope Valley
(2) Extra flows will become available from the LWRP and also used to meet demands

2.5.3 Palmdale Water District Groundwater Recharge (2015)

PWD has identified the potential of using a blend of imported and recycled water to recharge the Antelope Valley groundwater at both the Littlerock Creek and Amargosa Creek. The City of Palmdale is currently designing the portion of the project that will recharge imported water at the Amargosa Creek. PWD is undertaking a feasibility study for the portion of the project that will recharge imported, storm and recycled water at the Littlerock Creek. The volumes shown in Table 5 reflect preliminary estimates identified in the SNMP.

2.5.4 Palmdale WRP Agricultural Site (Existing)

Currently, LACSD leases land from Los Angeles World Airports for agricultural operations that is irrigated with recycled water produced by the PWRP. The LACSD has acquired additional land further east for future agricultural operations and the property is not currently using recycled water. However, recycled water storage reservoirs and conveyance facilities have been constructed and are in use. It is important to note that as the recycled water is used for M&I purposes and groundwater recharge, the LACSD anticipates reducing the amount of water that it provides for agriculture. The SNMP identifies an increasing amount of use at this time because until these alternative M&I uses are developed, the recycled water must still be disposed of via agricultural irrigation.

2.6 GROUNDWATER RECHARGE REGULATIONS

Federal requirements relevant to the use of recycled water for groundwater recharge are contained in the 1986 amendments of the Safe Drinking Water Act of 1974 (Public Law 93-523). The Safe Drinking Water Act focuses on the regulation of drinking water and control of public health risks by establishing and enforcing maximum contaminant levels (MCLs) for various compounds in drinking water.

The State regulations regarding groundwater recharge, known as *Groundwater Replenishment Reuse Regulations,* are currently under development (California Department for Public Health , 2013). According to the draft regulations for surface application facilities, recycled municipal wastewater must be blended with other sources of water (diluent water). The initial maximum blending ratio known as Recycled Water Contribution shall not exceed 0.2 (i.e., 20% recycled water) unless an alternative initial Recycled Water Contribution is approved by the California Department for Public Health . The Recycled Water Contribution is calculated based on the running monthly average for the preceding 120 months. The maximum Recycled Water Contribution may be increased over time pending California Department for Public Health and Regional Water Quality Control Board approvals and compliance with total organic carbon (TOC) requirements.

The draft regulations note that a higher Recycled Water Contribution (up to 100 percent) may be possible with full advanced treatment, which is the treatment of an oxidized wastewater using a reverse osmosis and an advanced oxidation treatment process (e.g. ultraviolet combined with hydrogen peroxide). The initial Recycled Water Contribution for full advanced treatment wastewater will be based on the California Department for Public Health's review of an engineering report prepared for a project and information obtained during a public hearing.

According to draft regulations, unless diluent water is a California Department for Public Health -approved drinking water source, it too should be monitored for nitrate and nitrite, and meet primary MCLs, secondary MCLs and notification levels, among other requirements.

One of the primary water quality constituents of concern for recycled water recharge is TOC. While some natural TOC removal will likely occur as recycled water percolates through the vadose zone (referred to as Soil Aquifer Treatment), partial TOC treatment may be needed for some recharge projects under the current regulations. To obtain a reasonable estimate of the treatment level, soil column testing will be required. The potential soil aquifer treatment credit is subject to California Department for Public Health approval.

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MARKET ASSESSMENT

This section presents an assessment of the market for recycled water use within the PRWA service area. The goals of a market assessment are to identify potential customers within a given area. Land use, historic demands, available supply, implementation challenges, installation, and utilization are all considered in developing a customer base. The methodology for developing the market used in this report is described below.

3.1 RECYCLED WATER MARKET

There are two groups of customers in the PRWA service area for which recycled water demand exists. The first group, the Schools, Parks, and Others, contains the high demand irrigation customers in the service area. This set of customers is primarily drawn from the two previous master plans (PWD, 2010 and COP, 2009) discussed in Chapter 1.0. The second group, Landscape Maintenance Districts (Lads), is comprised of common landscaped areas irrigated off of a single connection in residential areas. This set of data was provided by Palmdale Water District.

3.1.1 Schools and Parks

The Schools, Parks, and Others list of customers was created after performing an analysis of the market assessment from the PWD 2010 Recycled Water Master Plan. A total of 50 customers were outlined in that report and those customers were carried over to form an updated database of potential customers. Annual demands from 2008 through 2012 were used where available to estimate future demands. Where updated data was not available, the estimated demands from the PWD 2010 Recycled Water Master Plan were incorporated. For planning purposes, the maximum annual use for each customer from 2008 to 2012 was used where available to establish customer demand.

The lists of schools, parks and other users can be found in Table 6, Table 7, and Table 8, respectively.

Table 6	Customer List – Schools Recycled Water Facilities Master Plan Palmdale Recycled Water Authority					
Customer Name	**Account Number**	**Site ID**	**Irrigated Area (acres)**	**Annual Demand (afy)**	**Max Day Demand (mgd)**	**Peak Hour Demand (gpm)**
Manzanita Elementary School	42961620	S1	3.8	27.0	0.05	100.6
Tumbleweed Elementary School	43662101	S10	5.6	29.6	0.05	110.1
Yucca Elementary School	42662450	S11	3.2	19.0	0.03	70.9
Cactus K-8	33061060	S12	4.5	37.9	0.07	140.8
Mesa Intermediate School	43261101	S13	9.1	47.7	0.09	177.5
Los Amigos School	23561917	S14	1.7	35.3	0.06	131.3
Pete Knight High School	23561001	S15	20	243.9	0.44	907.5
Shadow Hills Intermediate School	23461001	S16	7.0	98.6	0.18	367.0
Yellen Learning Center School	40481015	S17	2.1	16.1	0.03	60.0
Oak Tree Learning Center	23261001	S18	7.1	40.9	0.07	152.2
Mesquite Elementary School	43361101	S2	3.4	28.7	0.05	106.7
R. Rex Parris High School	22362903	S20	1.7	16.6	0.03	61.9
Buena Vista Elementary School	40451001	S22	7.1	53.2	0.10	198.1
Cimmaron Elementary School	10551004	S23	2.8	28.1	0.05	104.5
Golden Poppy Elementary School	43561001	S24	2.3	29.3	0.05	109.1
Chaparral Elementary School	33461101	S26	2.5	16.3	0.03	60.5

Table 6 Customer List – Schools
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Customer Name	Account Number	Site ID	Irrigated Area (acres)	Annual Demand (afy)	Max Day Demand (mgd)	Peak Hour Demand (gpm)
Palmtree Elementary School	60794001	S3	3.3	32.1	0.06	119.6
Tamarisk Elementary School	12562700	S5	3.3	24.4	0.04	90.7
Wildflower Elementary School	32971136	S6	3.8	30.4	0.05	113.0
Palmdale Learning Plaza	22762900	S7	6.6	52.3	0.09	194.7
Palmdale High School	33061061	S8	5.6	82.1	0.15	305.5
Desert Rose Elementary School	23161801	S9	4.4	26.2	0.05	97.3
High School (47th & Pearblossom)	n/a	S27	6.8	26.2	0.05	97.5
Phoenix High School	n/a	S4	4.4	11.7	0.02	43.5
Barrel Springs Elementary School	n/a	S19	9.7	58.0	0.10	215.8
Desert Millow Intermediate School	n/a	S21	10.2	36.8	0.07	136.9
Joshua Hills Elementary School	n/a	S25	9.3	22.9	0.04	85.2
Total	**-**	**-**	**151**	**1,172**	**2.09**	**4,358**

Table 7	Customer List – Parks Recycled Water Facilities Master Plan Palmdale Recycled Water Authority					
Customer Name	**Account Number**	**Site ID**	**Irrigated Area (acres)**	**Annual Demand (afy)**	**Max Day Demand (mgd)**	**Peak Hour Demand (gpm)**
Dr. Robert C. St. Clair Parkway	12662405	P1	2.8	31.9	0.06	118.5
Pelona Vista Park	43462001	P10	26.2	116.6	0.21	434.0
Dry Town Water Park	40551905	P11	7.1	68.4	0.12	254.5
McAdam Park	23271901	P2	15.3	64.1	0.11	238.6
Courson Park	32562226	P3	4.0	35.1	0.06	130.7
Desert Sands Park	76700008	P4	11.3	53.7	0.10	199.7
Domenic Massari Park	01762991	P7	30	150.6	0.27	560.2
60th St E/Ave S-8 Park	n/a	P12	19.2	84	0.15	312.5
72nd St E/Ave R-8 Park	n/a	P13	10.4	42	0.07	156.3
70th St E/Ave R Park	n/a	P14	10.4	42.0	0.07	156.3
Sam Yellen Park	n/a	P15	0.8	105.0	0.19	390.6
Sierra Hwy Green Belt	n/a	P16	0.2	16.0	0.03	59.5
Palmdale Park	n/a	P17	0.3	11.0	0.02	40.9
Desert Sands Expansion	n/a	P5	4.0	29.0	0.05	107.9
Desert Lawn Memorial Park	n/a	P6	47	32.3	0.06	120.2
Joshua Hills Park	n/a	P8	3.6	16.3	0.03	60.6
Total	**-**	**-**	**142**	**849**	**1.6**	**3,160**

Table 8	Customer List – Others Recycled Water Facilities Master Plan Palmdale Recycled Water Authority					
Customer Name	**Account Number**	**Site ID**	**Irrigated Area (acres)**	**Annual Demand (afy)**	**Max Day Demand (mgd)**	**Peak Hour Demand (gpm)**
American Indian Little League	76700006	O1	4.5	10.5	0.02	39.0
Ponciltan Square	22662991	O2	1.5	0.0	0.00	-
Ponciltan Square (New Mtr-A)	69400291	O2	1.5	8.9	0.02	32.9
Ponciltan Square (New Mtr-B)	69400292	O2	1.5	7.6	0.01	28.1
Palmdale Pony League	33061000	O_3	21.4	19.9	0.04	74.0
Trailer Shay	20351003	O4	14.1	3.7	0.01	13.8
Palmdale City Library	22662701	O5	0.2	5.0	0.01	18.6
Palmdale Parks & Rec Office	32562260	O6	0.3	3.5	0.01	12.9
Palmdale Playhouse	32562334	O7	0.1	2.8	0.01	10.5
Total(1)	**-**	**-**	**42**	**62**	**0.11**	**230**

Note:

(1) Ponciltan Square area only counted once

As shown on Table 6, Table 7, and Table 8, schools represent the largest group of recycled customers within the PRWA service area with more than 1,100 afy of annual demand. Parks are the second largest group, with 850 afy of annual demand, and roughly 60 afy of annual demand used by the Other category.

3.1.2 Landscape Maintenance Districts (LMDs)

In addition to the Schools, Parks, and Others list of customers, the PRWA could provide water to a second group, the Landscape Maintenance Districts (LMDs), which represent residential areas similar to homeowners associations. These areas are within residential neighborhoods and typically consist of communal landscape areas such as street medians or sidewalk shoulders. One hundred sixty-six (166) LMDs have been identified by the PWRA. Where available, consumption data from 2012 was used to predict future demands. Using 2012 consumption data for 133 of the identified LMDs, an average LMD demand of 31 HCF per acre per year was developed. This water demand factor was assigned to the remaining 33 LMDs for which 2012 consumption data was unavailable. The total annual demand for all 166 LMDs is approximately 300 afy.

The complete list of LMD sites can be found in Appendix B.

3.1.3 Groundwater Recharge

While not a direct use, a significant potential for recycled water use in the PRWA service area is groundwater recharge. Recharge of the Antelope Valley Groundwater basin would help alleviate the overdraft condition of the basin and offer a valuable opportunity to temporarily store available water supplies for future use. Recycled water would need, at least initially, to be blended with available imported or storm water. Two different recharge sites, Littlerock Creek and Amargosa Creek, are already being analyzed or developed by the City and PWD as locations for recharging excess imported water. By extending the PWRA's delivery system to these locations, significantly more recycled water could be put to beneficial use through indirect potable reuse than could be directly used in the PWRA's service area even if all the identified direct use customers were connected to a distribution system.

As discussed in Section 2.5, the regulations regarding groundwater recharge with recycled water are still in draft form. Based on the current draft of the regulations, a second approved source of water (likely either storm or imported) would also need to be used for recharge at a rate of between double and quadruple the amount of recycled water.

3.1.4 Agricultural Demands

As previously discussed, LACSD leases land from Los Angeles World Airports for agricultural operations that is irrigated with recycled water produced by the PWRP. There is future potential that LACSD could utilize recycled water at sites acquired further east for future agricultural operations. These sites are not currently using recycled water. However, recycled water storage reservoirs and conveyance facilities have been constructed and are in use. Although the potential to utilize recycled water within the near-term for agricultural use, the supply may be reduced to accommodate M&I and groundwater recharge.

3.1.5 Summary of Recycled Water Market Assessment

The combination of 50 Schools, Parks, and Others customers and 166 LMD sites comprises the total recycled water direct use market in the PRWA service area. With the exception of the City of Palmdale Hybrid Power Plant Project, discussed in Chapter 2, there are no industrial customers in the PRWA service area that could take advantage of recycled water. All demand (summarized in Table 9) comes in the form of irrigation, and each customer can be classified as either Schools, Parks, and Others or LMD. Demand for agricultural irrigation and for groundwater replenishment are also included in Table 9 although the locations for each are located outside of the PRWA service area.

Table 9 Others Customer List Recycled Water Facilities Master Plan Palmdale Recycled Water Authority				
Customer Class	**Number of Accounts**	**Annual Demand (afy)**	**Max Day Demand (mgd)**	**Peak Hour Demand (gpm)**
Schools	27	1,172	2.09	4,358
Parks	14	849	1.60	3,160
Others	9	62	0.11	230
Landscape Maintenance Districts	166	309	0.55	1,150
City of Palmdale Hybrid Power Plant Project	1	3,200	n/a	n/a
Groundwater recharge[1]	2	6,000	n/a	n/a
Agriculture	TBD	TBD	TBD	TBD
Total	**217**	**5,592**	**4.35**	**8,898**

Note:
(1) Based on the draft SNMP for the Antelope Valley.

A map of the total recycled water market can be found in Figure 2. This map also displays relative demands of the individual customers throughout the service area.

3.2 PRE-DETERMINED ALIGNMENT LIMITATIONS

As mentioned above, the recommended alignment for recycled water delivery lines within the PRWA service area was determined by the prior Master Plans. This has the effect of making several of the Schools, Parks, Others and LMD sites non-viable prior to the alternative analysis presented in Chapter 4.

Because their demands are mainly comprised of small scale, residential irrigation, LMD annual demands are relatively small. Of the 166 LMD customers, 79 use less than 1 afy and 151 use less than 5 afy. Furthermore, the LMDs are geographically dispersed, found scattered throughout the PRWA service area rather than clustered along any major street or thoroughfare. It is, therefore, economically difficult to justify the installation of significant lengths of pipe to reach LMD customers. However, where identified LMDs are adjacent to the pre-determined alignment, it makes sense to include them in the project alternative analysis presented in Chapter 4.

Similar to the LMD customers, the 50 Schools, Parks, and Others customers were assessed based on their proximity to the pre-determined alignment. The Schools, Parks, and Others customers generally had significantly higher annual demand however, which resulted in 32 of the original 50 customers being carried forward to the alternative analysis presented in Chapter 4.

3.3 RECYCLED WATER SUPPLIES

Existing recycled water supplies are dependant on wastewater flows to the PWRP. In 2011, the PWRP produced 10,640 af of tertiary treated recycled water. Based upon preliminary discussions between the local jurisdictions, water retailers and LACSD, PWRA staff indicate that they anticipate 98% of the treated wastewater produced at the PWRP with be available to the PRWA. The remaining 2% will be reserved for reuse within the County unincorporated areas. Using 2011 flows as a baseline, 10,430 afy will therefore be available for use in the PWRA service area. The first 3,200 afy of this available recycled water will be used at the City of Palmdale Hybrid Power Plant Project. The remaining 7,230 afy are available for other direct recycled water uses, groundwater recharge, and crop irrigation. This balance is described below in Table 10.

Table 10 PRWA Recycled Water Supply Balance
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

	PWRP Allotment(1) (afy)	City of Palmdale Hybrid Power Plant Project Supply (afy)	Remaining Balance(2) (afy)
PRWA Recycled Water Allotment	10,430	3,200	7,220

Notes:
(1) Based on 2011 data. Non-flushing years will allow for a greater allotment. 2011 selected for conservative planning purposes
(2) Current remaining balance used to meet demands at McAdams park, while all other flows are used for fodder crop irrigation.

In 2000, the Lahontan Regional Water Quality Control Board issued revised Waste Discharge Requirements (Lahontan Regional Water Quality Control Board Order 6-00-57) for the PWRP that set receiving water limits and ordered LACSD to take action in regards to suspected groundwater nitrate contamination attributed in part to historical land application and agricultural practices. To comply with these requirements, the PWRP is currently disposing of effluent via crop irrigation at agronomic rates. This use is anticipated to continue until the customers described above are reached with the recycled water pipeline, whereupon direct recycled customers will take priority over fodder crop irrigation.

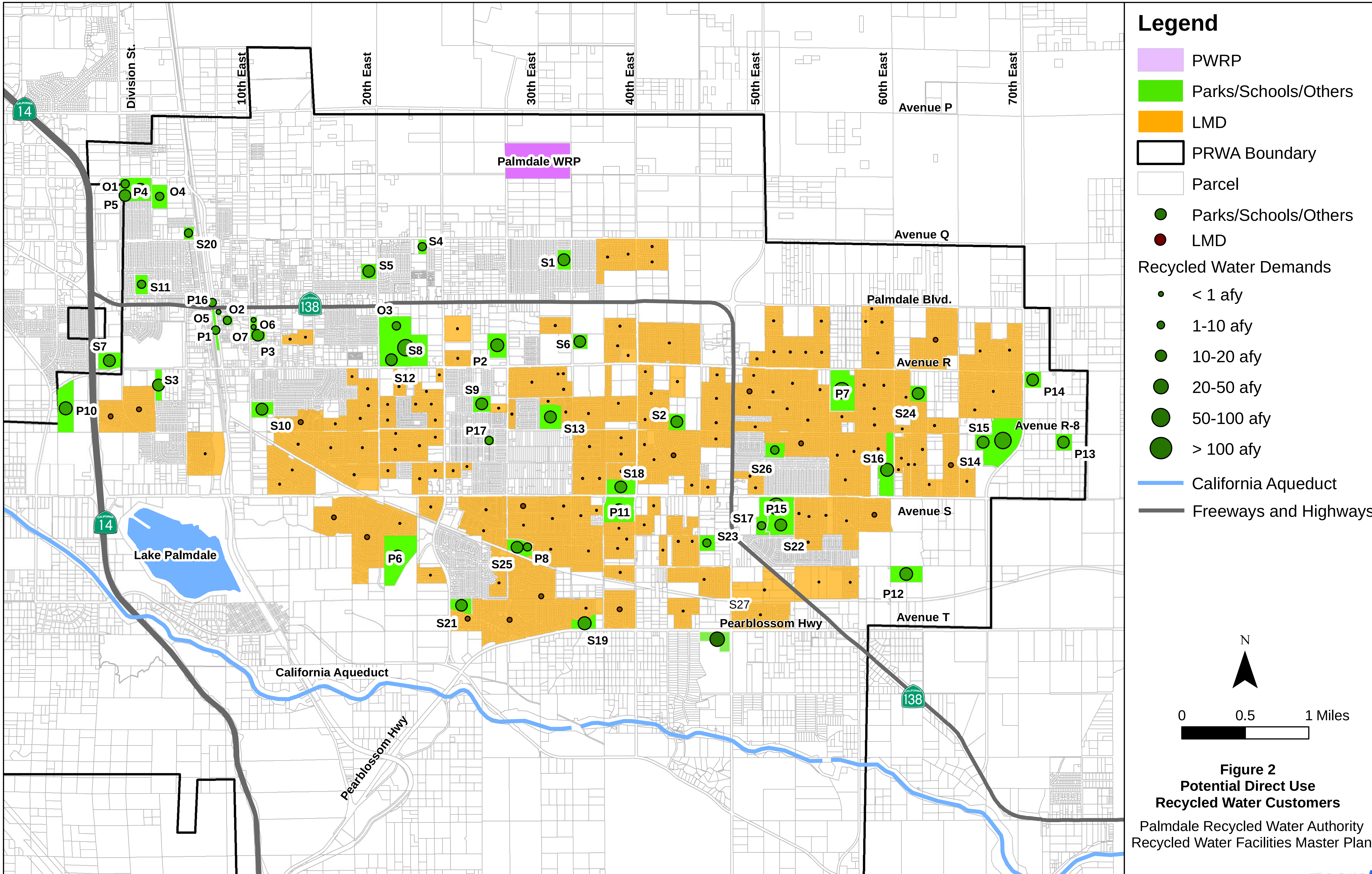

Figure 2
Potential Direct Use
Recycled Water Customers

Palmdale Recycled Water Authority
Recycled Water Facilities Master Plan

3.4 WATER QUALITY

2013 water quality data of PWRP's tertiary treated effluent is presented below in Table 11.

Table 11 2013 Palmdale WRP Recycled Water Priority Constituent Concentrations
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Ammonia Nitrogen (mg/L) [1]	Nitrate Nitrogen (mg/L) [1]	Nitrite Nitrogen (mg/L) [1]	Total Nitrogen (mg/L) [1]	Chloride (mg/L) [1]	TDS[1]	TOC[2]
4.0 - 6.3	2.17 - 2.68	0.162 - 0.178	8.97 - 10.5	178	500-560	5.34

Notes:

(1) Data from the PWRP Water Recycling Monitoring Report - First Quarter 2013
(2) Data from the PWRP Monthly Monitoring Report – July 2013

As discussed in Section 2.5, groundwater recharge regulation states that the water quality of discharged waters must be of higher quality than the maximum allowable groundwater basin contaminant load, as presented in the Antelope Valley SNMP. Current PWRP tertiary effluent water quality, detailed in Table 11, meet this requirement.

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PROJECT ALTERNATIVES AND ANALYSIS

Five recycled water project alternatives were developed and compared in this chapter. For each alternative, a description of the alignment, potential customers served and their estimated demands, and major infrastructure requirements are presented.

This chapter also presents the basis for infrastructure sizing, cost development and other non-monetary criteria to evaluate and compare the identified alternatives. These criteria were used to rank the alternatives and identify the one that best meets the Palmdale Recycled Water Authority's (PRWA's) goals and objectives. A "No Project" alternative is also discussed in this chapter.

4.1 INFRASTRUCTURE SIZING ASSUMPTIONS

PRWA's future recycled water system facilities were sized based on the projected demands (as defined in Chapter 3) and sizing criteria presented in Table 12 and discussed briefly below. The criteria were developed based on industry standards and experience with similar systems. Several of the criteria listed in Table 12 represent conservative planning assumptions. During the next phase of design, and as the commitment of potential customers becomes more certain, these planning and evaluation criteria should be further refined.

4.1.1 Conveyance Sizing

The recycled water system conveyance components (i.e., pumping and piping) should be able to supply the peak hour demand of the recycled water system. The peak hour demand could be supplied from the pump station at the Palmdale Water Reclamation Plant (PWRP) alone or from a combination of the PWRP's pump station and a storage tank.

If storage is present, the pump station at PWRP is sized to provide the maximum day demand of the system and the supply in excess of maximum day demand required for peak hour demand would come from operational storage. If no operational storage is present, the pump station at PWRP is sized for the system's peak hour demand.

For reliability purposes, it is desirable that the pump station's firm capacity be able to supply maximum day demand. The firm capacity of a pump station is the total capacity minus the capacity of the largest pump.

Table 12	Infrastructure Sizing Criteria Recycled Water Facilities Master Plan Palmdale Recycled Water Authority
Category	**Criteria**
Storage	
Operational Storage[1]	(peak hour $\text{demand}_{\text{mgd}}$-maximum day $\text{demand}_{\text{mgd}}$) x (8 hours) x (1 day/24 hours)
Pipelines	
Maximum Velocity	5 fps
Roughness Coefficient	135
Typical Pipeline Sizes	6, 8, 12, 16, 18, 20, 24 inches
Service Pressure	
Minimum Pressure During peak hour demand	40 psi
Maximum Pressure During peak hour demand	150 psi
Peaking Factors	
Irrigation:	
Maximum Day PF	2.0
Minimum Day PF	0.5
Hourly PF	3.0

Note:
(1) This criterion is used to approximate the storage requirement of various alternatives assuming a nighttime 8-hour irrigation diurnal pattern.

4.1.2 Operational Storage

Operational storage is the amount required to provide the difference in quantity between the customers' peak demands and the system's firm supply capacity. Because the various alternatives assume a nighttime 8-hour irrigation diurnal pattern, the required operational storage, in million gallons, is calculated using the following formula:

Operational Storage = (peak hour demand – maximum day demand) x (8 hours) x
(1 day/24 hours)

4.1.3 Peaking Factors

Peaking factors represent the seasonal and daily variations in recycled water use, above or below the average day recycled water demand. The peaking conditions that are of particular significance for recycled water planning include the maximum day demand and the peak hour demand. Peaking factors for expressing these demands as a function of the average seasonal demand were developed based on the criteria summarized in this section.

A maximum day irrigation peaking factor of 2.0 was assumed for irrigation users. This factor was taken from Palmdale Water District's (PWD's) Recycled Water Facilities Plan (RMC, 2010) which had been estimated from the evapotranspiration data. The minimum day irrigation peaking factor was assumed to be 0.5.

An 8-hour nighttime pattern (10 PM – 6 AM) was assumed for irrigation customers based on discussion with PWRP staff and consistent with previous master plans.

To avoid oversizing conveyance facilities, no peaking was assumed for groundwater recharge operation. The recharge amount at any given time was assumed to be determined based on the excess supply after serving all direct use customers. Therefore, the maximum day recharge demand would occur during wintertime when irrigation demand is lowest. The peak hour recharge demand would occur during daytime when full supply and conveyance capacities are available.

4.2 RECYCLED WATER SUPPLY

The supply for all alternatives was assumed to be provided from PWRP. The maximum supply availability at buildout was estimated to be 10,750 afy. This estimate was developed based on the following assumptions:

- The current PWRP's capacity is 9.5 mgd resulting in maximum average annual supply availability of about 10,640 afy.
- The unincorporated allotment will remain constant at about 210 afy through buildout, which will be supplied from PWRP.
- City of Palmdale Hybrid Power Plant Project demand will remain constant at about 3,200 afy through buildout, which will be supplied from PWRP.
- The remaining current supply (i.e., 7,230 afy) will grow at about 1 percent annually for the next 40 years (buildout).

Using the above assumptions the recycled water supply availability at buildout was estimated to be about 10,750 afy, which is equivalent to 9.6 mgd or 6,675 gpm. This is roughly the capacity of the existing 24-inch diameter pipeline along 30th Street East.

4.3 DISTRIBUTION SYSTEM ALTERNATIVES

The main goal of developing distribution system alternatives is to connect to as many potential recycled water users with high demands as possible in the most cost effective and operationally flexible manner.

Five alternatives were developed using all or a portion of the predetermined alignment as discussed in Chapter 3. Two of the alignments extend recycled water for landscape irrigation only along the entire or a portion of the predetermined alignment. The remaining three alternatives extend recycled water to both irrigation users and groundwater recharge location(s). The main difference in these three alternatives is the location and the amount of groundwater recharge.

Table 13 presents a brief description and a summary of average annual direct use and groundwater recharge demands of each of the five alternatives.

Table 13 Estimated Average Annual Recycled Water Demands
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Alt	Description	Direct Use (afy)	Upper Amargosa Creek (afy)	Littlerock Creek (afy)	Total Yield (afy)
1	Full direct use with no recharge	1,725	0	0	**1,725**
2	Full direct use and full recharge split between Upper Amargosa and Littlerock creeks	1,675	4,550	4,550	**10,775**
3	Eastern direct use with full recharge at Littlerock Creek	1,325	0	9,450	**10,775**
4	Eastern direct use with half recharge at Littlerock Creek	1,325	0	4,725	**6,050**
5	Eastern direct use with no recharge	1,325	0	0	**1,325**

A hydraulic computer model of all five alternatives was developed in Innovyze's H2OMap Water® modeling software. The model was used to simulate peak demand conditions under each alternative in order to size conveyance capacity using the criteria presented in Table 12. A summary of major distribution system facilities is presented in Table 14.

The alternative alignments, demands and major infrastructure facilities are further described in this section.

Table 14	Summary of Infrastructure Needs Recycled Water Facilities Master Plan Palmdale Recycled Water Authority		
Alt	**Pipeline (LF)**	**Net Operational Storage (MG)**	**Firm Pump Station Capacity (brake horsepower)**
1	118,700	2.1	325
2	124,400	0	900
3	69,900	0	800
4	69,900	0	575
5	62,700	0	575

4.3.1 Alternative 1 – Full Direct Use with No Recharge

This alternative was developed to plan for the possibility of extending recycled water across PWRA's service area for direct use without any groundwater recharge supplied from PWRP.

This section describes the alignment, potential customers served and their demands and the infrastructure required for Alternative 1.

Alignment

This alternative was developed to serve all potential direct recycled water users along the predetermined alignment assuming no groundwater recharge would occur in the future. The alignment for this alternative extends from the end of the existing 24-inch pipeline on 30th Street East eastward along Avenue R to Pelona Vista Park on Tierra Subida Avenue and southward along 30th Street East to Avenue R-8 and along Avenue R-8 to Pete Knight High School on 70th Street East.

The buildout alignment under this alternative is shown on Figure 3.

Potential Customers and Demands

This alternative would serve 33 customers from the Schools, Parks, and Others category with a combined average annual demand of about 1,615 afy and 50 LMDs with a combined estimated average annual demand of about 110 afy. The total average annual demand of this alternative at buildout was therefore estimated to be about 1,725 afy. The maximum day demand and peak hour demand of potential direct use customers served under this alternative were estimated to be about 3.1 mgd and 6,425 gpm during peak summer demand, respectively.

The potential customers served under this alternative is also shown on Figure 3. The complete list of customers served under this alternative is shown in Appendix C.

Infrastructure Needs

To determine whether the system could benefit from operational storage, this alternative assumed a storage tank would be located at the intersection of 47th Street East and California Aqueduct. This location has a ground elevation of about 2,950 ft above mean sea level (msl) providing adequate hydraulic grade line for the system. The benefit of such storage is a reduced pumping capacity requirement at PWRP. This is because only one third of the peak hour demand would be pumped from the plant with the remaining two thirds supplied from the storage by gravity.

The main disadvantage of the proposed configuration in Alternative 1 is that the alternative would require approximately 2.5 miles of additional pipeline to connect the storage to the main supply pipe on Avenue R-8. Due to the distance from PWRP, the storage tank's fill/drain pipeline must be at least 20 inches in diameter in order to minimize headloss and allow the reservoir to be filled during the day.

The hydraulic model was utilized to simulate peak summer time demand conditions and to size various conveyance capacities under this alternative. As shown on Figure 3, the pipelines for this alternative range from 6 to 20 inches in diameter. It should be noted that the presented pipeline sizes are the minimum diameters hydraulically required to provide adequate service pressures. These minimum requirements may be increased based on market availability and ease of procurement for piping at the time of construction.

The major infrastructure includes approximately 118,700 feet of new recycled water pipe, a storage tank with a net operational storage of about 2.1 MG and a pump station with a firm pumping capacity of about 325 brake horsepower to be located at PWRP. The firm pumping capacity was determined based on design flow of about 2,150 gpm, total dynamic head of about 410 ft and 70 percent pump efficiency.

4.3.2 Alternative 2 – Full Direct Use and Full Recharge Split between Upper Amargosa and Littlerock Creeks

This alternative was developed to plan for the possibility of extending recycled water across PWRA's service area for direct use with in stream groundwater recharge at both Upper Amargosa and Littlerock creeks.

This section describes the alignment, customers served and their demands and the infrastructure required for Alternative 2.

Alignment

This alternative was developed to serve all potential direct recycled water users along the predetermined alignment assuming the remaining supply capacity at PWRP would be fully used for groundwater recharge. The recharge would occur in stream or in basins constructed separately for imported water recharge and would be split between Upper Amargosa and Littlerock creeks.

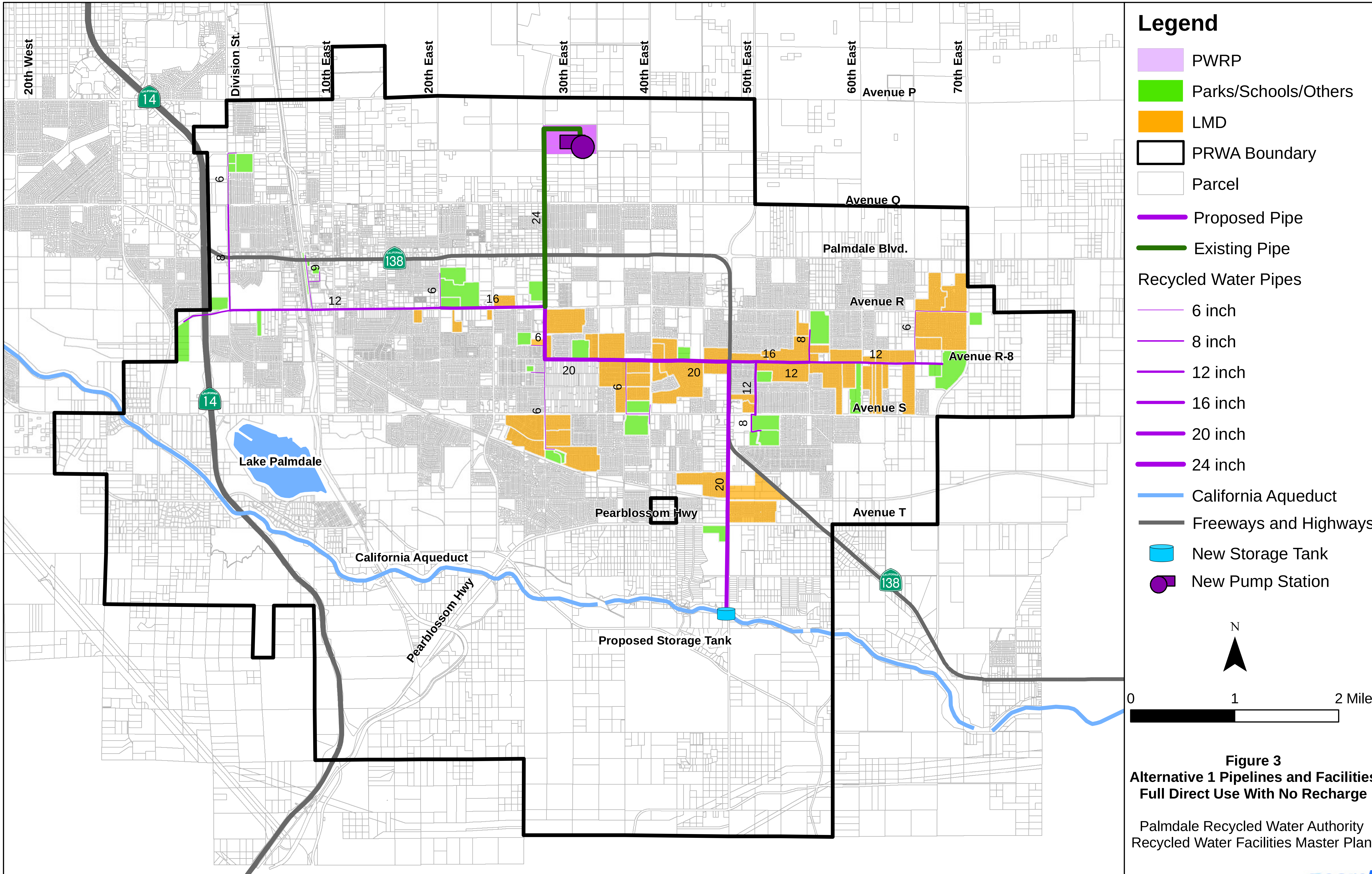

Figure 3
Alternative 1 Pipelines and Facilities
Full Direct Use With No Recharge

Palmdale Recycled Water Authority
Recycled Water Facilities Master Plan

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The buildout alignment under this alternative is shown on Figure 4. As shown, the alignment for this alternative is similar to Alternative 1 with the following exceptions:

- To reach Littlerock Creek for groundwater recharge, the alignment extends about 7,400 ft eastward along Avenue R from the intersection of Avenue R and 70th Street East.
- To reach Upper Amargosa Creek for groundwater recharge, the alignment extends about 11,000 ft westward along Avenue Q from the intersection of Avenue Q and Division Street.
- Because a storage is not required, the pipeline along 47th Street East is not included in this alternative.

Potential Customers and Demands

The potential direct use customers served in this alternative include all of those served by Alternative 1 except the four users located along 47th Street East (i.e., S27 and LMDs 213, 287, and 318). This alternative would serve 32 customers from the Schools, Parks, and Others category with a combined estimated average annual demand of about 1,590 afy and 47 LMDs with a combined estimated average annual demand of about 85 afy. The total average annual demand for this alternative at buildout was therefore estimated to be about 1,675 afy. It was assumed the remaining supply capacity or approximately 9,100 afy would be split between Upper Amargosa and Littlerock creeks for recharge.

The maximum day demand and peak hour demand of potential direct use customers served under this alternative were estimated to be about 3.0 mgd and 6,250 gpm during peak summer demand, respectively.

The potential customers served under this alternative are also shown on Figure 4. The complete list of customers served under this alternative is shown in Appendix C.

Infrastructure Needs

This alternative would not benefit from operational storage. Because the full capacity of the treatment plant would be utilized under this alternative at all times, including operational storage would not result in reduced pumping capacity requirement at PWRP. Furthermore, without separate fill and drain lines, keeping the storage full during daytime when recycled water is recharged would be difficult.

Two demand conditions were modeled to determine the condition governing pipeline sizing: peak summertime direct use demand conditions and peak wintertime groundwater recharge demand conditions. As shown on Figure 4, the pipelines for this alternative range from 6 to 20 inches in diameter.

The major infrastructure includes approximately 124,500 feet of new recycled water pipe, and a pump station with a firm pumping capacity of about 875 brake horsepower to be located at PWRP. The firm pumping capacity was determined based on maximum supply capacity of about 6,675 gpm, total dynamic head of about 360 ft and 70 percent pump efficiency.

4.3.3 Alternative 3 – Eastern Direct Use and Full Recharge at Littlerock Creek

This alternative was developed to plan for the possibility of extending recycled water only to those customers located east of 20th Street East. This was because the potential recycled water users are generally concentrated on the eastern side of PWRA's service area, as shown on Figure 5. Subsequently, groundwater recharge would only occur at Littlerock Creek under this alternative. This section describes the alignment, customers served and their demands and the infrastructure required for Alternative 3.

Alignment

The alignment for Alternative 3 is exactly the same as the portion of Alternative 2 alignment located east of 20th Street East.

Because no conveyance is extended to Upper Amargosa Creek, the entire surplus capacity at PWRP after serving all direct users was assumed to be used for recharge within Littlerock Creek. Recycled water from Lancaster Water Reclamation Plant could be used for groundwater recharge within the Upper Amargosa Creek under this alternative.

The buildout alignment under this alternative is shown on Figure 5.

Potential Customers and Demands

This alternative would serve 21 customers from the Schools, Parks, and Others category with a combined estimated average annual demand of about 1,235 afy and 45 LMDs with a combined estimated average annual demand of about 90 afy. The total average annual demand for this alternative at buildout was therefore estimated to be about 1,325 afy. It was assumed the remaining supply capacity or approximately 9,450 afy would be recharged within the Littlerock Creek.

The maximum day demand and peak hour demand of potential direct use customers served under this alternative were estimated to be about 2.3 mgd and 4,900 gpm during peak summer demand, respectively.

The potential customers served under this alternative are also shown on Figure 5. The complete list of customers served under this alternative is shown in Appendix C.

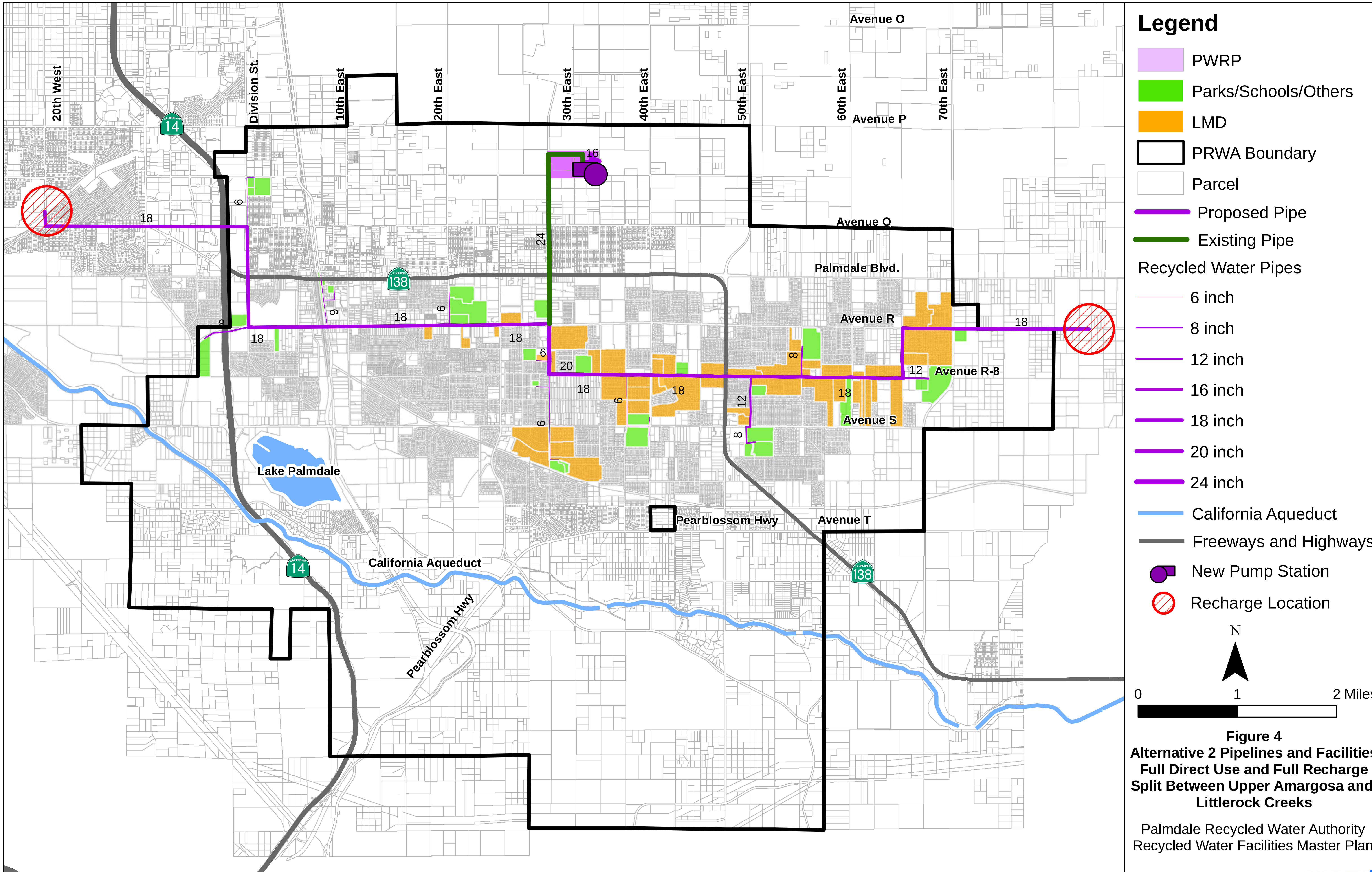

Figure 4
Alternative 2 Pipelines and Facilities
Full Direct Use and Full Recharge
Split Between Upper Amargosa and
Littlerock Creeks

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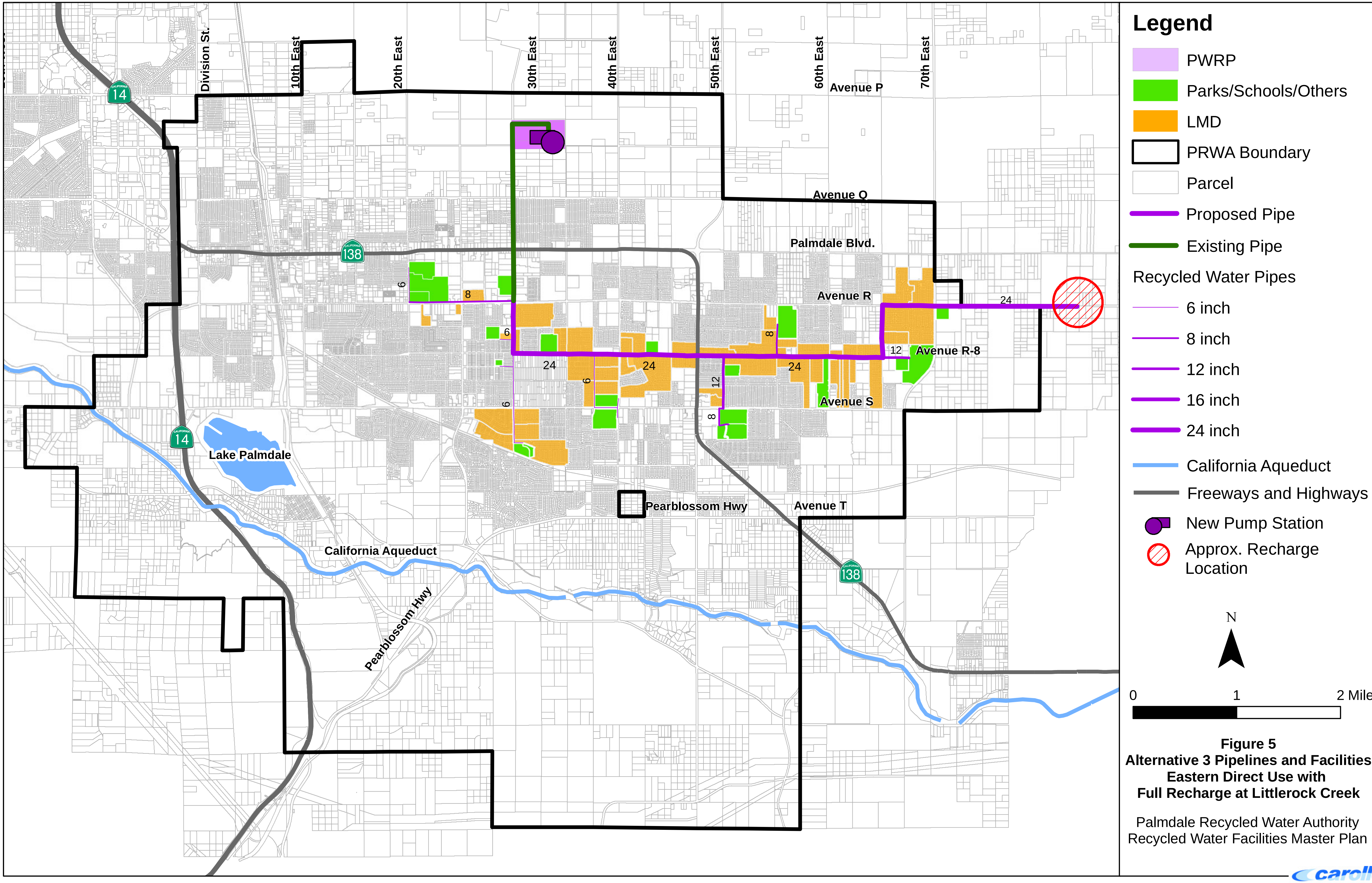

Figure 5
Alternative 3 Pipelines and Facilities
Eastern Direct Use with
Full Recharge at Littlerock Creek

Palmdale Recycled Water Authority
Recycled Water Facilities Master Plan

Infrastructure Needs

Similar to Alternative 2, no operational storage was required for this alternative. Two demand conditions were modeled to determine the condition governing pipeline sizing: peak summertime direct use demand conditions and peak wintertime groundwater recharge demand conditions. As shown on Figure 5, the pipelines for this alternative range from 6 to 24 inches in diameter.

The major infrastructure includes approximately 70,000 feet of new recycled water pipe, and a pump station with a firm pumping capacity of about 800 brake horsepower to be located at PWRP. The firm pumping capacity was determined based on maximum supply capacity of about 6,675 gpm, total dynamic head of about 330 ft and 70 percent pump efficiency.

4.3.4 Alternative 4 – Eastern Direct Use and Half Recharge at Littlerock Creek

This alternative was developed to plan for the possibility of extending recycled water only to those customers located east of 20th Street East with reduced recharge at Littlerock Creek and no recharge at Upper Amargosa Creek provided by this system. Water for recharge at Upper Amargosa Creek would be provided through the regional backbone infrastructure.

This section describes the alignment, customers served and their demands and the infrastructure required for Alternative 4.

Alignment

The alignment for this alternative is exactly the same as Alternative 3. The only difference between the two alternatives is the amount of recharge within the Littlerock Creek. Because of the possibility of PWRP supplying recycled water for groundwater recharge within Upper Amargoa Creek through the regional backbone infrastructure, it was assumed that only half the surplus capacity at PWRP after serving direct use customers would be available for recharge within the Littlerock Creek under this alternative.

The buildout alignment under this alternative is shown on Figure 6.

Potential Customers and Demands

This alternative would serve exact same direct use customers as Alternative 3 with a total estimated average annual demand of about 1,325 afy. It was assumed half the remaining supply capacity or approximately 4,725 afy would be recharged within the Littlerock Creek.

Similar to Alternative 3, the maximum day demand and peak hour demand of potential direct use customers served under this alternative were estimated to be about 2.3 mgd and 4,900 gpm during peak summer demand, respectively.

The potential customers served under this alternative are also shown on Figure 6.

The complete list of customers served under this alternative is shown in Appendix C.

Infrastructure Needs

Similar to Alternatives 2 and 3, no operational storage was assumed for this alternative. Two demand conditions were modeled to determine the condition governing pipeline sizing: peak summertime direct use demands condition and peak wintertime groundwater recharge demands condition. As shown on Figure 6, the pipelines for this alternative range from 6 to 20 inches in diameter.

The major infrastructure includes approximately 62,700 feet of new recycled water pipe, and a pump station with a firm pumping capacity of about 575 brake horsepower to be located at PWRP. The firm pumping capacity was determined based on peak hour direct use supply of about 4,900 gpm, total dynamic head of about 325 ft and 70 percent pump efficiency.

4.3.5 Alternative 5 – Eastern Direct Use with No Recharge

This alternative was developed to plan for the possibility of extending recycled water only to those customers located east of 20th Street East without any groundwater recharge supplied from PWRP.

This section describes the alignment, customers served and their demands and the infrastructure required for Alternative 5.

Alignment

The alignment for this alternative is similar to those of Alternatives 3 and 4 with the exception that the dedicated pipeline for recharge within Littlerock Creek does not exist in this alternative. This pipeline extends for about 7,400 ft eastward along Avenue R from the intersection of Avenue R and 70th Street East. Under this alternative, groundwater recharge could still occur within the Upper Amargosa Creek from either PWRP or Lancaster WRP or both plants via the regional backbone infrastructure.

The buildout alignment under this alternative is shown on Figure 7.

Potential Customers and Demands

This alternative would serve exact same direct use customers as Alternatives 3 and 4 with a total estimated average annual demand of about 1,325 afy. No groundwater recharge occurs under this alternative.

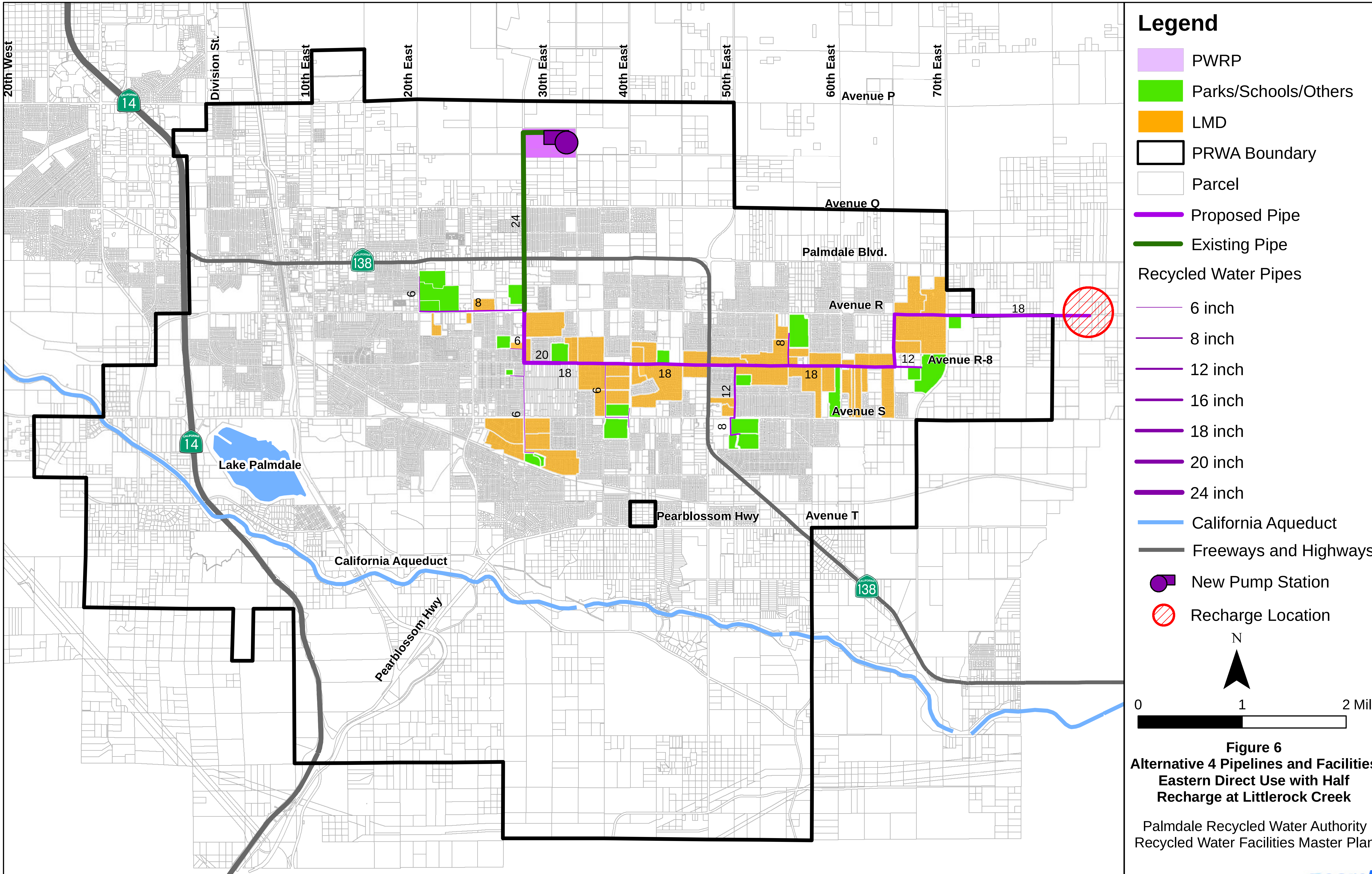

Figure 6
Alternative 4 Pipelines and Facilities
Eastern Direct Use with Half
Recharge at Littlerock Creek

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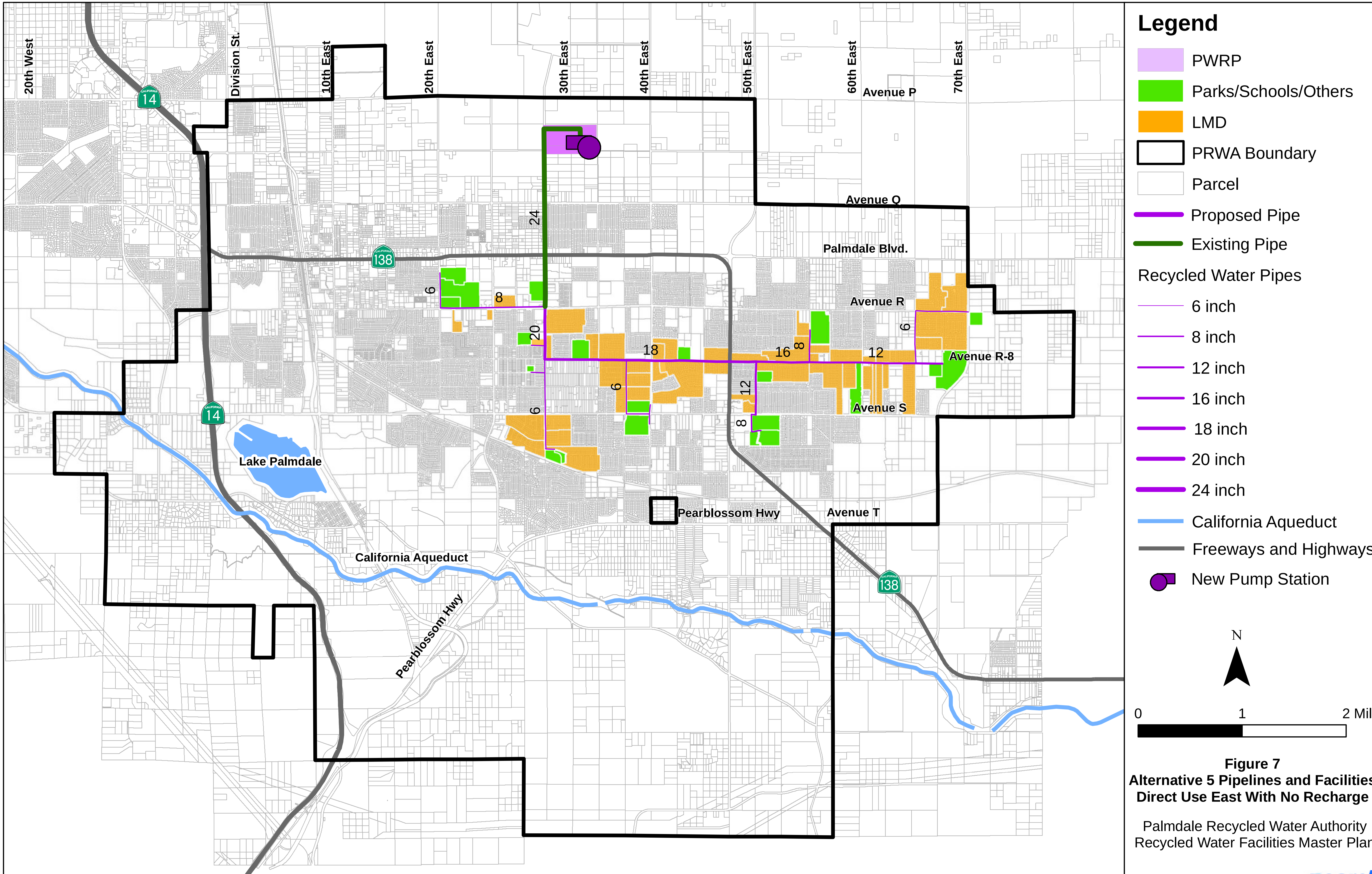

Figure 7
Alternative 5 Pipelines and Facilities
Direct Use East With No Recharge

Palmdale Recycled Water Authority
Recycled Water Facilities Master Plan

Similar to Alternative 3 and 4, the maximum day demand and peak hour demand of potential direct use customers served under this alternative were estimated to be about 2.3 mgd and 4,900 gpm during peak summer demand, respectively.

The potential customers served under this alternative are also shown on Figure 7. The complete list of customers served under this alternative is shown in Appendix C.

Infrastructure Needs

Similar to Alternatives 2, 3 and 4, no operational storage was assumed for this alternative. To size pipelines, peak summertime demand conditions for direct recycled water use were modeled. As shown on Figure 7, the pipelines for this alternative range from 6 to 24 inches in diameter.

The major infrastructure includes approximately 70,000 feet of new recycled water pipe, and a pump station with a firm pumping capacity of about 575 brake horsepower to be located at PWRP. The firm pumping capacity was determined based on peak hour direct use supply of about 4,900 gpm, total dynamic head of about 325 ft and 70 percent pump efficiency.

4.3.6 Alternative 6 – 'No Project' Alternative

PWD currently receives water from three sources: Groundwater, Littlerock Dam Reservoir, and imported water from the State Water Project (SWP). Groundwater is obtained from the Antelope Valley Groundwater Basin via 25 active wells scattered throughout the PWD. PWD's local surface water supply is from Littlerock Dam Reservoir. This water is transferred from the reservoir to Lake Palmdale for treatment and distribution. PWD's imported water is provided by the SWP and is conveyed to Lake Palmdale, which acts as a forebay for the PWD's 35 million gallon per day (mgd) water treatment plant. Lake Palmdale can store approximately 4,250 acre-feet (af) of SWP and Littlerock Dam Reservoir water. In 2010, PWD received 41 percent of its supplies from groundwater, 50 percent from SWP and about 9 percent from Littlerock Dam Reservoir (PWD, 2011).

PWD projects an aggressive growth in demand in its service are over the next 20 years. According to the 2010 Urban Water Management Plan, water demands are projected to grow from 19,800 afy in 2010 to about 60,000 afy in 2035 representing an average annual growth of about 4.5 percent. PWD plans to acquire additional sources of supply to meet future demands. Future supply sources include recycled water, groundwater banking and water supplies from transfers and exchanges. Table 15 provides a summary of existing and future supplies. As shown, PWD anticipates supplying approximately 20 percent of its future demand with recycled water.

Table 15 Existing and Future Water Supplies
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

	Entitlement (afy)	2010 Supply (afy)	2035 Supply (afy)
Groundwater	NA	8,000	12,000
Imported Water	21,300	9,800	12,800
Local Surface Water	5,500	2,000	4,000
Recycled Water	NA	0	12,000
Groundwater Banking	NA	0	9,600
Transfers and Exchanges	NA	0	9,600
Total		**19,800**	**60,000**

Source: 2010 Urban Water Management Plan (PWD, 2011)

The recommended project alternative presented in this report would result in potable water offset of about 1,160 afy for existing customers. It would also serve several future customers with combined average annual demand of approximately 165 afy. Furthermore, the project would recharge Antelope Valley Groundwater Basin with about 9,450 afy of recycled water.

If the recommended alternative was not implemented, PWD would have to continue using the current potable supply sources and the need to acquire new sources of supply in the future would be exacerbated. Moreover, the use of recycled water as a local drought-proof supply is crucial for groundwater recharge to help improve or eliminate the overdraft condition of the Antelope Valley Groundwater Basin. If the recommended project was not implemented, PWD would have to increase purchasing imported water from SWP to serve future demands and recharge the basin. The estimated 'capital cost' of purchasing SWP beyond PWD's current allocation is $5,000 times the annual amount of water to be purchased. This is equivalent to about $375 per acre-foot assuming a 5 percent discount rate and 30 years life cycle. The distribution cost of water is currently estimated at about $400 per acre-foot. However, it is anticipated that this latter cost is repaid by the customers and therefore is not included in this alternatives evaluation consistent with other alternatives.

4.4 ALTERNATIVES COST COMPARISON

Planning level cost estimates were prepared for each of the five alternatives based on the information developed as a part of this study. This section presents the cost assumptions made and planning level estimate of capital and life cycle costs for various alternatives.

4.4.1 Cost Assumptions

Several assumptions were used in the development of cost estimates. Scope and anticipated range of accuracy are discussed, followed by a discussion of the markups and contingencies and a presentation of the unit costs used in this study.

4.4.2 Scope and Accuracy Range

The cost estimating criteria presented herein develop a consistent methodology for comparing alternatives. This methodology allows for different alternatives to be evaluated on the same cost basis. The cost estimates presented in this study have been prepared for feasibility study purposes and for guidance in project evaluation and implementation.

The Association for the Advancement of Cost Engineering International defines five different class estimate categories as summarized in Table 15. The costs developed in this study shall be considered Class 4 estimates, unless noted otherwise. A definition of the Class 4 estimate is described below.

Table 15 Cost Estimating Class Definitions
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

		Accuracy Range	
Class	**Status of Design**	**Low Side**	**High Side**
5	N/A	-50% to -20%	+30% to +100%
4	1% to 5%	-30% to -15%	+20% to +50%
3	10% to 40%	-20% to -10%	+10% to +30%
2	30% to 70%	-15% to -5%	+5% to +20%
1	80% to 110%	-10% to -3%	+3% to +15%
5	Rough Order-of-Magnitude Planning Estimate		
4	Detailed Planning Level Estimate		
3	Project Budget Estimate		
2	Detailed Project Control Estimate		
1	Bid Check Estimate		

Source*:* Association for the Advancement of Cost Engineering
Note:
Percentages are based on the construction cost value and not on an incremental subtotal after each percentage category

Class 4.This estimate is prepared based on information where the preliminary engineering is 1 to 5 percent complete. Detailed strategic planning, business development, project screening, alternative scheme analysis, confirmation of economic and/or technical feasibility, and preliminary budget approval are needed to proceed with this class estimate. Examples of estimating methods used would include equipment and/or system process factors, scale-up factors, as well as parametric and modeling techniques. The typical expected accuracy range for this class estimate is -15 to -30 percent on the low side and +20 to +50 percent on the high side.

A Class 4 estimate may also be justified by the methods presented for this cost evaluation if suitable definitions of project components, individual consideration of special project components/conditions, and independent cost verifications are conducted. Commensurate reductions in project contingencies should also be considered for the Class 4 estimate.

All classes of cost estimates described, and any resulting conclusions on project financial or economic feasibility or funding requirements, are prepared for guidance in project evaluation and implementation. The final costs of the project, and resulting feasibility, will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. Therefore, the final project costs will vary from the estimate developed using the information in this feasibility study. Because of these factors, project feasibility, cost-benefit ratios, risks, and funding needs must be carefully reviewed prior to making specific financial decisions or establishing project budgets to help ensure proper project evaluation and adequate funding.

4.4.3 Markups and Contingency

This evaluation is concerned with alternatives analysis and project screening, as well as technical feasibility. Therefore, Class 4 estimates were developed. For the development of the project costs, a construction cost contingency and other markups were applied consistent with Table 16. The markups are intended to account for costs of engineering, design, construction management, and legal and environmental efforts associated with implementing the project. It should be noted that construction contingency and markups were applied incrementally; that is, the percentage for each component is applied to the previous subtotal.

The cost estimates are based on current perceptions of conditions at the project locations. These estimates are subject to change as the project details are further defined. Variances in the cost of labor, materials, equipment, services provided by others, contractor’s methods of determining prices, competitive bidding, or market conditions, practices, or bidding strategies cannot be controlled.

Table 16	General Cost Estimating Assumptions Recycled Water Facilities Master Plan Palmdale Recycled Water Authority
Description	**Percent of Construction Cost[1]**
Construction Cost	100%
Construction Cost Contingency	30%
Subtotal: Construction Cost + Construction Contingency	**130%**
Engineering and Design	10%
Construction Management	10%
Legal and environmental	5%
Subtotal of Total Markups	25%
Total Project Cost	**162.5%**

Note:

(1) Percentages are based on the construction cost value and an incremental subtotal after each category for contingencies and total markup cost. Total Project Cost = Construction Cost x (1 + Construction Cost Contingency) x (1 + Total Markups).

4.4.4 Unit Construction Costs

The construction cost estimates presented in this report are based on the unit construction costs listed in Table 17, Table 18 and Table 19. These unit costs are gathered from various sources and are only valid for planning purposes.

Construction costs for recycled water pipelines include pipe material, valves, appurtenances, excavation, installation, bedding material, backfill material, transport, and paving where applicable.

For booster pumping stations, unit costs are based on the required horsepower assuming the project involves a new booster pumping stations requiring new piping and all associated appurtenances. If a project only requires the replacement or addition of a pump to an existing booster pump station, the unit costs must be evaluated on a per site basis at that time.

The storage tank unit costs are applicable to above ground tanks.

Table 17 Planning Level Unit Construction Costs for Pipelines
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Pipe Diameter	Unit Construction Cost (per linear foot)
6 inches	$130
8 inches	$165
10 inches	$195
12 inches	$200
16 inches	$225
18 inches	$250
20 inches	$275
24 inches	$300

Source: Based on observed costs of PWD's projects.

Table 18 Planning Level Unit Construction Costs for Storage Tanks
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Size	Unit Construction Cost ($/gal)
1.0 MG	$1.65
2.0 MG	$1.25
3.0 MG	$1.10

Source: Based on observed costs.

Table 19 Planning Level Unit Construction Costs for Booster Stations
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Size	Unit Cost ($/hp)
200 hp	$3,800
250 hp	$3,400
300 hp	$3,200
350 hp	$2,900
400 hp	$2,600
500 hp	$2,300

Source: Based on observed costs.

4.4.5 Excluded Costs

There are several other components that may be needed to support the development of major recycled water facilities. Since most of these items are unique and project specific, they should be applied on a project-by-project basis:

- **Land acquisition.** Land acquisition costs were not included in the capital costs as land acquisition was not anticipated to be required for any of project alternatives.
- **Easement acquisition.** The cost of acquiring easements was not evaluated.
- **Power transmission lines.** The cost of these to support a major pumping or treatment facility is often on a shared cost basis with the power utility.
- **Overall program management.** If the sheer magnitude of the capital cost program exceeds the capacity of the PRWA staff to manage all of the work, then the services of a program management team may be required.
- **Public information program.** Depending on the relative public acceptability of a major recycled water facility or a group of facilities, there may be a need for a public information program, which could take many different shapes.
- **Customer retrofits.** Retrofit costs are associated with separating the customer's existing potable water system from a new recycled water system. An example would be a park where restroom and drinking fountain water supply pipes would need to be isolated from an existing irrigation system. Additional costs include posting signage, which identifies where recycled water is being used. Customer retrofits are one-time costs and are dependent upon the complexity of existing irrigation systems at each individual site. If the meters proposed for recycled water conversion were dedicated irrigation meters, the on-site conversion/retrofit costs would be minimal. It was assumed that the individual potential customers are responsible for their customer laterals and conversion of their irrigation systems from potable to recycled water.
- **Foundation requirements.** Foundation reinforcement or support requirements are very site specific with regard to necessary method and type, and a geotechnical study is typically needed to determine such requirements. These costs, therefore, have not been included in any of the unit cost curves.
- **Regulatory requirements.** Costs associated monitoring groundwater and compliance with Groundwater Replenishment Regulations and securing pertinent permits were not evaluated.
- **Other costs.** Other costs may be necessary for some projects including environmental mitigation and permitting costs; special legal, administrative, or financial assistance; easements or rights-of-way and land acquisition costs; and expediting costs, such as separate material procurement contracts. These *other* costs typically range from 5 to 15 percent of construction cost.

4.4.6 Estimate of Planning Level Costs

Table 20 presents a preliminary estimate of capital costs for the 5 recycled water project alternatives described earlier in this chapter. Preliminary life cycle costs were also developed in order to compare the alternatives on a long-term basis. The cost comparison considered capital and O&M costs for a project term of 30 years and a debt rate of 5 percent to determine the alternatives unit costs in dollars per acre-foot. Payments to LACSD for the purchase or reimbursement of recycled water were included in this analysis. Table 21 presents life cycle and unit water costs of the alignment alternatives.

As shown, capital cost estimates ranged from about $22 million for Alternative 5 to $48 million for Alternative 2. The project unit cost estimates ranged from $2,375 per acre-foot for Alternative 1 to about $400 per acre-foot for Alternative 3. The continued use of current supplies or the ‘No Project’ alternative would not incur any significant capital cost. However, the weighted average unit cost of all three supply sources appear to be comparable with Alternative 3.

Table 20 Estimate of Planning Level Construction and Capital Costs
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Alternative	**1**	**2**	**3**	**4**	**5**
Pipeline Construction Cost	$23.9 M	$27.6 M	$16.6 M	$14.7 M	$12.0 M
Storage Tank Construction Cost	$2.6 M	-	-	-	-
Booster Station Construction Cost	$1.0 M	$2.0 M	$1.8 M	$1.3 M	$1.3 M
Total Construction Cost	$27.5 M	$29.6 M	$18.4 M	$16.0 M	$13.3 M
Contingency and Markups	$17.2 M	$18.5 M	$11.5 M	$10.0 M	$8.3 M
Total Capital Cost	**$44.7 M**	**$48.1 M**	**$29.9 M**	**$26.0 M**	**$21.6 M**

Table 21	**Estimate of Planning Level Construction and Capital Costs Recycled Water Facilities Master Plan Palmdale Recycled Water Authority**				
Alternative	**1**	**2**	**3**	**4**	**5**
Total Capital Cost	$44.7 M	$48.1 M	$29.9 M	$26.0 M	$21.6 M
Amortized Capital Cost$^{(1)}$	$2.9 M/yr	$3.2 M/yr	$2.0 M/yr	$1.7 M/yr	$1.4 M/yr
Annual O&M Cost$^{2)}$	$0.9 M/yr	$1.0 M/yr	$0.6 M/yr	$0.5 M/yr	$0.5 M/yr
Annual Payments to LACSD for RW$^{(3)}$	$0.3 M/yr	$1.7 M/yr	$1.7 M/yr	$1.0 M/yr	$0.2 M/yr
Total Annual Cost	$4.1 M/yr	$5.9 M/yr	$4.3 M/yr	$3.2 M/yr	$2.1 M/yr
Average Annual Demand	1,725 afy	10,775 afy	10,775 afy	6,050 afy	1,325 afy
Project Unit Cost	**$2,375/af**	**$550/af**	**$400/af**	**$525/af**	**$1,550/af**

Notes:

(1) Based on 5 percent interest rate and payback period of 30 years.
(2) Based on 2 percent of total capital cost.
(3) Cost of recycled water from LACSD (approximately $160/af).

4.5 ALTERNATIVES EVALUATION

Three evaluation criteria were considered for comparison of various alternatives. These criteria were the alternative's unit water cost, the amount of new supply yield and the operational flexibility to serve additional demands in the future.

The environmental impact related to traffic and circulation, noise and other pollutions during construction and potential implementation hurdles such as utility conflicts or special crossings appeared to be comparable for all alternatives and were not evaluated in detail as part of this study.

Each alternative is scored on a scale of 1 to 5 with respect to each criterion. A low score for a particular criterion and alternative indicates that the criterion has a negative impact on the alternative and vice versa. Once the impact of all criteria on an alternative were identified, the aggregate score was calculated and compared with other alternatives. The various evaluation criteria are described below.

4.5.1 Life Cycle Cost

The life cycle costs of various alternatives were developed and presented earlier in this chapter in Table 21. As shown, Alternative 3 with an estimated unit cost of $400 per ac-ft has the lowest life cycle cost and Alternative 1 with an estimated unit cost of $2,375 per ac-ft has the highest cost among the recycled water project alternatives. The unit water cost of the 'No Project' alternative is estimated at about $650 per ac-ft.

4.5.2 New Supply Yield

A recycled water project is a local, drought-resistant and reliable supply that is generally not impacted by climate change. The main goal of implementing a recycled water project is to maximize the use of recycled water. The more new supply an alternative produces, the more favorable it becomes.

The average annual demands presented in Table 21 indicate that Alternatives 2 and 3 with 10,775 afy provide highest supply yield while Alternative 5 with 1,325 afy provides lowest supply yield among the recycled water project alternatives. The 'No Project' alternative does not result in any new water supply and is scored 1 (lowest).

4.5.3 Operational Flexibility

The ability to serve additional customers beyond the market assessment presented in this study or recharge high volumes results in a more desirable alternative. Alternatives 1 and 5 were sized to serve a well-defined set of customers and were not sized for groundwater recharge. Therefore, these alternatives were scored 1.

Alternative 3 on the other hand, was sized for maximum groundwater recharge under the assumption that recharge in the Littlerock Creek proves to be feasible. Should demands in the eastern portion of PRWA's service area increase beyond what is currently anticipated, the 24-inch transmission main would be able to serve additional demand while groundwater recharge was cutback or diverted to Upper Amargosa Creek. This alternative provides maximum operational flexibility between direct use and groundwater recharge and is scored 5.

Alternatives 2 and 4 also provide some level of flexibility. This is because the main transmission pipelines were sized 18 inches in diameter all the way across the service area allowing to connect additional direct use customers at the expense of lower recharge volumes. Alternative 2 and 4 were scored 3 and 2 as they provide more flexibility than Alternatives 1 and 5 and less flexibility than alternative 3. Moreover, Alternative 4 provides less flexibility than Alternative 2 as it only serves the eastern portion of service area.

Because PWD's water distribution system is near its capacity, the 'No Project' alternative does not provide significant level of flexibility to serve additional future demands.

4.5.4 Comparison of Alternatives

Based on the discussions presented in the previous section, the 6 alternatives were compared and scored on their technical and non-technical merits. The scoring and ranking process is summarized in Table 22. As shown, Alternative 3 with its numerous benefits and minimal life cycle cost scored highest (15) and Alternative 1, 5 and 6 scored the lowest and the least favorable (5).

Table 22 Comparison of Alternatives
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Alternatives	**1**	**2**	**3**	**4**	**5**	**6**
Life Cycle Cost	1	4	5	4	2	3
New Supply Yield	3	5	5	4	2	1
Operational Flexibility	1	3	5	2	1	1
Total Score	**5**	**12**	**15**	**10**	**5**	**5**

Note:
(1) Score of 1 = very poor; Score of 5 = Excellent

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PROJECT RECOMMENDATIONS AND CONCLUSIONS

5.1 RECOMMENDED ALTERNATIVE DESCRIPTION

This section provides a detailed description of Alternative 3 (Project), the recommended recycled water implementation project.

Alternative 3 has been selected as the Recommended Project based on its ability to provide recycled water to the majority of the PRWA recycled water direct use market while also incorporating the use of recycled water for groundwater recharge, all done with a minimum of transmission and distribution infrastructure. The Recommended Project will help reduce the need for new or expanded potable water supplies, including reducing the amount of imported water needed to meet regional water demands.

5.1.1 The Project

Potential PRWA recycled water customers are mainly concentrated on the eastern side of PRWA's service area. To meet this demand, the Project entails installing a pipeline in order to move recycled water directly south along 30th Street East from the PWRP and then east along Avenue R-8. A significant number of customers will be met along Avenue R-8, before the pipeline turns north on 65th Street East. In the event that the Littlerock Creek Recharge Project proves feasible, this pipeline could be extended east again on Avenue R to provide recycled water to it. The recommended Project also includes utilizing an alternate location for groundwater recharge with recycled water, namely the Upper Amargosa Creek Recharge Project site. Alternative 3 does not include a pipeline to this location, because it is outside of the PRWA service area. However, the PRWA should participate with other water retailers in the region if and when a recycled water pipeline is extended to this location. This alternate location may be used in conjunction with Littlerock Creek recharge, or in lieu of Littlerock Creek recharge until groundwater recharge at Littlerock Creek becomes possible.

Despite the two possible groundwater recharge sites, planning was performed with the assumption that Littlerock Creek will be used as the groundwater recharge location, and facilities were therefore sized accordingly. This entailed utilizing a 24-inch diameter pipeline for the main transmission line from the PWRP out to Littlerock Creek, as opposed to a 24-inch diameter pipeline, which tapers into an 18-inch diameter pipeline partway along Avenue R-8. This sizing assumption was made for several reasons.

- Upsizing the portion of the Project that would be needed anyway to serve all other customers while maintaining the ability to recharge over 9,500 afy at Littlerock Creek only entailed a price increase of 10 percent.
- 24-inch diameter pipeline is a common, standard size. As such, they are much easier to stock, service, and maintain, compared to less common sizes of 16-20-inch diameter that would be needed anyway to meet peak demands.

- The slight increase provides PRWA with the flexibility to serve potential customers in the future that do not yet exist in or around the service area.

The Project will most effectively be implemented in multiple, manageable, phases. Six such phases have been identified. Rather than prioritizing these six recommended phases sequentially, they are each identified by an anchor customer. Three of the phases can proceed all the way to construction, regardless of the status of the other phases, which provides the PRWA with options based on the availability of grant funds and local support from the community.

The recycled water system conveyance components (i.e., pumping and piping) will be able to supply the peak hour demand of the recycled water system. The necessary pressure will be supplied by the recommended variable head pump station at the Palmdale Water Reclamation Plant (PWRP).

5.1.2 Project Costs

A full list of the assumptions used to generate the project costs, including O&M estimates, contingency markups, and facility costs, is presented in Chapter 4. The phasing specific data presented in this chapter uses the same data.

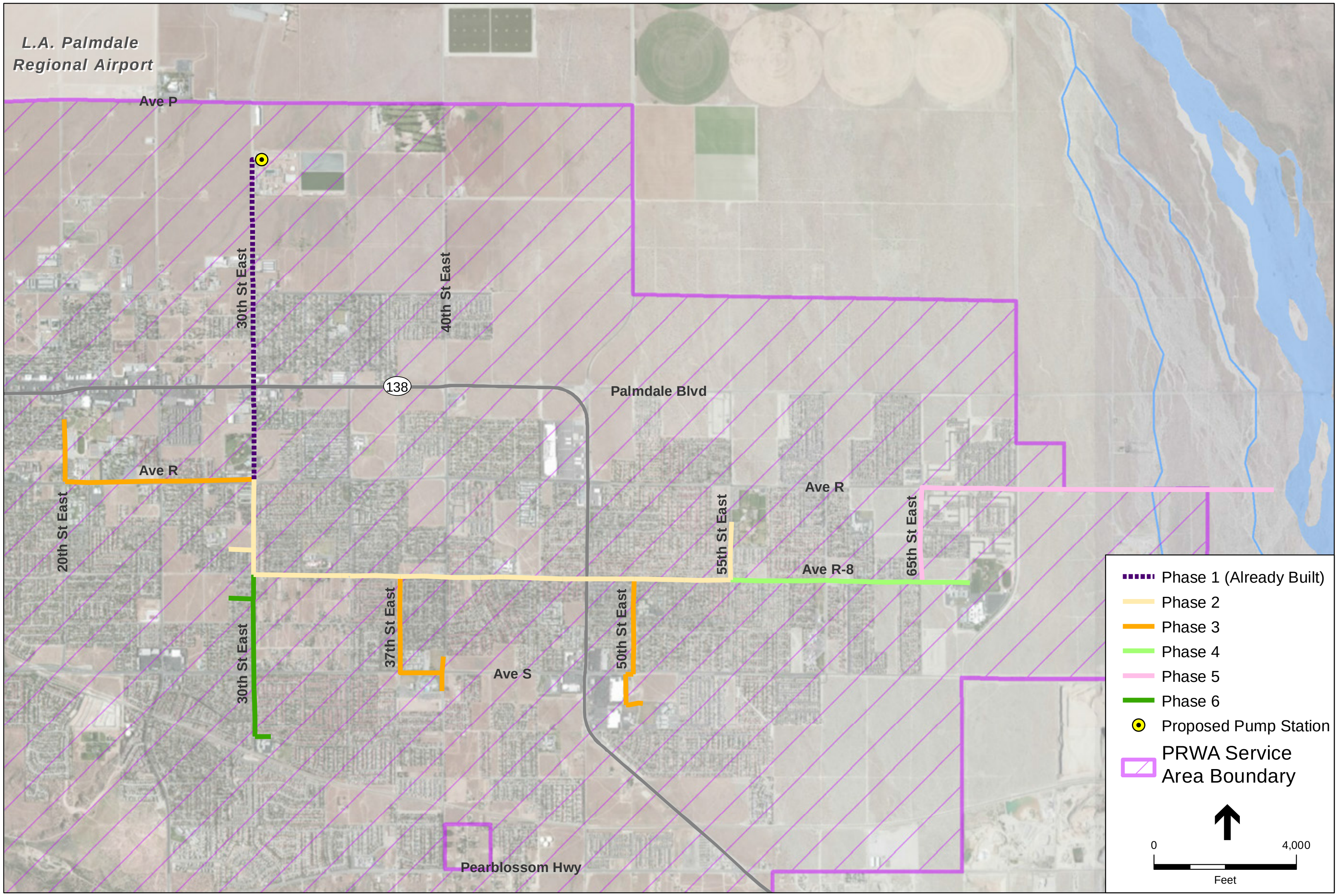
The majority of the Project costs will be upfront costs in the form of construction, engineering, construction management, environmental, legal, and contingency. In total, the entire recycled water system is projected to cost roughly $30 million. A full list of costs, by phase and facility is presented in the following section in Table 24 and Table 25.

5.2 IMPLEMENTATION

This section gives an overview of project implementation. Individual pipe segment phasing is considered foremost. Schedule, finance, permitting, and agreements are all also included in the discussion.

5.2.1 Phasing

The Project will most effectively be implemented in multiple, manageable, phases as demonstrated on Figure 8. As there are currently minimal existing revenue streams available to the PRWA for designing or constructing the Project, it is anticipated that the Project will likely proceed only after PRWA secures grant funds for individual phases of the Project. As such, the phases need to be sized such that they can be packaged as standalone projects, meet typical grant requirements, and have an overall budget that includes a realistic amount of matching funds from the PRWA. Rather than prioritizing the six recommended phases sequentially, they are each identified by an anchor customer. Three of the phases can proceed all the way to construction, regardless of the status of the other phases, which provides the PRWA with options based on the availability of grant funds and local support from the community.



SOURCE: ESRI

PRWA Recycled Water Facilities Plan IS/MND . 130096

Figure 4

Proposed Construction Phases

Finally, the appropriate next steps for each Phase are identified, again providing the PRWA with options.

Prior to the use of recycled water within the PRWA service area, a pump station must be built at the PWRP in order to provide sufficient pressure so that recycled water can be supplied to customers.

The total system peak hour demand at build out is estimated to be about 6,700 gpm. Given the total dynamic head requirement of 335 ft and average pump efficiency, the pump station should have a net capacity of about 800 hp, and be variable speed, in order to meet shifting and expanding system demands.

Palmdale High School Phase

The Palmdale High School Phase will connect to the existing recycled water pipeline on 30th Street East and transport this water west along Avenue R to 20th Street East. This will allow PRWA to serve Palmdale High School, located at 2137 Avenue R. Because this phase is an offshoot of the main trunk line, it can be constructed independent of the other phases. Other customers met by this phase include the Cactus School and Palmdale Pony League. In total, this phase will be used to meet approximately 140 afy of recycled water demand.

Domenic Masari Park Phase

The Domenic Masari Park Phase will extend the existing recycled water pipeline south along 30th Street East then continue east along Avenue R-8 to 55th Street East via a 24" line. This phase will allow PRWA to serve Mesa Intermediate School, Mesquite Elementary School, Desert Rose Elementary School, and finally Domenic Masari Park. Similar to the Palmdale High School Phase, this section of pipe can be constructed independent of other phases. In total, this phase will be used to meet approximately 290 afy of recycled water demand.

Dry Town Laterals Phase

The Dry Town Laterals Phase does not include the installation of any trunk line to transport PRWA recycled water supplies eastward. Instead, this phase focuses on extending smaller distribution laterals south from the mainline along Avenue R-8. These laterals will be located on 30th Street East, 40th Street East, and 50th Street East, and will serve demand at four parks and five schools. The largest of these customers are Dry Town Water Park and Sam Yellow Park. In total, this phase will be used to meet approximately 350 afy of recycled water demand.

Implementing this phase requires the completion of the Domenic Masari Park Phase.

Pete Knight High School Phase

The Pete Knight High School Phase will move recycled water supplies from the intersection of 55th Street East and Avenue R-8 north to Avenue R, and then directly east along Avenue R until reaching 70th Street East. This will allow PRWA to serve Pete Knight High School, Shadow Hills Intermediate School, and Los Amigos School. As with the Dry Town Laterals phase, implementing this phase requires the completion of the Domenic Masari Park Phase. In total, this phase will be used to meet approximately 390 afy of recycled water demand.

Littlerock Creek Phase

The Littlerock Creek Phase will move recycled water from the intersection of 70th St and Avenue R to the future Littlerock Creek recharge site. As the terminus of the system, this location will serve as a groundwater recharge site where recycled water may be supplemented with imported water resources for the purposes of recharging the groundwater basin. In addition to groundwater recharge, this phase will also serve a new park at 70th Street East. The park will use approximately 40 afy while recharge is anticipated to utilize 9,450 afy.

Implementing this phase requires the completion of the Domenic Masari Park Phase and Pete Knight High School Phase

Before this phase may be undertaken, PRWA must complete the Feasibility Study for the Littlerock Creek Recharge Project. This will involve initiating communication with LCID, Waterworks No. 40, and AVEK, as well as meeting with the Regional Water Quality Control Board and the California Department for Public.

Amargosa Creek Phase

Groundwater recharge at Amargosa Creek does not rely on the recycled water transmission lines described in the other phases. Rather, the Amargosa Phase would use currently planned infrastructure to move recycled water supplies to the Upper Amargosa Creek Recharge Project site or another potential recharge area along the Amargosa Creek.

As shown in the Alternatives Evaluation in Section 4, the effective unit cost for reuse of the available recycled water is dramatically reduced when groundwater recharge is included as part of the Project. In order for the PRWA to use recycled water for recharge, it will likely occur in locations outside of PRWA's service area and require collaboration with neighboring agencies such as AVEK, Waterworks No. 40, and others. This will be the case for recharge occurring in either Littlerock or Amargosa Creeks.

While the entire Amargosa Creek is located outside of the PRWA service area, preliminary studies by the USGS for the Upper Amargosa Creek Recharge Project have predicted that water that infiltrates into the ground from the creek serves to recharge the groundwater basin underlying the PRWA service area. Once the Upper Amargosa Creek Recharge

Project is operational and shown to be functional, the initial results can be used to determine if recycled water could be used to supplement imported and storm water supplies. Ultimately, the ability to use Amargosa Creek as a site for groundwater recharge and indirect potable reuse hinges on the success of the Upper Amargosa Creek Recharge Project.

The City has partnered with Waterworks No. 40 to design and construct a 24-inch recycled water pipeline from the PWRP to the City of Palmdale Hybrid Power Plant Project. A portion of this pipeline runs adjacent to Amargosa Creek and terminates approximately two miles north of the Upper Amargosa Creek Recharge Project. Independent of the design and construction of all other phases of the Project, the PRWA should partner in any effort to extend a recycled water pipeline to the Upper Amargosa Creek Recharge Project

Total Project Phasing

The completed recycled water system will require approximately 70,000 linear feet of pipe to be installed, along with a variable horsepower pump station. These facilities are presented by phase in Table 23.

Table 23 Summary of Proposed Facilities by Phase
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

	Pump Station	Palmdale High School (Feet)	Domenic Masari (Feet)	Dry Town Laterals (Feet)	Pete Knight High School (Feet)	Littlerock Creek (Feet)	Total (Feet)	Capital Cost ($ M)
Pipelines								
6-inch Pipeline	-	2,450	700	10,450	-	-	13,600	$2.9 M
8-inch Pipeline	-	7,800	1,650	1,850	-	-	11,300	$3.0 M
12-inch Pipeline	-	-	750	3,550	1,350	-	5,650	$1.8 M
24-inch Pipeline	-	-	21,400	-	5,400	12,600	39,400	$19.2 M
Pump Station	PWRP Pump Station	-	-	-	-	-		$3.0 M

As shown in Table 23, the largest facility expansion will occur in the Domenic Masari Phase of the project. Other phases either focus more on transmission or distribution. While the pump station Phase is shown separately in this table, it is anticipated that it will be constructed simultaneously with either the Palmdale High School Phase or Domenic Masari

Phase. Below, Table 24 shows all the stages of project phasing along with demand and unit costs. Again, the pump station construction is separated into its own phase for cost presentation purposes, but will be constructed simultaneously with either the Palmdale High School Phase or Domenic Masari Phase.

Table 24 Project Costs by Phase
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Phase	Prerequisite[1]	Total Annual Demand (afy)	Annual Demand per Phase (afy)	Total Capital Cost ($ M)	Capital Cost per Phase ($ M)	Unit Cost[2] ($/af)
Pump Station	n/a	n/a	n/a	$3.0 M	$3.0 M	n/a
Palmdale High School	Pump Station	145	145	$5.6 M	$2.6 M	$3,425
Domenic Masari Park	Pump Station	295	295	$14.3 M	$11.3 M	$4,275
Dry Town Laterals	Domenic Masari Park	645	350	$18.1 M	$3.9 M	$2,550
Pete Knight High School	Domenic Masari Park	685	390	$17.3 M	$3.1 M	$2,300
Littlerock[3]	Peter Knight High School	10,200	9,500	$23.5 M	$6.1 M	$350
Complete System	**All**	**10,700**	**n/a**	**$29.9 M**	**n/a**	**$400**

Note:

(1) Total capital costs and unit costs are calculated with the assumption that phases are completed with minimum number of prerequisites (e.g. Pete Knight phase assumes Palmdale High School and Dry Town Lateral phases have *not* been built)
(2) Unit cost is derived by amortizing capital costs over a 30 year payback period, and includes O&M (2% of capital cost, annually)
(3) The Littlerock phase annual demand is composed of roughly 50 afy of direct non-potable reuse, and roughly 9,450 afy of groundwater recharge

As shown in Table 24, the unit cost to deliver recycled water to direct non-potable customers within the PRWA is expected to range from $350 per afy to over $4,000 per afy. Once recycled water can be delivered to the groundwater recharge site planned for Littlerock Creek, utilization of the system will increase by roughly 9,500 afy.

It is also important to note that after the Domenic Masari Phase is complete, further expansion of the system leads to a decrease in unit cost. This is because the majority of potential customers are in the eastern half of the PRWA service area and once that area is reached, recycled water utilization should significantly increase, relative to the cost of the system. As shown, the majority of project costs are due to installation of nearly 40,000 linear feet of the 24-inch pipeline.

It should be noted that following installation of the pump station, the phasing costs will be determined by pipeline construction. The project costs presented in Table 23 and Table 24 assume a 30-year payback period on all project capital costs.

5.3 SCHEDULE

A tentative project schedule is presented below in Figure 9.

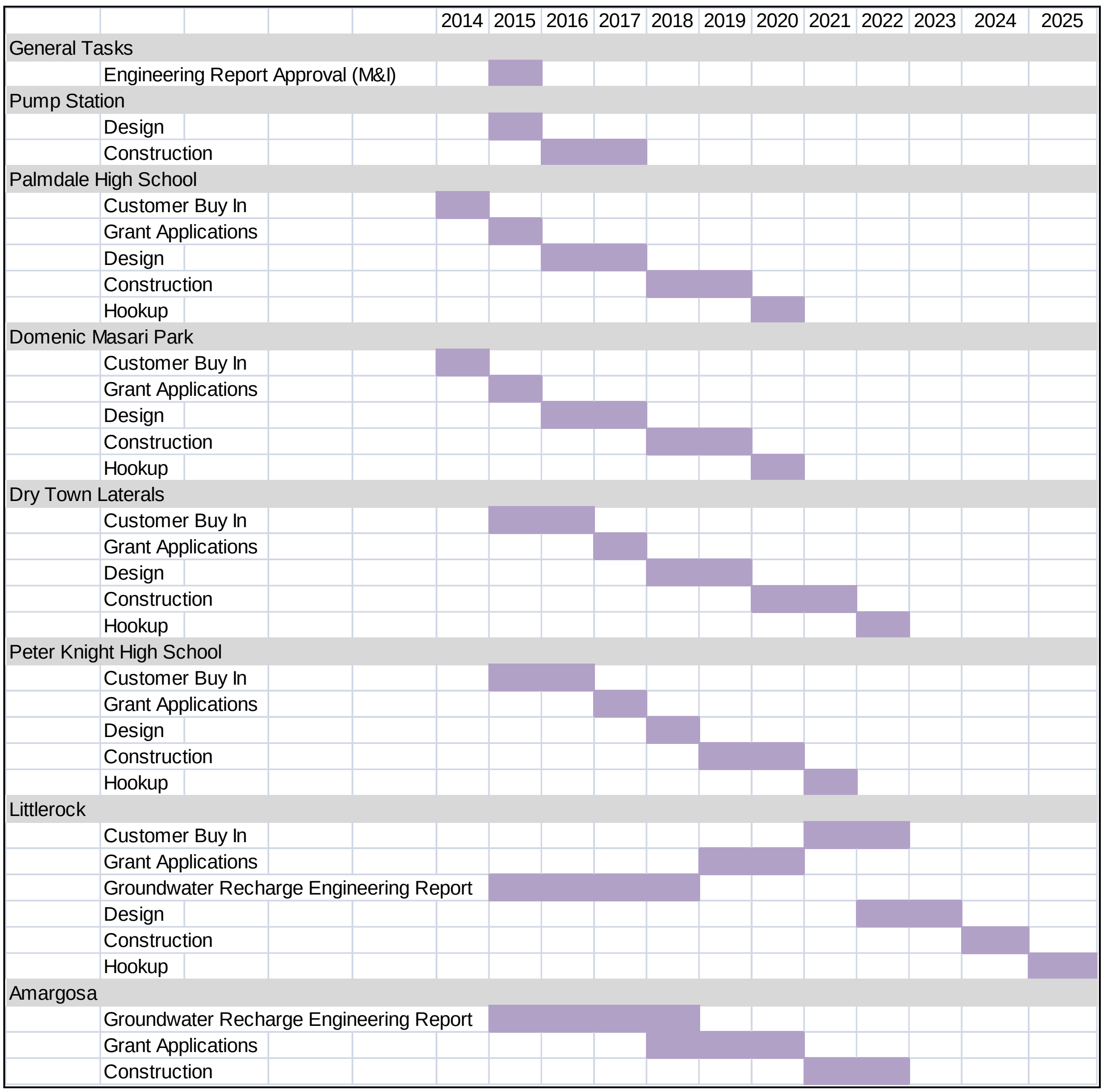


Figure 9 Project Schedule

As shown in Figure 9, the Project is anticipated to require over 10 years to complete. The direct non-potable use stages of the project have the potential to be completed much earlier.

5.4 FINANCE

This section describes how the recycled water project will generate funds for the PRWA, as well as how different elements of the project will be financed.

5.4.1 Rates

Based on the assumption that Alternative 3 is selected at the estimated total capital cost of $30 million (Table 24), a *Preliminary Recycled Water Financial Plan* (Carollo, 2014) was prepared to assess the PRWA recycled water rates, primarily the City and PWD. The City will purchase recycled water for its parks and landscape maintenance districts, while PWD will use recycled water for groundwater recharge. Recycled water will also be sold to private customers, mostly in the form of schools, which use recycled water for irrigation purposes.

To develop recycled water rate unit costs, three methodologies were evaluated: (1) Straight Unit Cost; (2) Rate Smoothing; (3) Percent of Potable. Under the first rate alternative, Straight Unit Cost, a unit cost is calculated by dividing that year’s assumed expenditures by assumed recycled water deliveries. As costs relative to deliveries are higher for the earlier phases, the unit cost is highest in the first few years and drops as expected recycled water deliveries expand. As such, this approach requires the least amount of funding commitments from the City and PWD. Since the system is projected to take nearly 10 years to expand projected deliveries, normalizing the short-term marginal cost of recycled water would be advantageous to prevent the system’s initial users from paying a higher rate than users later in the development phase.

Conceptualizing the recycled water system as a complete system involves allocating upfront costs of the system (e.g. pump stations) to all users based on full utilization, rather than to existing usage. As the second alternative, a rate smoothing approach was evaluated to guard initial users (first connectors) from large fluctuations in unit costs over the initial phases of the project. This approach further provides a mechanism to smooth upfront costs to future users. For example, given the financial assumptions, the pump station unit cost for initial users is $541 per af (pump station debt service / 2020 demand). Spreading this fixed cost over the full demand of the system reduces the unit cost to $195 per af (pump station debt service / 2025 demand). A rate smoothing approach calculates the revenue difference between the two prices and amortizes that lost revenue (expense) over a set number of years for repayment (recovery). However, this methodology would require either adequate reserves or an outside funding source to fund the impact of the rate normalization. The rate smoothing approach results in a lower cost in the short term, but higher in the long term as the reserves are replenished or outside funding commitments are repaid.

The last alternative based the recycled water rate as a percent of potable. This method provides an adequate rate incentive to encourage potable users to utilize the new and drought proof supply. Similar to the rate-smoothing alternative, the percent of potable method provides greater rate stability; however, it does so by greatly reducing the financial and build-out assumptions. For planning purposes, the potable rate is expected to escalate at inflation (3 percent). Given the current drought and recent variability in potable water costs, the spread between potable and recycled water is likely to widen. Therefore, the Percent of Potable rate should be reviewed and adjusted as necessary every couple of years.

Figure 10 presents a cost per acre-foot rate comparison of each unit cost alternative compared to the estimated potable unit. As summarized above, the straight unit cost has large fluctuations in upfront expenditures that are spread over limited deliveries. The latter two options provide rate smoothing; however, both require use of reserves or outside funding commitments to provide short-term rate support.

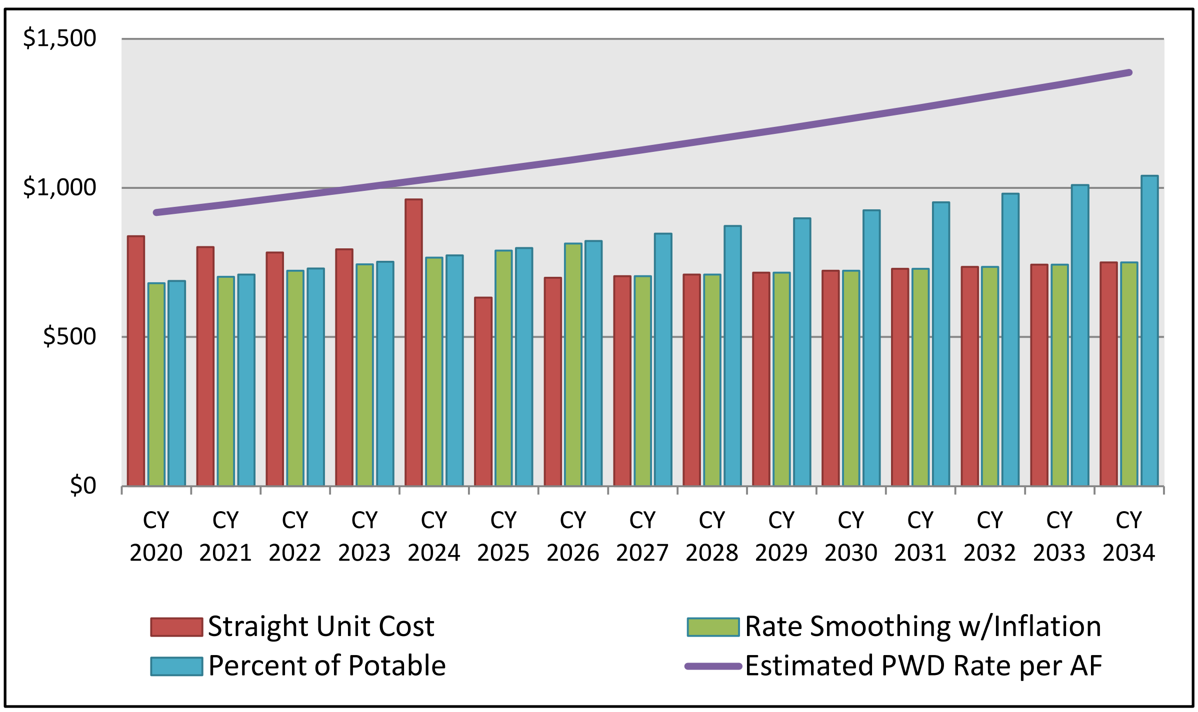


Figure 10 Unit Cost Rate Comparison

Large users or anchor users, such as agriculture users or Littlerock (ground water recharge) are necessary to lower the marginal cost of recycled water. Without these projects (or similar water deliveries), the PRWA would no longer benefit from the economies of scale. As such, the marginal unit cost of recycled water would far exceed existing potable rates. Preliminary analysis shows that the unit cost would be two to three times the existing potable rate.

Additionally, if the agriculture phase were not implemented, the Littlerock phase would use 3,000 afy. Since deliveries to the Littlerock phase commence five years after the agriculture phase, this delay impacts projected cash flows.

A high-level demand sensitivity analysis was performed to review the potential rate impacts associated with fluctuations in demand. These impacts are detailed in Table 25 below.

Table 25 Recycle Water Rate Sensitivity Analysis
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

2025 Forecasted afy Demand(1)	**8,066**	**8,228**	**8,394**	**8,563**
Demand Reduction	0%	10%	20%	30%
Straight Unit Cost	$632	$702	$790	$902
Rate Smoothing	$759	$844	$949	$1,085
Percent of Potable	$797	$797	$797	$797
Estimated PWD Potable Rate	**$1,063**	**$1,063**	**$1,063**	**$1,063**
Percent of Potable				
Straight Unit Cost	59%	66%	74%	85%
Rate Smoothing	71%	79%	89%	102%
Percent of Potable	75%	75%	75%	75%

Note:
(2) All rates are escalated to 2025 rates.

Based on the results of the above analysis, the calculated recycled water unit cost for all rate alternatives falls below the assumed existing potable rate. These rates are based on the financial assumptions and are contingent on the City and PWD contributions, water deliveries, and the PWRA's ability to finance each phase. The calculated unit costs are highly sensitive to changes in variables. Should any of these key assumptions fail to materialize, the calculated unit costs could increase beyond the cost of potable water. The results shown in the figures and tables above are detailed in the *Preliminary Recycled Water Financial Plan* (Carollo, 2014).

5.4.2 Revenue Requirements

In the *Preliminary Recycled Water Financial Plan* (Carollo, 2014), a revenue requirements analysis was performed to define the annual system revenue to be recovered through recycled water rates and charges. The revenue requirements typically encompass five components: Operations and Maintenance (O&M) Expenditures; Annual Debt Service; Policy Requirements and Debt Coverage; Capital Expenditures; and, Offsetting Revenues. For this analysis, forecasted expenditures were based on the defined capital costs and proposed phasing for Alternative 3.

Using the projected capital projects and costs found in Table 25, a preliminary cash flow analysis was developed. Certain assumptions, such as debt financing of all projects, were utilized to spread the upfront capital costs over a longer time horizon. This was necessary since revenues are not immediately available (concurrent) upon the initiation of construction.

The planning level cost estimates have been prepared for guidance in project evaluation and implementation. Capital Costs refers to the direct outlay of funds to cover capital expenditures or projects. Recycled Water O&M expenditures are based on 2 percent of total capital costs and are projected for future years assuming a 3.0 percent per year cost escalation factor. Payments to Los Angeles County Sanitation District (LACSD) are for the purchase or reimbursement of recycled water. The cost is currently at $160 per af and will be adjusted per the existing contract between the City and LACSD.

Figure 11 presents the forecasted annual capital and operating expenditures prior to any issuance of debt or use of reserves.

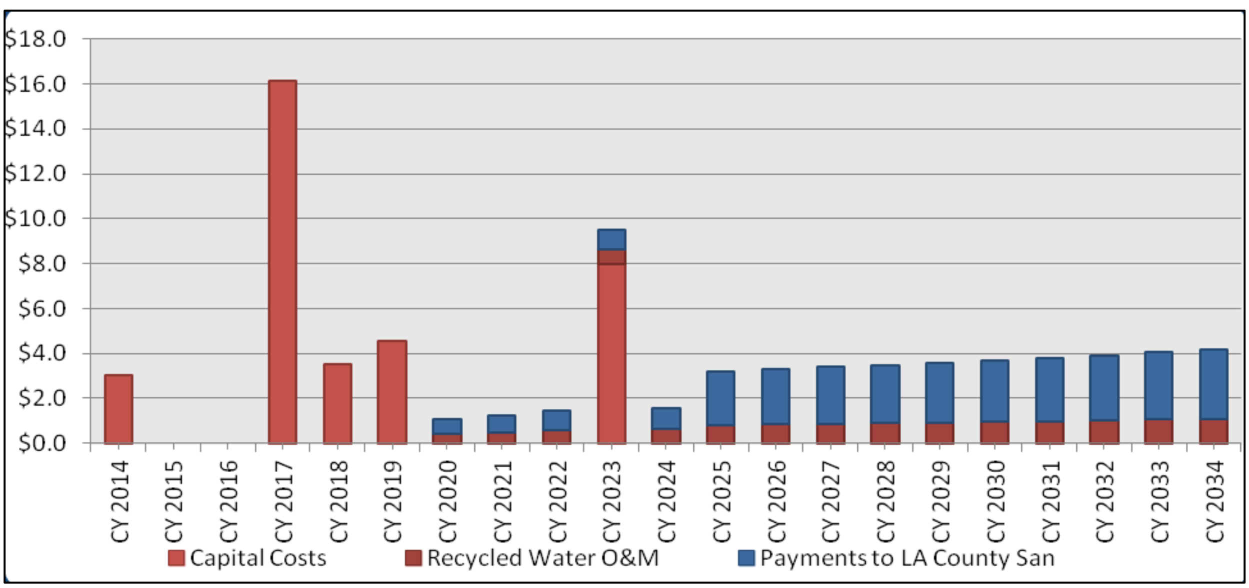


Figure 11 Forecasted Cash Flows of Cash Funding Capital Expenditures

Figure 12 illustrates the forecasted annual capital and operating expenditures assuming debt financed capital projects. All costs, including upfront engineering, legal, and acquisition expenses are assumed to be financed. Additionally, capitalized interest is utilized to further defer the onset of initial debt service payments. As presented in Figure 11, the Capital Costs are replaced with corresponding debt services expense. This smoothes and normalizes annual payments to align with recycled water deliveries and mitigate large upfront capital outlays.

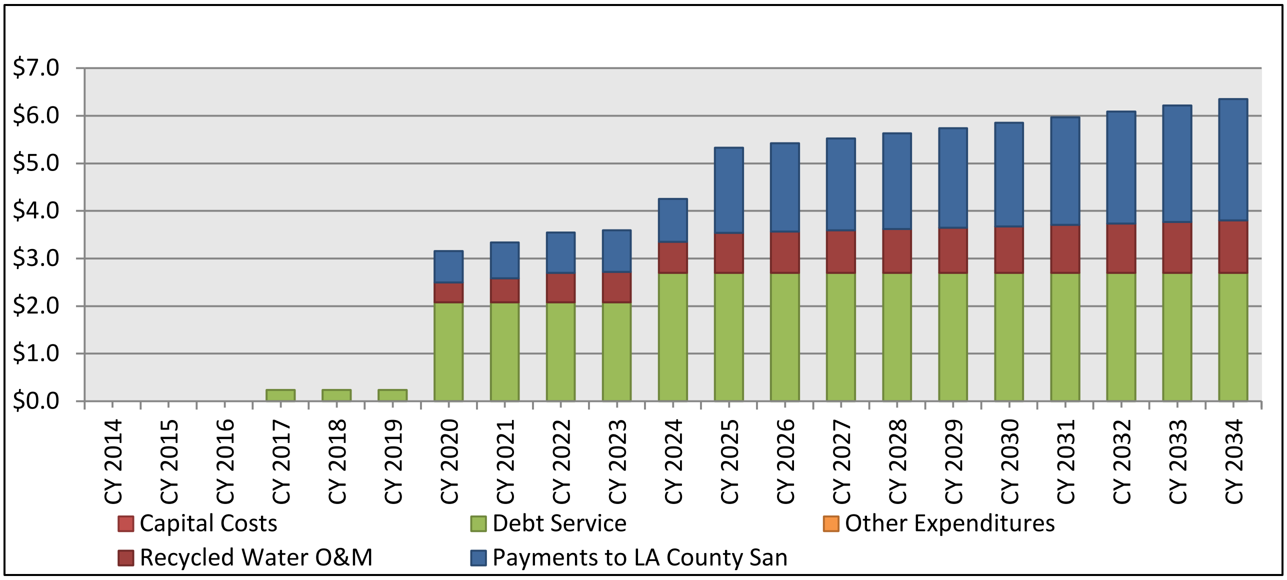


Figure 12 Forecasted Cash Flows of Cash Funding Capital Expenditures

Although construction is scheduled to commence in Calendar Year (CY) 2015, as capital projects (including engineering, legal, and acquisition costs) are financed with capitalized interest, no expenses are incurred until Calendar Year (CY) 2017. The identified required revenue is roughly $240,000 in CY 2017, increasing to over $6 million over the outlined 15 year time horizon. A 15 year outlook encompasses full development of the recycled water system as detailed in this Plan..

As the development of capital infrastructure occurs prior to any recycled water deliveries, without issuing debt or utilizing contributed funds, there are no available revenues to offset expenditures. Since the PRWA is not forecasted to have recycled water deliveries until CY 2020, and thus no rate revenues, the assumption that early expenditures of up to $250,000 annually would be funded through short-term commitments with the City and PWD, until such a time that recycled water revenues are sufficient to cover all expenditures. These commitments can also be utilized to lower the annual revenue requirement and thus recycled water unit cost, to keep it under the cost of potable water. The annual commitment funding will act as an operating reserve fund to cash fund short-term needs and revenue shortfalls. The revenue sufficiency point depends on the selected revenue mechanism as well as the City's and PWD's desire to mitigate future rates. The financial forecast assumed that funding contributions will not be paid back. If this funding is considered a short-term loan, a repayment period following system build-out (2025) could be considered with a minimal impact to recycled water rates.

5.4.3 Grants

Current imported water costs, based on recent transaction involving both SWP and non-SWP water, are about $1,000 per acre-foot. In order to bring recycled water rates down to a similar, competitive level, grants will be required to finance anywhere between 50 percent and 75 percent of individual phase capital costs. In later stages of development, when the system may be utilized for recycled water recharge, recycled water use is estimated to increase to a point where rate payment is sufficient to cover annual cost.

If PRWA wants to finance 50 to 75 percent of capital costs with grants, they will need to acquire roughly $20 million in grant money over the life of the project. This sum will need to be generated in quantities ranging from $1.3 to $10 million depending on the phase of the project. During the Domenic Masari Phase, for instance, 75 percent of the project cost will need to be covered in order to reduce unit cost down to a competitive $1,000 per acre foot. Seventy-five percent of the project cost would equate to a grant of approximately $10 million. This would be the largest grant however, with grants for the Dry Town Laterals Phase and Pete Knight Phase being less than $2 million each.

These grants can be applied for individually, or as part of the regional grant applications for the entire Antelope Valley, such as with Prop 84.

5.5 PERMITTING

This section details the necessary permitting which will be required to implement the recycled water project.

5.5.1 Title 22 Engineering Report

In order for the Regional Water Quality Control Board to approve the discharge of recycled water within its region, the LACSD will need to produce a Title 22 Engineering Report, which examines the use of recycled water within the study area. This report must be consistent with the requirements of section 60623 of the California Code of Regulations in order to initiate a formal review of the project by both California Department for Public Health and the Regional Water Quality Control Board.

At this time, AV Engineering has prepared a Title 22 Engineering Report on the use of recycled water in and around the PRWA service area that may be used to fill the Regional Water Quality Control Board requirement. The PRWA will need to finalize the AV Engineering Title 22 Engineering Report for the Project in accordance with CCR Title 22 and California Department for Public Health Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water (2001). The report will be provided to the LACSD to submit to the Lahontan Regional Water Quality

Control Board California Department for Public Health, and Los Angeles County Department of Health Services as part of the project permitting process. The report content will include recycled water production facilities, transmission and distribution facilities, and use areas.

The existing report content does not include analysis of groundwater recharge. A new Title 22 Engineering Report that continues an analysis of using recycled water for groundwater recharge will be required before the Project can include groundwater recharge at Amargosa or Littlerock Creek.

5.5.2 CEQA

The *Draft Palmdale Recycled Water Authority Recycled Water Facilities Plan - Initial Study/Mitigated Negative Declaration* (IS/MND) was prepared by ESA in 2014 to provide the public and responsible agencies with information about the potential environmental impacts associated with implementation of Alternative 3 of this Plan. The IS/MND includes project level analysis of the proposed recycled water facilities, including distribution pipelines, laterals, and pump stations.

As the CEQA Lead Agency, PRWA intends to use this IS/MND to consider implementation of the proposed project based on environmental factors along with the acquisition of regulatory permits or approvals, such as those listed in Table 26.

Table 26 Regulatory Requirements and Authorizations
Recycled Water Facilities Master Plan
Palmdale Recycled Water Authority

Agency	Type of Approval
California Department of Fish and Wildlife (CDFW)	Section 1602 Streambed Alteration Agreement
Antelope Valley Air Quality Management District	Permit to Construct
California Department of Transportation (Caltrans)	Encroachment Permit
State Water Resources Control Board (SWRCB)	Notice of Intent to comply with Landscape Irrigation General Permit
Los Angeles County Department of Public Works	Roadway Encroachment Permit
City of Palmdale	Roadway Encroachment Permit
Los Angeles County Sanitation District	Easements at PWRP
SWRCB Division of Drinking Water (DWW)	Domestic Water Supply Permit
Los Angeles County Department of Public Health	Cross Connection Plan Approval

The environmental factors analyzed as part of the IS/MND identify potential impacts and their significance. The significance of each impact dictates whether the project is acceptable as-is, with mitigation, or with further evaluation. Each environmental factor can either have: (1) no impact, (2) less than significant impact, (3) less than significant with mitigation, and (4) potentially significant. Factors that have no impact or less than significant impact are acceptable as-is. Factors that are less than significant with mitigation are acceptable as long as they are reduced to the threshold level (to less than significant) given reasonable and available mitigation measures. Factors that are potentially significant require further evaluation through an Environmental Impact Report (EIR).

On the basis of the draft IS/MND, it was determined that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. The IS/MND found that all potential impacts are either less than significant or can be reduced to less than significant by implementing mitigation measures for each affected environmental factor. No environmental factor has a potentially significant impact.

Additionally, the CEQA document and Title 22 Engineering Report for the project will incorporate and reflect information from the Master Permit. The Lahontan Regional Water Quality Control Board will ultimately decide whether the Project is covered by the Master Permit after the Title 22 Engineering Report and CEQA review is complete. If the Regional Water Quality Control Board decides that the project cannot be covered under the Master Permit, a separate application for Water Reclamation Requirements would need to be secured from the Lahontan Regional Water Quality Control Board by the PRWA or LACSD prior to starting operations.

Pipeline construction will all take place in existing City streets and will therefore be covered under the CEQA documentation.

5.5.3 Recharge

California Department for Public Health has recommended an implementation plan in its Groundwater Replenishment Reuse Regulations that the PRWA should follow when implementing the Littlerock and or Amargosa Creek Phases.

The main consideration in any recycled water recharge project is to identify a source(s) for the blending or diluent water. The California Department for Public Health currently regulates groundwater recharge reuse applications. California Code of Regulations Title 22, Division 4, Chapter 3, Article 5.1 details groundwater recharge requirements including Diluent Water Requirements, and Recycled Water Contribution (Recycled Water Contribution) Requirements (CDPH, 2011).

According to the latter set of requirements, the current diluents water requirements are dependent upon the nature of application. The following bullets list the requirements for different types of Groundwater Recharge Reuse Projects (GRRPs) in more detail (CDPH, 2011).

- Subsurface Application - The initial maximum Recycled Water Contribution would be determined by California Department for Public Health based upon a review of engineering reports and information obtained as a result of the public hearing.
- Surface Application with Full Advanced Treatment - 0.20 initial maximum Recycled Water Contribution for GRRPs that provide reverse osmosis treatment as well as subsequent advanced oxidation treatment to the entire recycled municipal wastewater. After one year, the applicant/operator may apply for reduced monitoring.
- Surface Application without Full Advanced Treatment - 0.20 initial maximum Recycled Water Contribution for surface application GRRPs not meeting the criteria stated in the second bullet.

A GRRP may increase its maximum Recycled Water Contribution provided a series of requirements are met. It should be noted that the Recycled Water Contribution is calculated each month as a monthly running average of the last 120 months, commencing after 30 months of operation.

A list of water quality requirements to meet the groundwater recharge requirements can be found in Chapters 3 and 4. These data are drawn from the current PWRP effluent monitoring and groundwater quality objectives presented in the Antelope Valley SNMP.

The first step to implementing groundwater recharge with recycled water will be discussing the concept with other stakeholders such as Waterworks No. 40 and AVEK to gauge interest, and identify potential locations to do recharge along the Amargosa and Littlerock Creek. After sites have been selected and stakeholders engaged, the PRWA must request meetings with both the Lahanton Regional Water Quality Control Board and the local California Department for Public Health office to brief them on the concept. Both entities will determine if any studies or technical memos need to be conducted or prepared to accompany the Engineering Report to move this phase forward. Alternatively, they may identify existing studies that have been conducted to support this phase.

Following submission of the Engineering Report to the Regional Water Quality Control Board and California Department for Public Health, the PRWA will host a public hearing to present the project to the general public. California Department for Public Health will attend the hearing to field any questions from the public regarding the regulations that govern GRRPs.

Based on the input received from the Public Hearing, California Department for Public Health will provide input to the Regional Water Quality Control Board to use when preparing and issuing a permit for this phase of the Project. The final stage in this process will be the acquisition of a Permit from the Lahontan Regional Water Quality Control Board.

5.6 AGREEMENTS

This section describes the various interagency and customer agreements that will be required once the recycled water system is in place.

5.6.1 JPA Operating Agreement

Ongoing project activities include maintenance of distribution system facilities, billing and customer service, and inspection/backflow prevention testing. PWD is in a good position operate the non-potable system and, therefore, provide staff and equipment for system operations. Based on experience with other water agencies and recycled water programs, the Project will likely need at least one recycled water coordinator and one certified operator. The PWD could provide existing trained staff in the interim. Staff could be added as needed, most likely in association with each major system expansion.

Large equipment will need to be made available to recycled water program staff, including a dump truck, a backhoe, a pick-up/utility vehicle, and spare mechanical parts for critical facilities such as the pump station.

5.6.2 Supply

Currently, wastewater supplies are managed by Waterworks No. 40, at the request of LACSD. As discussed in Chapter 3, preliminary discussions have resulted in a tentative agreement wherein 98% of wastewater flows will be made available to the City, to in turn provide to the PRWA. The agreement for this supply still needs to be finalized.

5.6.3 Customers

The PRWA will develop a standard Recycled Water User Agreement with each individual recycled water user. The agreement will include the application process for recycled water service and recycled water user requirements for safe use of recycled water, as described in the LACSD Recycled Water User Handbook. The user agreement will facilitate the addition of qualified users to the recycled water distribution system.

It is a requirement of the SWRCB (and good practice) that user commitments be obtained for a project to be eligible for state funding through the SWRCB Water Recycling Funding Program. The PRWA should begin and continue engaging potential users to obtain commitment to use recycled water. This commitment will be memorialized in the user agreement.

REFERENCES

(PWD, 2010)	Palmdale Water District. *Recycled Water Facilities Plan 2010.* Adopted February 2010
(PWD, 2011)	Palmdale Water District. Urban Water Management Plan 2010
(COP, 2009)	City of Palmdale. *Palmdale Recycled Water Facilities Plan 2009.* Adopted July 2009
(CDPH, 2013)	California Department of Public Health. *Groundwater Replenishment Reuse Regulations.* Adopted 2013.
(LACWD, 2006)	Los Angeles County Waterworks District No. 40. *Final Facilities Planning Report, Antelope Valley Recycled Water Project*. August 8, 2006
(LACWD, 2013)	Los Angeles County Waterworks District No. 40. *Draft Salt and Nutrient Management Plan for the Antelope Valley*. June 2013
(PWD, 2010b)	Palmdale Water District. *Strategic Water Resources Plan Final Report.* Adopted March 2010
(LACSD, 2013a)	Los Angeles County Sanitation Districts. *Palmdale Water Reclamation Plant Water Recycling Monitoring Report – First Quarter 2013*. May 30, 2013
(LACSD, 2013b)	Los Angeles County Sanitation Districts. *Palmdale Water Reclamation Plant, WDID No 6B190107069 Monitoring Report for July 2013*. September 16, 2013
(ESA, 2014)	ESA. *Draft Palmdale Recycled Water Authority Recycled Water Facilities Plan - Initial Study/Mitigated Negative Declaration (IS/MND).* December 2014.
(Carollo, 2014)	Carollo. *Preliminary Recycled Water Financial Plan.* May 2014.

Finally, information based on personal correspondence with Mike Sullivan (LACSD), Gordon Phar (COP), and Matt Knudsen (PWD) was used in the writing of this report.

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LMD LIST

Table 1 **LMD List**
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

LMD Tract	LMD Number	Parcels	Acres
301	62974	62	19.8
241	53221	85	23.1
274	54383	62	28.7
276	60128	38	9.5
206	46333	80	19.2
267-III	60745		1.1
287	46356, 52029	198	63.2
280	53920		60.3
295	62068	50	21.1
282	61699	38	21.2
283	61770	33	8.9
267-II	54266		29.0
217	46757	388	90.7
272	49147-1, -2, & -3	171	45.5
289	61660	23	6.3
296	62020	73	22.5
281	52921	168	42.6
278	60028-1 & -2	372	98.2
272-I	49147, 49147-4, & -5	172	45.2
299	52806	204	27.0
65	42900,44903, 45540	320	44.5
1	33574	75	16.9
10	36905, 43206, 43207, 43399	176	41.7
101	45246		7.3
103	44402, 45927, 45928	229	55.1
105	45216, 45392, 45393, 45394	260	53.2
109	44701	109	25.0
11	37748, 42879	208	36.5
111	32793, 33925	77	19.0
235	45057	148	34.6
112	44136	103	25.0
113	45276	83	19.2
114	44898	42	9.7
12	31130, 42144, 43329, 44017	205	48.2
120	45705	154	40.7
121	45750	49	12.6
122	45382, 45508	178	47.1
125	46092	72	30.2
128	44813, 46012, 43581	413	100.4
13	4,324,143,242	130	29.2
133A	45802, 46804, 46805, 46806, 46808,46819		56.4
135	45363, 46279, 46280	58	19.9
136	45777	84	18.9
137	45672, 46867, 46868	207	50.8

Table 1	**LMD List** Recycled Water Facilities Plan Palmdale Recycled Water Authority		
LMD Tract	**LMD Number**	**Parcels**	**Acres**
138	44567, 46320	93	21.4
139	46089	161	39.9
14	44014	67	17.0
141	44544, 47115, 47116, 47117	159	40.5
144	45911	90	20.0
145	45548, 45682, 46725, 46726, 46765, 46788	402	100.1
147	45156		20.2
148	36720	115	23.8
15	42971	60	19.9
151	44476	91	20.6
153	45092	100	25.0
155	45328		2.3
156	46032	81	19.9
158	46551		11.9
159	44543	46	10.7
16	43325	45	11.6
163	45277	75	19.5
168	45525, 46355	87	32.1
169	45198		9.7
17	43665	92	23.9
171	45493	36	10.3
18	38776, 39034, 39260, 42932		42.6
180	48846, 48847	74	23.5
182	47630	60	17.8
183	48665	42	12.1
188	45411	82	21.2
189	47548	38	9.6
19	42956	44	9.9
190	45219	68	16.7
191	46044	84	19.6
197	46710	43	10.0
2	35171, 35177, 35198, 35571	223	38.0
201	45842	82	20.6
203	48254	56	14.7
204	45506	83	20.1
207	45038	194	47.8
209	45712		25.0
21	43306	40	10.0
210	48154		2.1
211	46755		5.1
212B	47628		10.4
213	46934	228	56.5
214	49058	49	11.3
22	4,306,543,825	78	19.9
220	45412	126	30.0
221	45218-01	92	23.4
222	45217, 46193, 46194	197	47.4

Table 1 **LMD List**
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

LMD Tract	LMD Number	Parcels	Acres
224	48672	78	20.6
227	46854		17.6
23	43826	142	48.2
263	46597	64	17.7
234	44826	48	11.9
25	43324	43	9.5
257	53608	78	16.2
26	43031	87	20.8
262	44893	122	26.7
264	60053	108	27.7
267-I	53199		39.8
29	43892	71	16.9
3	35969		9.9
30	44045	36	10.0
31	43514	86	19.9
32	43312	107	30.0
33	44528	167	40.7
35	43887	14	3.0
36	43024	61	15.0
37	44165	47	10.0
38	44558		3.8
39	44256	45	7.9
42	43356	39	10.0
43	44183, 44184,44154	172	31.7
45	44271		10.2
46	29800	45	9.4
48	38007	39	9.5
49	44220	55	12.7
51	44140	59	14.1
52	32702, 44579	127	37.4
55	34175		10.0
56	26332, 42883, 42884	178	39.5
58	44909	41	9.5
59	43310, 44782, 45091	179	40.0
6	42989	19	4.6
60	45381, 45659	81	19.8
64	32799, 43275, 43821	120	30.4
66	30937, 31247, 31495, 31506, 31591, 31622, 31678, 31694, 43126	327	92.0
67	44892	173	29.5
68	44556	100	23.8
69	44915	89	19.1
7	42880, 42881, 42882	167	39.4
72	43536	219	52.3
74	43079, 43645		19.7
75	43564	111	26.0
76	43637	84	19.8
77	43636	40	8.8

Table 1 **LMD List**
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

LMD Tract	LMD Number	Parcels	Acres
78	44876	174	63.1
8	42693		15.7
82	45045	19	5.0
83	35564	25	3.8
84	45263	69	16.8
86	45073	86	19.3
87	44762, 45273, 45274	318	93.9
89	44928, 45324, 45325, 45326, 45327	407	97.6
9	40573, 42405, 42406	289	46.8
92	45507	40	9.7
93	43321	21	4.8
94	45220	78	18.2
96	44897	88	19.6
98	45125, 46035	225	48.7
4	32267, 36357, 37895		59.4
286	60954	78	22.0
65A	44251, 44585		30.7
133B	46807		10.8
212A	47629		8.3
315	60511	4	8.9
314	51224	1	31.6
294	60789	1	4.8
297	61610	5	10.1
298	61611	3	19.7
300	61488		5.8
302	60926	1	8.3
304	53067		19.3
318	51451-1; 51451-2		53.5

ALTERNATIVES LIST

Table 1 Alternatives 1 Through 5 Customer List
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

Customer Name	Account Number	Site ID	Irrigated Area (acres)	Annual Demand (afy)	Max Day Demand (mgd)	Peak Hour Demand (gpm)	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
Schools											
Manzanita Elementary School	42961620	S1	3.8	27	0.05	100.6					
Barrel Springs Elemntary School	n/a	S19	9.7	58	0.1	215.8					
Buena Vista Elementary School	40451001	S22	7.1	53.2	0.1	198.1	X	X	X	X	X
Cactus K-8	33061060	S12	4.5	37.9	0.07	140.8	X	X	X	X	X
Chaparral Elementary School	33461101	S26	2.5	16.3	0.03	60.5	X	X	X	X	X
Cimmaron Elementary School	10551004	S23	2.8	28.1	0.05	104.5					
Desert Millow Intermediate School	n/a	S21	10.2	36.8	0.07	136.9					
Desert Rose Elementary School	23161801	S9	4.4	26.2	0.05	97.3	X	X	X	X	X
Golden Poppy Elementary School	43561001	S24	2.3	29.3	0.05	109.1					
High School (47th & Pearblossom)	n/a	S27	6.8	26.2	0.05	97.5	X				
Joshua Hills Elementary School	n/a	S25	9.3	22.9	0.04	85.2	X	X	X	X	X
Los Amigos School	23561917	S14	1.7	35.3	0.06	131.3	X	X	X	X	X
Mesa Intermediate School	43261101	S13	9.1	47.7	0.09	177.5	X	X	X	X	X
Mesquite Elementary School	43361101	S2	3.4	28.7	0.05	106.7	X	X	X	X	X
Oak Tree Learning Center	23261001	S18	7.1	40.9	0.07	152.2	X	X	X	X	X
Palmdale High	33061061	S8	5.6	82.1	0.15	305.5	X	X	X	X	X

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Customer Name	Account Number	Site ID	Irrigated Area (acres)	Annual Demand (afy)	Max Day Demand (mgd)	Peak Hour Demand (gpm)	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
School											
Palmdale Learning Plaza	22762900	S7	6.6	52.3	0.09	194.7	X	X			
Palmtree Elementary School	60794001	S3	3.3	32.1	0.06	119.6	X	X			
Pete Knight High School	23561001	S15	20	243.9	0.44	907.5	X	X	X	X	X
Phoenix High School	n/a	S4	4.4	11.7	0.02	43.5					
R. Rex Parris High School	22362903	S20	1.7	16.6	0.03	61.9					
Shadow Hills Intermediate School	23461001	S16	7	98.6	0.18	367	X	X	X	X	X
Tamarisk Elementary School	12562700	S5	3.3	24.4	0.04	90.7					
Tumbleweed Elementary School	43662101	S10	5.6	29.6	0.05	110.1					
Wildflower Elementary School	32971136	S6	3.8	30.4	0.05	113					
Yellen Learning Center School	40481015	S17	2.1	16.1	0.03	60	X	X	X	X	X
Yucca Elementary School	42662450	S11	3.2	19	0.03	70.9					
Parks											
60th St E/Ave S-8 Park	n/a	P12	19.2	84	0.15	312.5					
70th St E/Ave R Park	n/a	P14	10.4	42	0.07	156.3	X	X	X	X	X
72nd St E/Ave R-8 Park	n/a	P13	10.4	42	0.07	156.3					
Courson Park	32562226	P3	4	35.1	0.06	130.7					
Desert Lawn Memorial Park	n/a	P6	47	32.3	0.06	120.2					
Desert Sands Expansion	n/a	P5	4	29	0.05	107.9	X	X			
Desert Sands Park	76700008	P4	11.3	53.7	0.1	199.7	X	X			
Domenic Massari	1762991	P7	30	150.6	0.27	560.2	X	X	X	X	X

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Park											
Dr. Robert C. St. Clair Parkway	12662405	P1	2.8	31.9	0.06	118.5	X	X			
Dry Town Water Park	40551905	P11	7.1	68.4	0.12	254.5	X	X	X	X	X
Joshua Hills Park	n/a	P8	3.6	16.3	0.03	60.6	X	X	X	X	X
McAdam Park	23271901	P2	15.3	64.1	0.11	238.6	X	X	X	X	X
Palmdale Park	n/a	P17	0.3	11	0.02	40.9	X	X	X	X	X
Pelona Vista Park	43462001	P10	26.2	116.6	0.21	434	X	X			
Sam Yellen Park	n/a	P15	0.8	105	0.19	390.6	X	X	X	X	X
Sierra Hwy Green Belt	n/a	P16	0.2	16	0.03	59.5	X	X			
Other											
American Indian Little League	76700006	O1	4.5	10.5	0.02	39	X	X			
Palmdale City Library	22662701	O5	0.2	5	0.01	18.6	X	X			
Palmdale Parks & Rec Office	32562260	O6	0.3	3.5	0.01	12.9					
Palmdale Playhouse	32562334	O7	0.1	2.8	0.01	10.5					
Palmdale Pony League	33061000	O3	21.4	19.9	0.04	74	X	X	X	X	X
Ponciltan Square	22662991	O2	1.5	0	0	-	X	X			
Ponciltan Square (New Mtr-A)	69400291	O2	1.5	8.9	0.02	32.9					
Ponciltan Square (New Mtr-B)	69400292	O2	1.5	7.6	0.01	28.1					
Trailer Shay	20351003	O4	14.1	3.7	0.01	13.8					
LMDs											
276				1.0	0.002	3.7	X	X	X	X	X
206				2.3	0.004	8.4	X	X	X	X	X
287				11.1	0.020	41.3	X			X	X
272				12.0	0.021	44.6	X	X	X		

Table 1 **Alternatives 1 Through 5 Customer List**
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

Customer Name	Account Number	Site ID	Irrigated Area (acres)	Annual Demand (afy)	Max Day Demand (mgd)	Peak Hour Demand (gpm)	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
278				12.5	0.022	46.3	X	X	X	X	X
272-I				3.2	0.006	12	X	X	X	X	X
65				1.7	0.003	6.2	X	X	X	X	X
10				0.1	0.000	0.5	X	X	X	X	X
101				0.5	0.001	1.9	X	X		X	X
103				1.5	0.003	5.7	X	X	X	X	X
105				0.9	0.002	3.3	X	X	X		
112				0.6	0.001	2.2	X	X	X	X	X
121				0.9	0.002	3.4	X	X	X	X	X
125				0.3	0.001	1.2	X	X	X	X	X
133A				4.0	0.007	14.9	X	X	X	X	X
14				0.1	0.000	0.5	X	X	X	X	X
141				7.2	0.013	26.9	X	X	X	X	X
147				1.4	0.003	5.3	X	X	X	X	X
148				0.1	0.000	0.2	X	X	X	X	X
151				0.5	0.001	1.9	X	X	X	X	X
158				0.8	0.002	3.1	X	X	X	X	X
159				0.6	0.001	2.2	X	X	X	X	X
17				9.3	0.017	34.7	X	X	X	X	X
171				0.0	0.000	0.2	X	X	X	X	X
18				3.0	0.005	11.3	X	X	X	X	X
183				1.1	0.002	4.2	X	X	X	X	X
201				0.5	0.001	1.7	X	X	X	X	X

Table 1 Alternatives 1 Through 5 Customer List
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

Customer Name	Account Number	Site ID	Irrigated Area (acres)	Annual Demand (afy)	Max Day Demand (mgd)	Peak Hour Demand (gpm)	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
204				0.8	0.001	3	X	X	X	X	X
211				0.4	0.001	1.3	X	X	X	X	X
212B				0.7	0.001	2.8	X	X	X	X	X
213				4.9	0.009	18.2	X				
29				0.6	0.001	2.2	X	X	X	X	X
31				0.4	0.001	1.6	X	X	X	X	X
38				0.3	0.000	1	X	X	X	X	X
39				0.3	0.001	1.1	X	X	X	X	X
43				1.6	0.003	5.8	X	X	X	X	X
60				1.6	0.003	5.8	X	X	X	X	X
66				5.5	0.010	20.5	X	X	X	X	X
69				1.1	0.002	4	X	X	X	X	X
72				2.4	0.004	8.8	X	X	X	X	X
76				1.5	0.003	5.6	X	X	X	X	X
77				0.7	0.001	2.7	X	X	X	X	X
8				1.1	0.002	4.2	X	X	X	X	X
84				1.1	0.002	3.9	X	X	X	X	X
9				1.1	0.002	4.2	X	X	X	X	X
94				1.4	0.003	5.3	X	X	X	X	X
212A				0.6	0.001	2.2	X	X	X	X	X
300				0.4	0.001	1.5	X	X	X	X	X
318				3.8	0.007	14.2	X				

Note:

Table 1 Alternatives 1 Through 5 Customer List
Recycled Water Facilities Plan
Palmdale Recycled Water Authority

Customer Name	Account Number	Site ID	Irrigated Area (acres)	Annual Demand (afy)	Max Day Demand (mgd)	Peak Hour Demand (gpm)	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5
(1)											