Kennedy/Jenks Consultants
2775 North Ventura Road, Suite 100
Oxnard, California 93036
805-973-5700
FAX: 805-973-1440

ADMIN DRAFT (SECTIONS 1-7) Castaic Lake Water Agency Recycled Water Master Plan

January to April 2016

Prepared for

Castaic Lake Water Agency
27234 Bouquet Canyon Road
Santa Clarita, CA 91350

K/J Project No. 1544241.00

Recycled Water Master Plan – Section Status

This document includes the Admin Draft RWMP Sections submitted by Kennedy/Jenks for review/comment by CLWA and the purveyors as of May 31, 2016.

Section	Status
Section 1 - Introduction Section 2 - Study Area Characteristics	Admin Submitted (1/13)
Section 3 - Water Supply Characteristics and Facilities Section 4 - Wastewater Characteristics and Facilities	Admin Submitted (2/17)
Section 5 - Treatment Requirements Section 6 - Recycled Water Market	Admin Submitted (3/17)
Section 7 - Project Alternatives Analysis * Figures 7-1 to 7-15 included as separate pdf * Appendix C included as separate pdf * Appendix E included as separate pdf	Admin Submitted (4/28)
Section 8 - Recommended Project Section 9 - Construction Financing Plan	To be included in Draft
Draft RWMP*	Anticipated Submittal 6/30
Final RWMP**	Anticipated Submittal 9/30

* The Draft RWMP will incorporate response to comments and updates to all prior sections
** The Final RWMP will incorporate response to comments and updates to the Draft RWMP

Castaic Lake Water Agency
Recycled Water Master Plan Update
ADMIN DRAFT

Status of Section by Section Reviews

Section	Scheduled Review	Status
Section 1 - Introduction	Jan 2016	Included herein (1/13)
Section 2 - Study Area Characteristics	Jan 2016	Included herein (1/13)
Section 3 - Water Supply Characteristics and Facilities	Feb 2016	
Section 4 - Wastewater Characteristics and Facilities	Feb 2016	
Section 5 - Treatment Requirements	Mar 2016	
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Section 9 - Construction Financing Plan	May 2016	
Draft RWMP*	June 2016	
Final RWMP**	Sept 2016	

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Section 1: Introduction

Due to the ongoing drought in California and the resulting fluctuations in water supply, the Castaic Lake Water Agency (CLWA) is seeking opportunities to accelerate the expansion of their existing recycled water system to offset potable water demands and improve water supply reliability. This Recycled Water Master Plan (RWMP) update explores opportunities to maximize the utilization recycled water in the Santa Clarita Valley.

1.1 Background

CLWA is the public water wholesaler in Santa Clarita Valley; delivering water to four local water purveyors: Los Angeles County Waterworks District 36 (LACWD36), Newhall County Water District (NCWD), Santa Clarita Water Division (SCWD), and Valencia Water Company (VWC).

CLWA is one of 29 State Water Project (SWP) contractors and receives water imported from northern California via the California Aqueduct. CLWA also receives imported water acquired from the Buena Vista Water Storage District in Kern County and Yuba County Water Agency, has access to "flexible storage" in Castaic Lake and has entered into four groundwater banking and water exchange programs. Even with this diverse portfolio of water supplies, the extreme prolonged drought conditions have required CLWA to focus on conservation and recycled water use in order to meet demands.

For the past decade CLWA has been receiving tertiary treated water from the Santa Clarita Valley Sanitation District's (SCVSD) Valencia Water Reclamation Plant (WRP), and wholesaling the recycled water through VWC within its territory for sale to retail customers for appropriate uses. The existing recycled water system (Phase 1) includes: the Valencia WRP Recycled Water Pump Station, a recycled water tank in the Westridge development, and approximately 15,600 feet of recycled water pipelines. Annual recycled water usage has averaged 415 acre-feet per year (AFY) for the last 10 years. Ninety percent of water use is between May and October, during the irrigation season.

1.2 Drivers and Objectives

In normal years, approximately 55 percent of the municipal and industrial demands within CLWA's service area are met with imported water. However, the reliability of the SWP is subject to the availability of the water (i.e., precipitation and snowpack of the present and past years) and deliveries can be curtailed. When sufficient imported water is not available, the balance is met with local groundwater provided by the purveyors.

It is anticipated that water demands will continue to increase. Accordingly, additional reliable sources of water are necessary to meet projected water demands. CLWA recognizes that recycled water is an important and reliable source of additional water. Recycled water enhances reliability in that it provides an additional source of supply and allows for more efficient utilization of CLWA's groundwater and imported water supplies. By increasing the use of recycled water, CLWA can more efficiently allocate its potable water and increase the reliability of water supplies in the Santa Clarita Valley.

The primary objective of this RWMP is to update the 2002 Recycled Water Master Plan based on recent developments affecting recycled water sources, supplies uses and demands. It is the intent of the CLWA and the purveyors in Santa Clarita Valley to make recycled water available and encourage its use where authorized and economically feasible.

This RWMP evaluates near-term, mid-term and long-term objectives as follows:

1. **Near-Term Objective:** Accelerate the implementation of next phase of recycled water projects (Phase 2) to support upcoming design work and the pursuit of currently available grants and loans for recycled water projects.

2. **Mid-Term Objective:** Incorporate the increased demands associated with planned new developments to optimize expansion of the recycled water system and identify further opportunities for non-potable reuse.

3. **Long-Term Objective:** explore opportunities for potable reuse through groundwater recharge, surface water augmentation and direct potable reuse. A feasibility study would be required to confirm the viability of any potable reuse opportunity and is not included in this scope of work.

1.3 Previous Studies

The following reports evaluated potential opportunities for recycled water use in the CLWA service area.

1.3.1 Recycled Water Master Plans -1993 & 2002

An initial Reclaimed Water System Master Plan (RWMP) was completed for CLWA in 1993 (Kennedy/Jenks 1993) and an update to the 1993 RWMP was completed in 2002 (Kennedy/Jenks 2002) to address the changes in the area that had occurred in the last preceding decade. The information developed in the 2002 RWMP was largely drawn from the 1993 RWMP supplemented with contacts from CLWA, Sanitation Districts of Los Angeles County (LACSD), local water purveyors, the City of Santa Clarita, the County of Los Angeles, oil company representatives, and potential water users. Additional analysis and computer modeling were performed as part of the Master Plan update. Water demand characteristics were also updated through discussions with potential users. The updated data and computer modeling were used to develop a revised cost-effective recycled water system. Construction costs and a construction schedule were included in the update.

The 2002 RWMP recognized that current WRP production is not anticipated to be adequate to meet the total demands of the CLWA service area. However, as potable water demands increase, recycled water production would similarly increase, thereby becoming more available to support non-potable uses in lieu of imported potable water or groundwater. The implementation plan outlined in the 2002 RWMP was phased to utilize the increases in plant production. Implementation phases were prioritized based on the status of the users (existing or future), the anticipated construction schedule of future users, and the proximity of the users to the recycled water source.

1.3.2 Water Resources Reconnaissance Study (2015)

CLWA and the purveyors commissioned a Water Resources Reconnaissance Study (Recon Study) to evaluate alternatives for expanding local supplies to offset future periodic occurrences of significant shortfalls in imported water supplies (Carollo 2015). The Recon Study provided an initial assessment of groundwater recharge with recycled water through surface spreading into the alluvial aquifer and aquifer storage and recovery via groundwater injection into the deeper Saugus formation. Groundwater recharge with recycled water through surface spreading has been further reviewed and refined as part of this RWMP.

1.3.3 Salt and Nutrient Management Plan (2015)

A Salt and Nutrient Management Plan (SNMP) for the Santa Clara River Valley East Subbasin is being prepared being developed in accordance with the State Water Resources Control Board's (State Water Board's) Recycled Water Policy (Policy). A Salt and Nutrient Task Force, facilitated by CLWA, is preparing the SNMP to determine the current (ambient) water quality conditions in the East Subbasin and ensure that all water management practices, including the use of recycled water, are consistent with water quality objectives. The SNMP is intended to provide the framework for water management practices to ensure protection of beneficial uses, and allow for the sustainability of groundwater resources consistent with the Basin Plan (Geoscience 2015).

The SNMP recognized the benefits of increased recycled water use in the East Subbasin. Furthermore, the SNMP demonstrated that implementation of proposed recycled projects represent a "maximum benefit" to the people of the State by providing beneficial uses for recycled water decreasing the use of assimilative capacity as compared to not adding planned projects to the East Subbasin (Geoscience 2015).

1.4 Master Plan Organization

The report is organized to align with the SWRCB funding division Appendix B - Recommended Planning Outline for Water Recycling Projects, which will facilitate future applications for funding through the State Revolving Fund (SRF) program. The organization of this RWMP will also serve to meet the Proposition 84 requirements, which provided grant funds for this study. The RWMP is organized as follows:

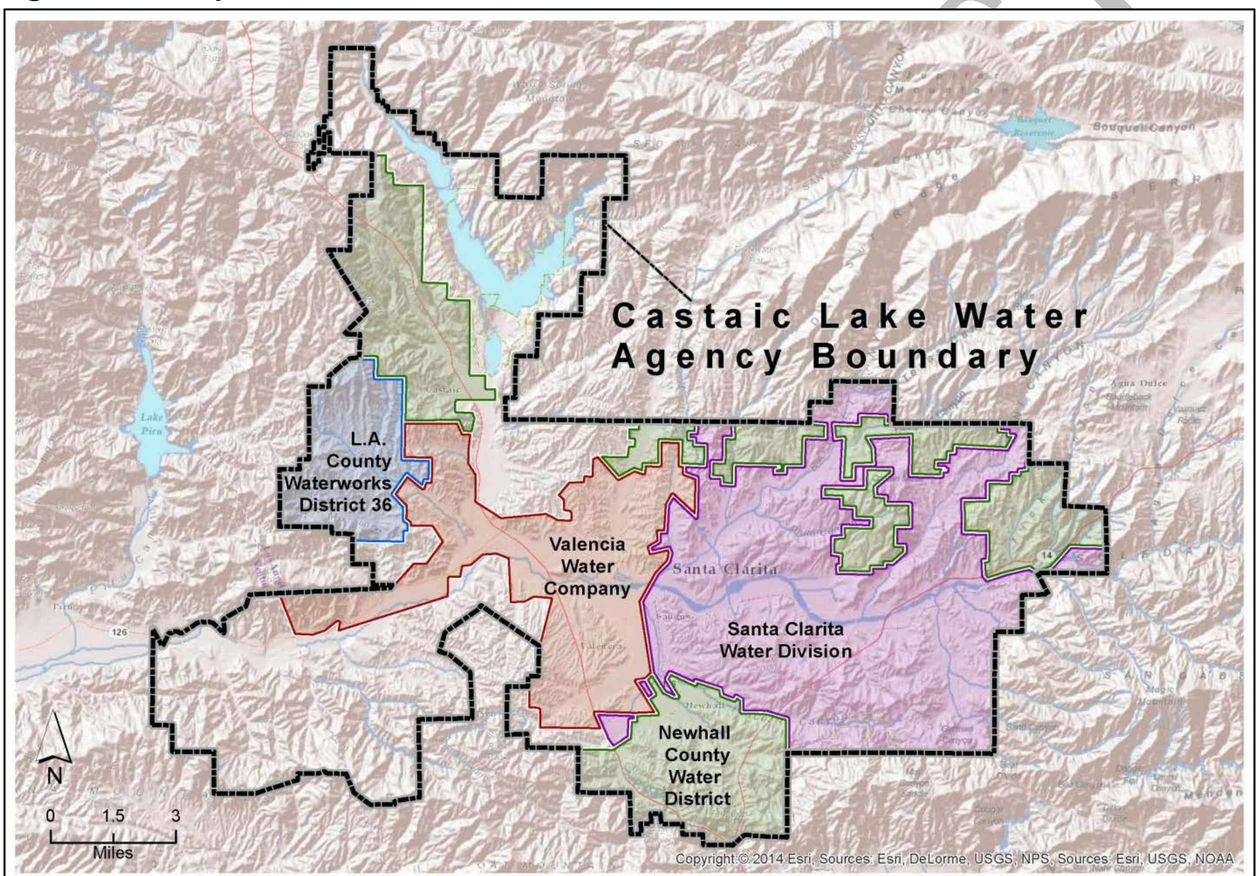
- **Section 1: Introduction** – summarizes the background and objectives of the Recycled Water Master Plan as well as addresses previous studies.
- **Section 2: Study Area Characteristics** – describes the study area, major hydrologic features, water quality, land use, population projections and beneficial uses of receiving waters in the Santa Clarita Valley.
- **Section 3: Water Supply Characteristics and Facilities –** describes wholesale and retail entities and discusses water supply reliability and projected water supply and demand for potable purposes, which necessitates the need for recycled water to serve non-potable demands.
- **Section 4: Wastewater Characteristics and Facilities –** presents an overview of water recycling facilities, effluent flows and recycled water quality in the Santa Clarita Valley.
- **Section 5: Treatment Requirements –** discusses regulations guiding recycled water production, discharge, distribution, and use to protect public health, including the most recent regulatory landscape for potable reuse.
- **Section 6: Recycled Water Market –** identifies potential recycled water users within the CLWA service area and estimates annual and peak demands.
- **Section 7: Project Alternatives Analysis –** describes the near-term, mid-term and long-term alternatives considered.
- **Section 8: Recommended Project –** discusses the planning criteria for system components, recommended infrastructure, and the modeling process used to size facilities. Costs are presented in this section along with a plan for implementing the recommended project.
- **Section 9: Construction Financing Plan and Revenue Program –** presents a plan for financing the proposed recommended project and discusses potential financing options, funding opportunities and considerations for a water rate policy.

Section 2: Study Area Characteristics

2.1 Study Area

The Study area for the RWMP includes the CLWA Service Area, as shown in Figure 2-1.

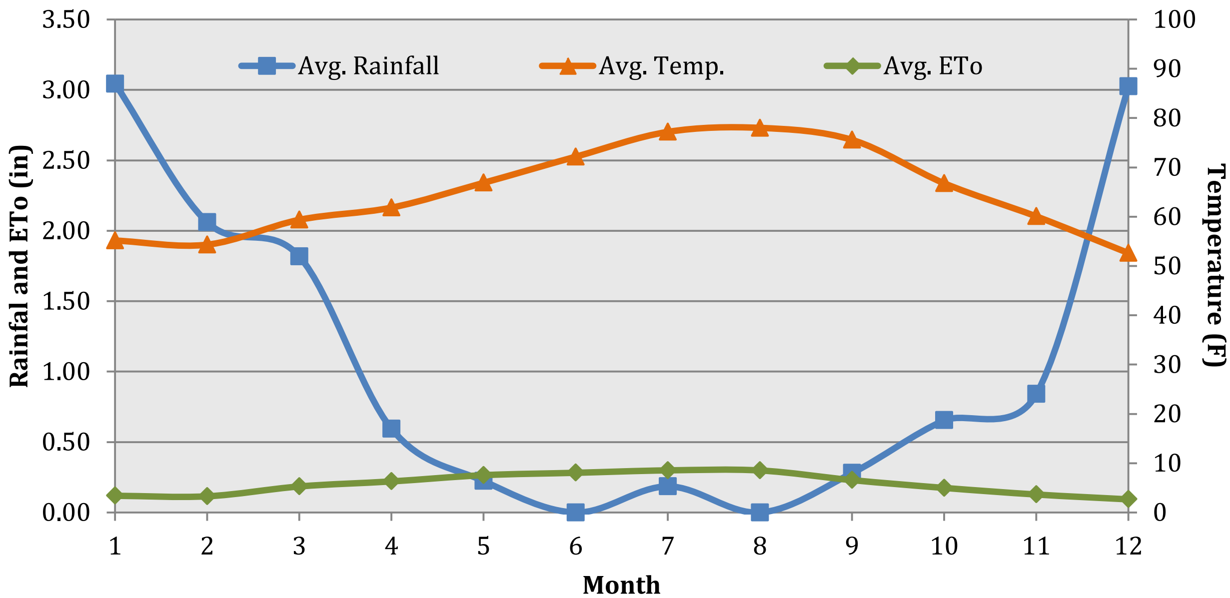
Figure 2-1: Study Area



Source: 2014 Santa Clarita Valley Water Report (Luhdorff & Scalmanini, 2014)

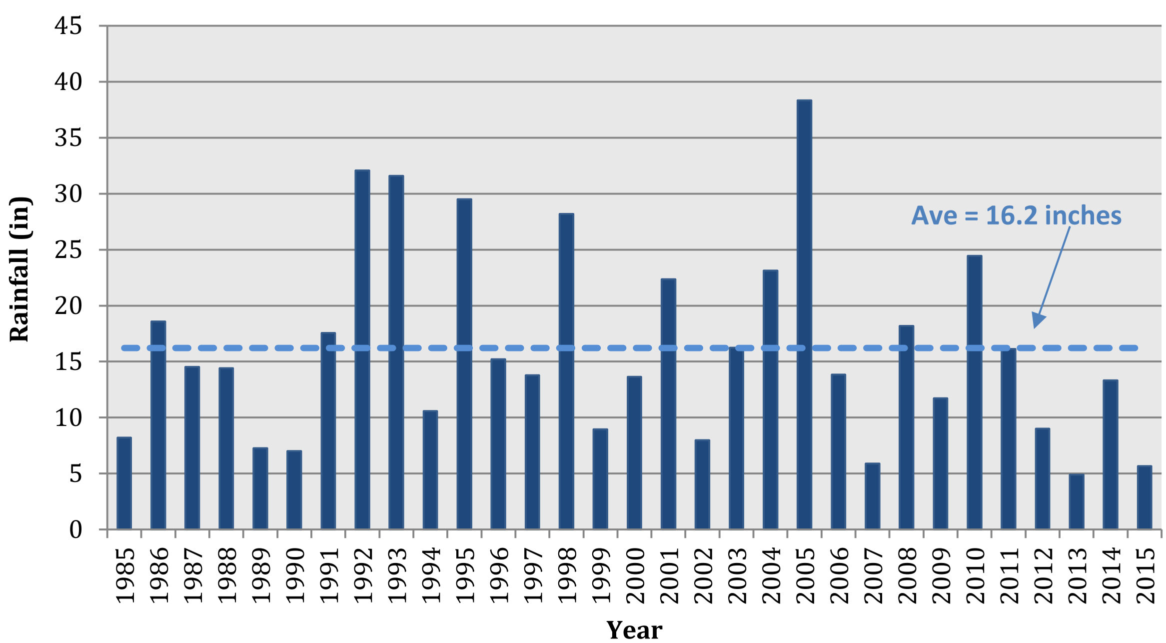
The climate in CLWA's service area is generally semi-arid and warm. Summers are dry with temperatures as high as 110°F. Winters are somewhat cool with temperatures as low as 20°F. Average rainfall since 1980 is about 17.3 inches per year in the flat areas and about 25 to 30 inches in the mountains. The region is subject to wide variations in annual precipitation and also experiences periodic wildfires. The region's average climate conditions are presented in Figure 2-2 and Figure 2-3.

Figure 2-2: Average Temperature, Evapotranspiration (ETo) and Rainfall



Source: Temp and ETo:CMIS Station #204
Precipitation: Los Angeles County Dept of Public Works data for Site32Z (Newhall-Fire Station 73)

Figure 2-3: Historical Average Annual Rainfall



Source: Precipitation: Los Angeles County Dept of Public Works data for Site32Z (Newhall-Fire Station 73)

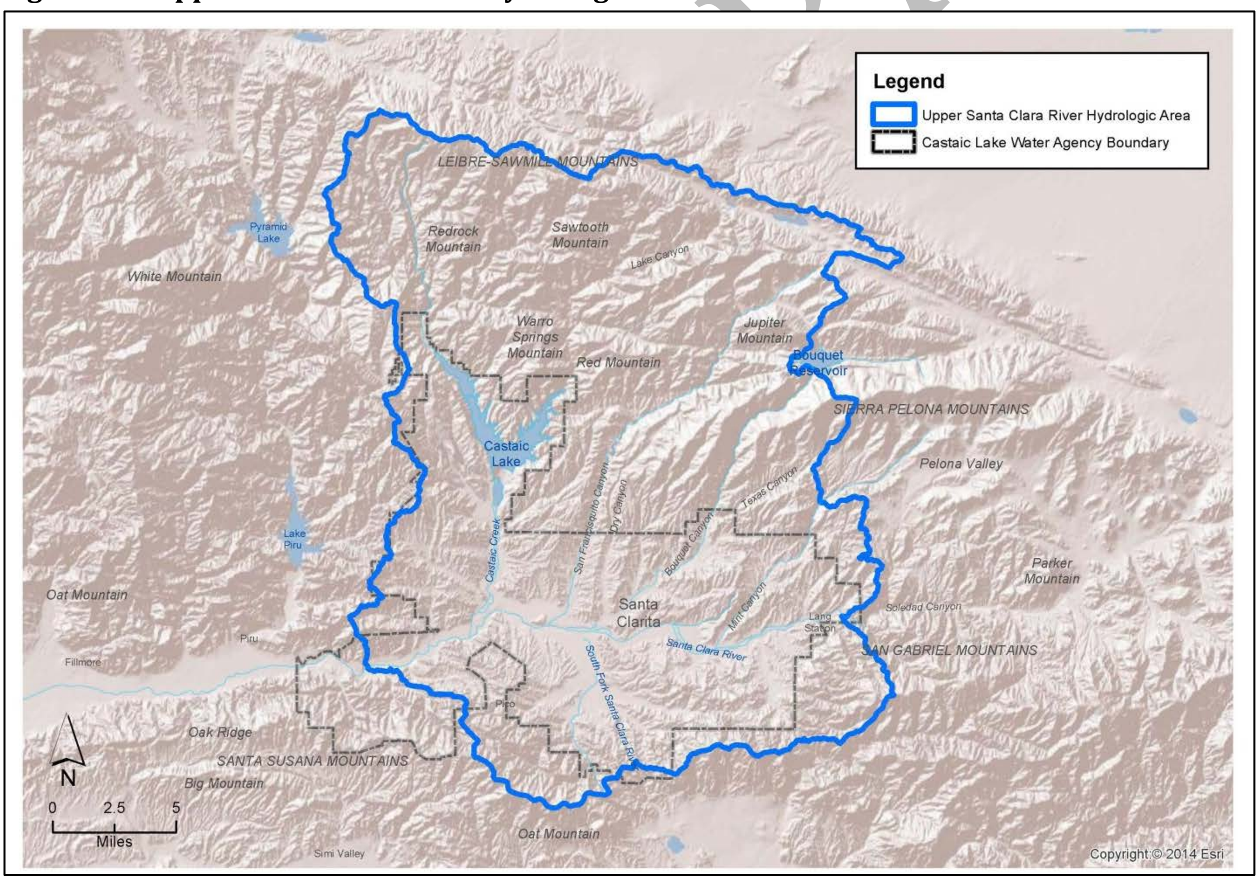
2.2 Major Hydrologic Features

2.2.1 Surface Water

The Santa Clara River is the Santa Clarita Valley's primary drainage course, which flows westward from Soledad Canyon through the CLWA service area. Major hydrologic features in the Upper Santa Clara River Hydrologic Area are depicted in Figure 2-4. All surface water flows into the Santa Clara River through year-round and ephemeral tributaries and intermittent mountain streams. Streamflow in the Santa Clara River consists of stormflow and base flow. Base flow consists of groundwater, effluent from the water reclamation plants (WRPs), reservoir releases, other point sources, bank seepage, and nonpoint discharge from agricultural and urban runoff (USGS 2003).

Castaic Lake, a man-made impoundment, is the largest surface water body within the hydrologic area, with a maximum storage capacity of 323,700 acre-fee (AF). Castaic Lake is fed State Water Project (SWP) water by the California Aqueduct and also store flood flows.

Figure 2-4: Upper Santa Clara River Hydrologic Area

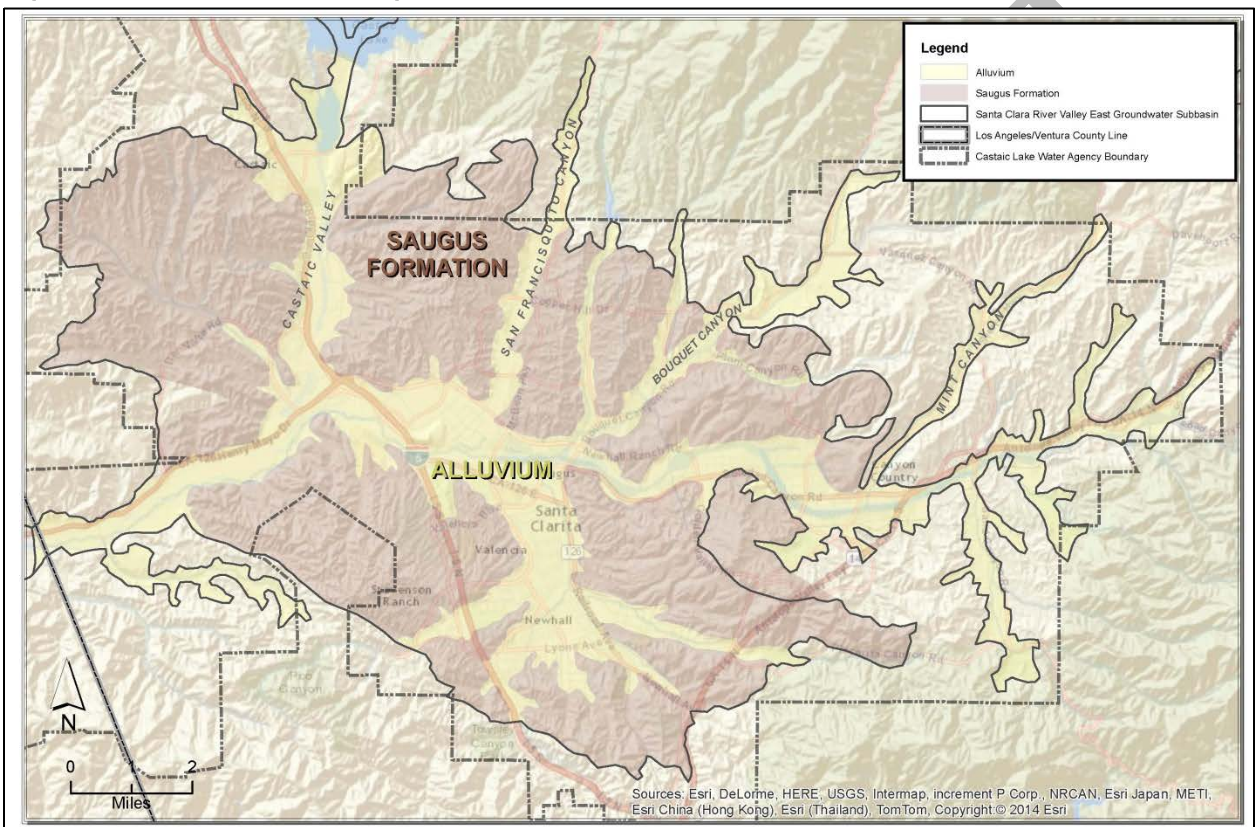


Source: 2014 Santa Clarita Valley Water Report (Luhdorff & Scalmanini, 2014)

2.2.2 Groundwater

The sole source of local groundwater for urban water supply in the Santa Clarita Valley is the groundwater basin identified in the DWR Bulletin 118, 2003 Update as the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin) (Basin No. 4-4.07). The Basin is comprised of two aquifer systems; (1) the Alluvium and (2) the Saugus Formation, shown in Figure 2-5.

Figure 2-5: Alluvium and Saugus Formation



Source: 2014 Santa Clarita Valley Water Report (Luhdorff & Scalmanini, 2014)

The Alluvium generally underlies the Santa Clara River and its several tributaries, to maximum depths of about 200 feet; and the Saugus Formation underlies practically the entire Upper Santa Clara River area, to depths of at least 2,000 feet. There are also some scattered outcrops of Terrace deposits in the Basin that likely contain limited amounts of groundwater. However, since these deposits are located in limited areas situated at elevations above the regional water table and are also of limited thickness, they are of no practical significance as aquifers for municipal water supply; consequently they have not been developed for any significant water supply in the Basin.

2.3 Water Quality

2.3.1 Surface Water Quality

The Santa Clara River, shown in Figure 2-4, provides most of the annual groundwater recharge to the groundwater system and has been identified as an impaired water body; it is listed in the Clean Water Act Section 303(d) list published by the US Environmental Protection Agency (EPA). The quality of the surface water in the Santa Clara River is the product of numerous factors, such as native surface water quality entering the East Subbasin, urban and natural storm flows, discharge of treated wastewater, effluent discharges from the groundwater system (Geoscience, 2015).

The State of California has determined that high levels of chloride (salt) harm salt-sensitive avocado and strawberry crops along Highway 126, downstream from the Valencia and Saugus WRPs and has ordered the Santa Clarita Valley Sanitation District (SCVSD) to reduce the chloride levels in the Valleys treated wastewater to below the strict legal limit of 100 mg/L, in certain portions of the river. The SCVSD has spent many years seeking the least costly solution to meeting State mandates related to the chloride levels allowed in the Valley's wastewater that is discharged to the Santa Clara River (LACSD 2013).

2.3.2 Groundwater Quality

The groundwater basin has two sources of groundwater, the Alluvial Aquifer whose quality is primarily influenced by rainfall and stream flow, and the Saugus Formation which is a much deeper aquifer and recharged primarily by a combination of rainfall and deep percolation from the partially overlying Alluvium (Figure 2-5).

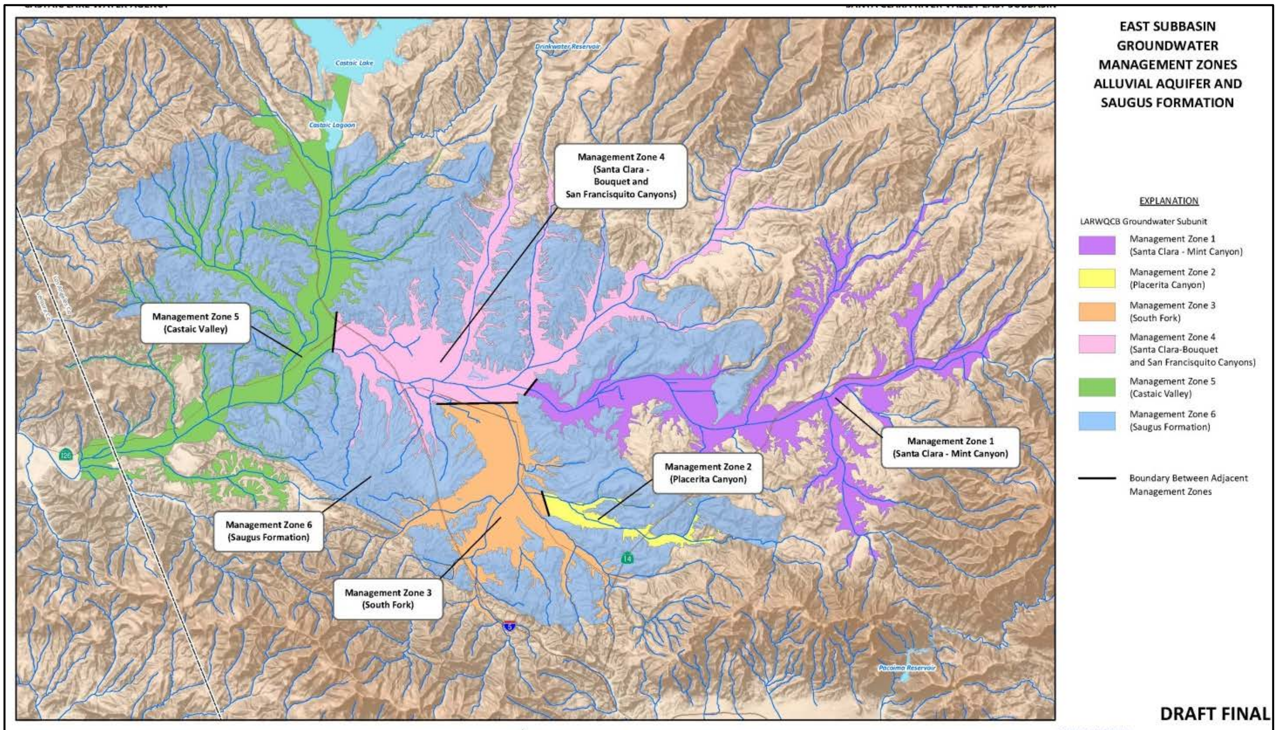
Local groundwater does not have microbial water quality problems. Parasites, bacteria and viruses are filtered out as the water percolates through the soil, sand and rock on its way to the aquifer. Even so, disinfectants are added to local groundwater when it is pumped by wells to protect public health. Local groundwater has very little total organic carbons (TOC) and generally has very low concentrations of bromide, minimizing potential for disinfection by-product (DPB) formation. Taste and odor problems from algae are not an issue with groundwater.

The groundwater is very "hard," and it has high concentrations of calcium and magnesium (approximately 250 to 600 mg/L total hardness as CaCO3). Groundwater may also contain higher concentrations of nitrates and chlorides when compared to SWP water for example.

2.3.3 Salt and Nutrient Management Plan

The Salt and Nutrient Management Plan, currently being prepared for CLWA in accordance with the State Water Resources Control Board's (SWRCB) Recycled Water Policy, assesses ambient concentrations and assimilative capacities for Total Dissolved Solids (TDS), chloride, nitrate, and sulfate for six management zones shown in Figure 2-6. The ambient groundwater concentrations and Basin Objectives for each management zone are listed in Table 2-1.

Figure 2-6 SNMP East Subbasin Groundwater Management Zones



Source: SNMP (Geoscience, 2015)

Table 2-1 Ambient Groundwater Concentrations and Basin Objectives

Management Zone	Groundwater Subunit	Water Quality (WQ) Status Comparison	TDS [mg/L]	Chloride [mg/L]	Nitrate [mg/L]	Sulfate [mg/L]
1a	Santa Clara-Mint Canyon	WQ Objective	800	150	45	150
		Ambient WQ	*728*	*89*	*20*	*138*
1b	Santa Clara-Mint Canyon	WQ Objective	800	150	45	150
		Ambient WQ	*833*	*72*	*21*	*269*
2	Placerita Canyon[1]	WQ Objective	700	100	45	150
		Ambient WQ	*NA*	*NA*	*NA*	*NA*
3	South Fork[1]	WQ Objective	700	100	45	200
		Ambient WQ	*NA*	*NA*	*NA*	*NA*
4	Santa Clara-Bouquet and San Francisquito Canyons	WQ Objective	700	100	45	250
		Ambient WQ	*710*	*77*	*16*	*189*
5	Castaic Valley	WQ Objective	1,000	150	45	350
		Ambient WQ	*727*	*77*	*8*	*246*
6	Saugus Formation[2]	WQ Objective	700	100	45	NA
		Ambient WQ	*636*	*28*	*14*	*235*

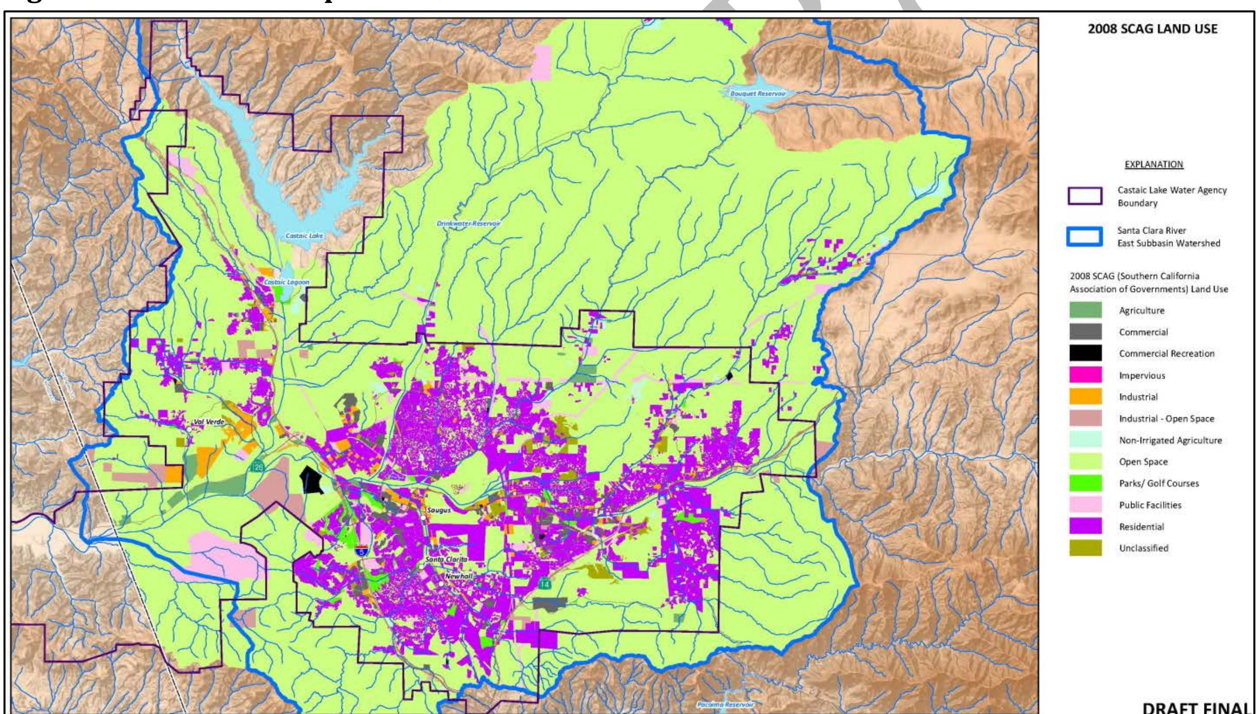
[1] Insufficient data to establish trend
[2] Water Quality Objectives (WQOs) have not been established for the Saugus Formation. Therefore, at the recommendation of the Los Angeles Regional Water Quality Control Board (LARWQCB), the most conservative of the alluvial management zone WQOs was used for calculation of assimilative capacity for TDS, chloride and nitrate.
Note: red values indicate exceedance of WQOs.

2.4 Land Use

Rapid development of portions of the valley floor and canyons has occurred due to growth influences from the Los Angeles metropolitan area and the presence of three major highways (U.S. Interstate 5/the Golden State Freeway, State Highway 14/the Antelope Valley Freeway, and State Highway 126). The Santa Clarita Valley specifically now includes a variety of residential, commercial, industrial, institutional, agricultural, open space, and parks/golf course areas as shown in Figure 2-7. Although a large portion of the valley is not suitable for development due to steep terrain, flooding potential, or federal jurisdiction (Angeles National Forest), many of these existing areas allow for the utilization of recycled water through irrigation or other methods of water use.

There are also a number of future development projects underway that are seeking approval in the Santa Clarita Valley. Many of these developments intend to maximize recycled water usage, in order to offset potable water demand and reduce waste discharge.

Figure 2-7: Land Use Map

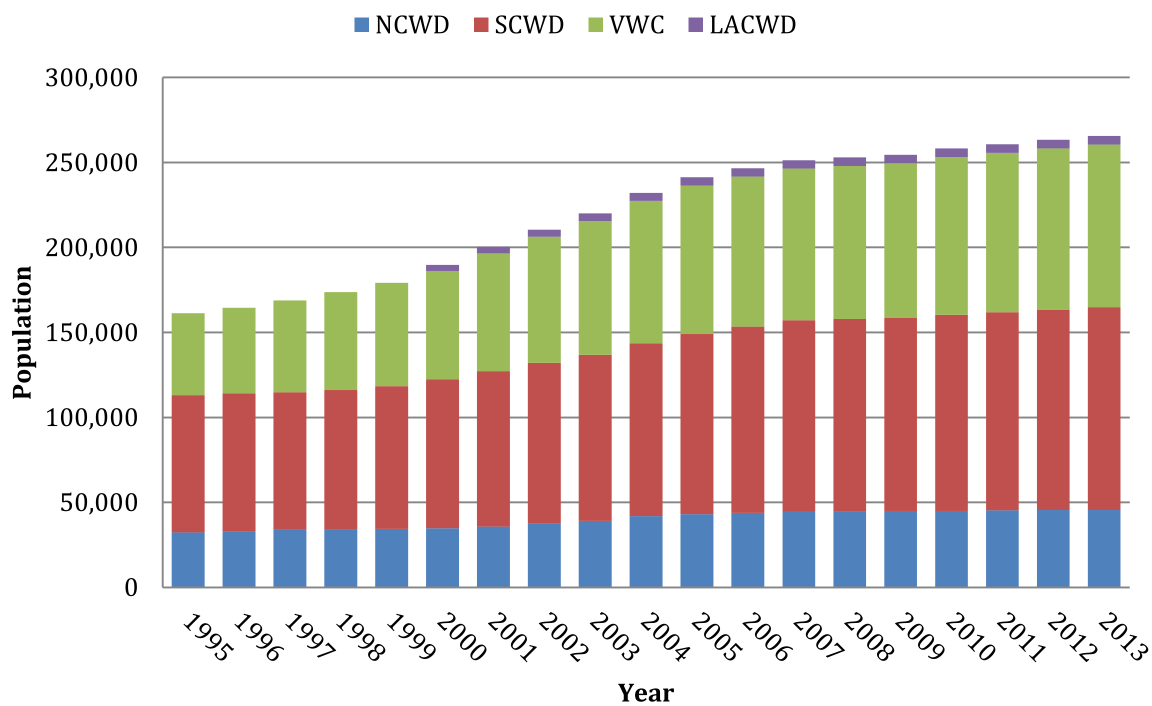


Source: SNMP (Geoscience, 2015)

2.5 Population Projections

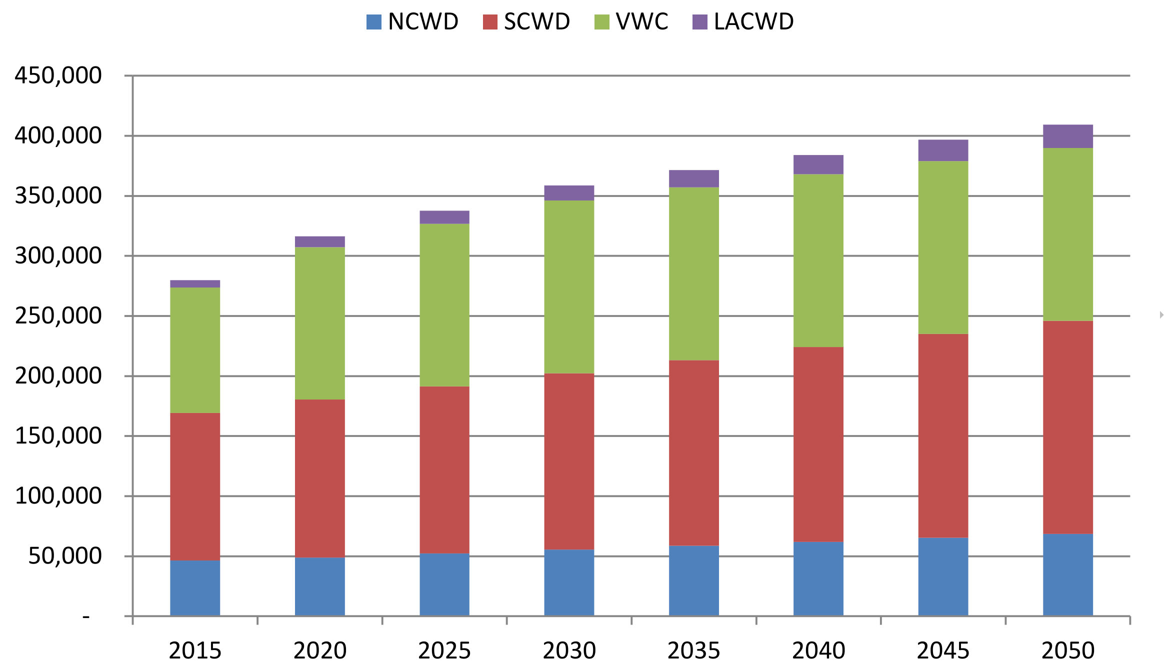
Historical population data categorized by purveyor is presented in Figure 2-8 for years 1995 through 2013 (Maddaus 2015). Most customers reside within the VWC, SCWD, and NCWD service areas and populations have almost doubled within the last 20-year period.

Figure 2-8: Historical CLWA Population by Purveyor



CLWA recently conducted a demand projection analysis to forecast predicted population and demand increases for in Santa Clarita Valley in order to comply with the 2015 Urban Water Management Plan (UWMP) Act (Maddaus 2015). The projected population estimates from that study, presented in Figure 2-9, are based on a land use analysis supplemented by information from the purveyors on planned future developments. The population in the Santa Clarita Valley is expected to continually grow; increasing water demands and also increasing wastewater flows. This subsequently increases the supply of recycled water coming from local water reclamation plants, while also increasing the demand for recycled water for a variety of uses (as discussed in the following section).

Figure 2-9: CLWA Population Projections by Purveyor



2.6 Beneficial Uses of Receiving Waters

The tertiary disinfected recycled water produced at the Valencia and Saugus WRPs is suitable for a wide variety of reuse applications. Within the recycled water service area, specific reuse applications were identified by the Water Quality Control Plan-Los Angeles Region: Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties, including the following:

- Industrial service/process supply
- Agricultural water supply groundwater recharge
- Freshwater replenishment
- Water contact recreation
- Non-contact water recreation
- Warm freshwater and wildlife habitat
- Preservation of rare and endangered species
- Wetland habitat

In 2013, 474 AFY of recycled water was utilized for landscape irrigation, with the balance of recycled water discharged to the Santa Clara River for environmental habitat preservation. In the future, it is assumed that the SCVSD will be required to maintain a minimum of 13 million gallons per day (mgd) discharge to the Santa Clara River to sustain the Santa Clara River biological resources (LACSD 2013). For the purpose of this study, it is assumed that 8.5 mgd of discharge must be maintained at the Valencia WRP and 4.5 mgd at the Saugus WRP. Recycled water supplies that are not discharged are available for reuse within Santa Clarita Valley.

References

Carollo Engineers (Carollo), 2015. Castaic Lake Water Agency – Water Resources Reconnaissance Study. May 2015

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Section 3: Water Supply Characteristics and Facilities

3.1 Water Supplies and Usage

The existing water resources in CLWA's service area include local groundwater, recycled water, imported supplies, and water from existing groundwater banking programs. Local and imported water resources in the Santa Clarita Valley are managed cooperatively between CLWA and the purveyors. Table 3-1 lists available water supplies in the Santa Clarita Valley based on 2015 data reported in the UWMP (Kennedy/Jenks 2016a).

Table 3-1 Summary of 2015 Existing Water Resources

Description of Supply	Supply AF
Local Groundwater[a]	
Alluvial Aquifer	24,000
Saugus Formation	9,225
Total Groundwater	**33,225**
Recycled Water [b]	**450**
Imported Water	
State Water Project[c]	58,100
Flexible Storage Accounts[d]	6,060
Buena Vista-Rosedale	11,000
Nickel Water - Newhall Land	1,607
Yuba Accord Water	445
Total Imported	**77,212**
Existing Banking Programs[e]	
Rosedale Rio-Bravo	20,000
Semitropic	15,000
Semitropic - Newhall Land	4,950
Total Banking	**39,950**
Total Existing Water Resources	**150,837**

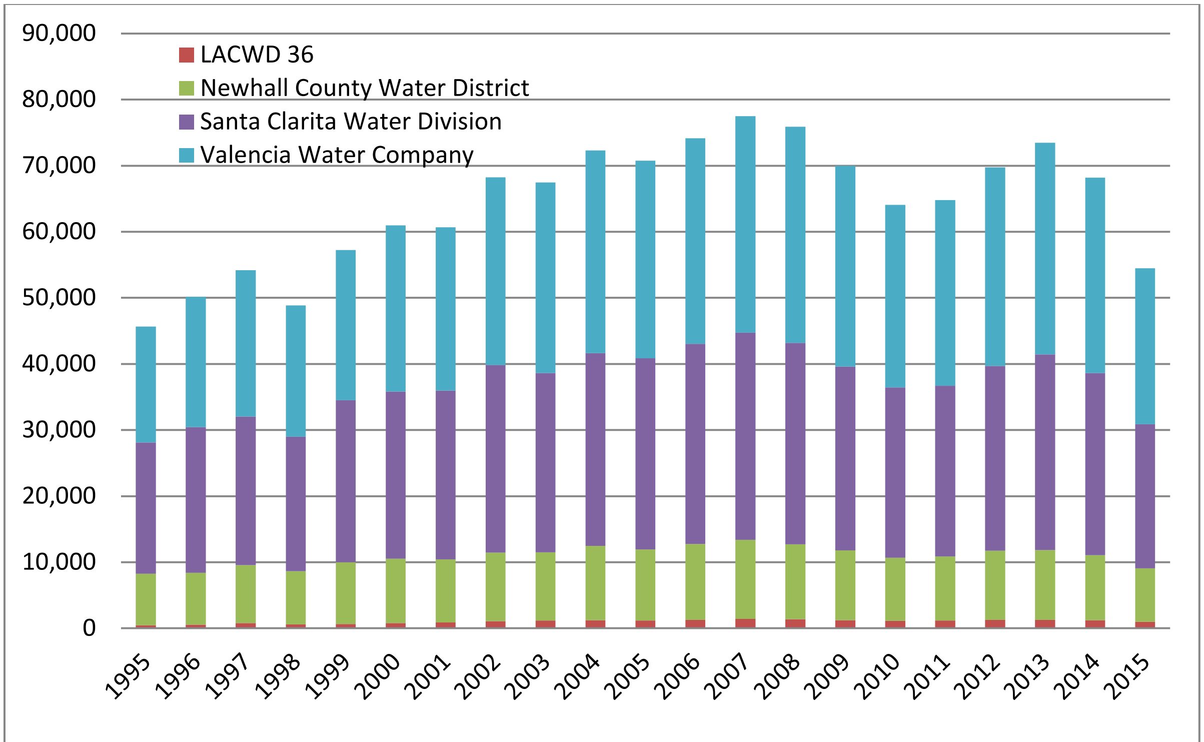
Notes:

(a) Local groundwater represents the quantity of groundwater pumped with existing wells.
(b) Represents recycled water delivered in 2015.
(c) SWP supplies are based on the Department of Water Resources "*2015 Delivery Capability Report (DCR)*."
(d) Includes both CLWA and Ventura County entities flexible storage accounts.
(e) Supplies shown are annual amounts that can be withdrawn and would typically be used only during dry years.

The water purveyors in Santa Clarita Valley primarily serve municipal and industrial (M&I) customers. Approximately 50 percent of the M&I demand within CLWA's service area is met with imported water. The VWC and SCWD are the two larger purveyors, responsible for 43 percent and 40 percent, respectively, of the total water usage in 2015. NCWD accounts for 15 percent and

LACWD No. 36 accounts for the remaining 2 percent of the 2015 water usage in CLWA, as illustrated in Figure 3-1.

Figure 3-1: CLWA Historical Water Usage



Source: 2014 Santa Clarita Valley Water Report (June 2015) and 2015 data provided by each retail water purveyor.

3.2 Water Supply Reliability

The reliability of the imported supply is subject to availability, which is a function of present and past years' precipitation and snowpack, the total amount requested and used by SWP contractors and more recently regulatory cutbacks. Imported water deliveries can be curtailed during dry periods. When sufficient imported water is not available, the balance of demand is met with local groundwater supplies provided by the purveyors. However, local groundwater may also be limited in some areas, highlighting the need for additional reliable sources of water to meet current and future demands under all hydrologic conditions. Implementing and expanding the recycled water system in the CLWA service area provides a reliable source of water year round that can help offset reliance on imported water and local groundwater.

3.3 Future Sources of Additional Supplies

CLWA and the purveyors recognize that recycled water is a critical component of their water supply portfolio along with new groundwater production and additional banking programs. Implementing and expanding the recycled water system in the Santa Clarita Valley provides a reliable source of water year round that can help offset reliance on imported water and local groundwater. Transfers, exchanges, and water banking are options available to CLWA for stabilizing SWP and groundwater supply. Previous evaluations of desalinated water have concluded it to be impractical or economically infeasible. Recycled water is another source of water that is available at a more constant rate throughout the year and may be banked during winter months for use in summer months. This water source adds diversity to Santa Clarita Valley's water portfolio and mitigates risk of low SWP water allocations. CLWA, NCWD, SCWD, VWC and LACWD are committed to working together to increase recycled water use in the Santa Clarita Valley.

The 2015 UWMP (Kennedy/Jenks 2016a) provides additional information about the projected sources and distribution of water supplies in the Santa Clarita Valley.

Section 4: Wastewater Characteristics and Facilities

4.1 Existing Water Reclamation Facilities

The Sanitation Districts of Lost Angeles County (LACSD) are a confederation of independent special districts that serve the wastewater and solid waste management needs of approximately 5.4 million people in Los Angeles County. LACSD operates ten water reclamation plants (WRPs) and one ocean discharge facility (Joint Water Pollution Control Plant), which treat approximately 510 million gallons per day (mgd); 165 mgd of which are available for reuse.

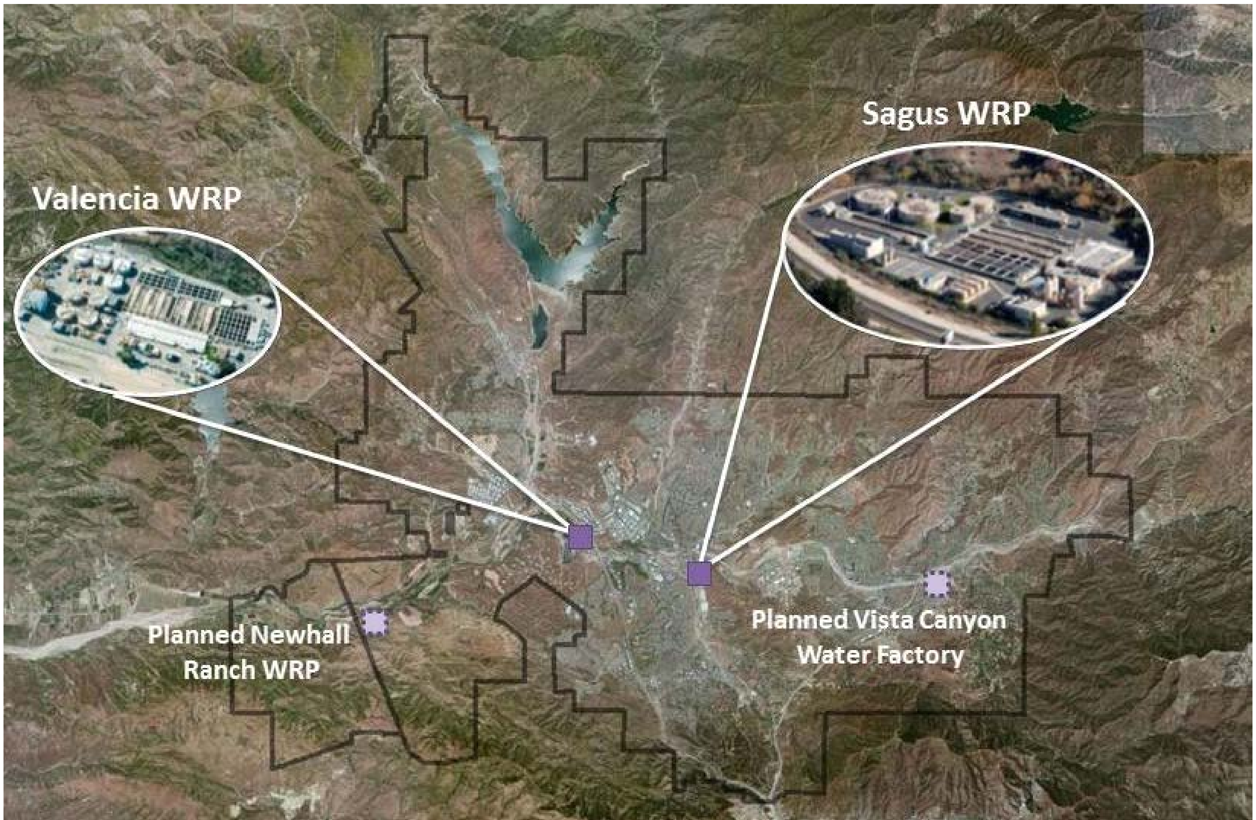
The Santa Clarita Valley Sanitation District of Los Angeles County (SCVSD) formed through a consolidation of Sanitation Districts Nos. 26 and 32 to provide wastewater management services to the Santa Clarita Valley. The SCVSD operates two water reclamation plants (WRPs) within the CLWA service area: 1) Saugus WRP and 2) Valencia WRP, as shown on Figure 4-1. The primary sources of wastewater to the Saugus and Valencia WRPs are domestic. The two plants produce high-quality tertiary disinfected recycled water, which is distributed for non-potable reuse or discharged into the upper reaches of the Santa Clara River (under NPDES Permit No. CA0054313 and No. CA0054216 respectively).

- The **Valencia WRP**, completed in 1967, is located on The Old Road near Magic Mountain Amusement Park. The Valencia WRP has a current treatment capacity of 21.6 mgd, developed over time in stages. In 2015, the Valencia WRP produced an average of 13.1 mgd of tertiary recycled water. Use of recycled water from the Valencia WRP is permitted under Los Angeles Regional Water Quality Control Board (RWQCB) Order Nos. 87-48.

- The **Saugus WRP,** completed in 1962, is located southeast of the intersection of Bouquet Canyon Road and Soledad Canyon Road. The Saugus WRP has a current treatment capacity of 6.5 mgd. No future expansions are possible at the plant due to space limitations at the site. In 2015, the Saugus WRP produced an average of 5.5 mgd of tertiary recycled water. Use of recycled water from this facility is permitted under Los Angeles RWQCB Order Nos. 87-49.

The Saugus and Valencia WRPs operated independently until 1980, at which time the two plants were linked by a bypass interceptor. The interceptor was installed to transfer a portion of flows received at the Saugus WRP to the Valencia WRP. Together, the Valencia and Saugus WRPs have a design capacity of 28.1 mgd.

Figure 4-1: Existing and Proposed Water Reclamation Plants



4.2 Planned Water Reclamation Facilities

Planned future developments in the Santa Clarita Valley, such as the Newhall Ranch and Vista Canyon developments, are also planning to construct water reclamation facilities to produce tertiary recycled water suitable for non-potable reuse to offset potable demands (Figure 4-1). Excess recycled water from these sources may be incorporated into the CLWA recycled water system or served directly to Santa Clarita Valley customers in the future.

4.2.1 Vista Canyon Water Factory

The proposed Vista Canyon Water Factory would be located near Highway 14, just south of the Santa Clara River. The Vista Canyon Water Factory would be constructed as a "turn-key" facility, to be owned and operated by the City of Santa Clarita. The facility is designed to be a scalping plant with no solids treated on-site and waste activated sludge treatment at the SCVSD's existing facilities downstream. The treatment process begins with pumping to the plant, screening, flow equalization, extended aeration activated sludge, disc filtration, and UV disinfection (Dexter Wilson 2015).

The Vista Canyon Water Factory is anticipated to come online in 2018 and is projected to treat an average flow of 392,000 gpd (approximately 440 AFY) of wastewater, consisting of flows from Vista

Canyon (approximately 214,000 gpd) and raw water extracted from LACSD's sewer line. Solids generated would be discharged to the existing sewer and treated at the Valencia WRP. Title 22 tertiary disinfected recycled water would be produced at full design capacity from the start (392,000 gpd or 440 AFY), taking wastewater from an existing sewer interceptor that serves existing development upstream of the project site (Impact Sciences 2010).

4.2.2 Newhall Ranch WRP

The proposed Newhall Ranch WRP would be located near the western edge of the development project along the south side of State Route 126. The Newhall Ranch WRP would serve the Newhall Ranch Specific Plan and a new County Sanitation District would be created to operate and maintain the Newhall Ranch WRP. The Newhall Ranch WRP is anticipated to produce 3.75 mgd (4,200 AFY) of recycled water, which would be available to meet a portion of the 7,100 AFY of non-potable demands anticipated for the development at buildout (GSI, 2015). Recycled water from the Valencia WRP would be used to meet the remainder of the non-potable demands.

4.3 Discharge Requirements

Historically, the effluent from the two WRPs has been discharged to the Santa Clara River. The Saugus WRP effluent outfall is located approximately 400 feet downstream (west) of Bouquet Canyon Road. Effluent from the Valencia WRP is discharged to the Santa Clara River at a point approximately 2,000 feet downstream (west) of The Old Road Bridge.

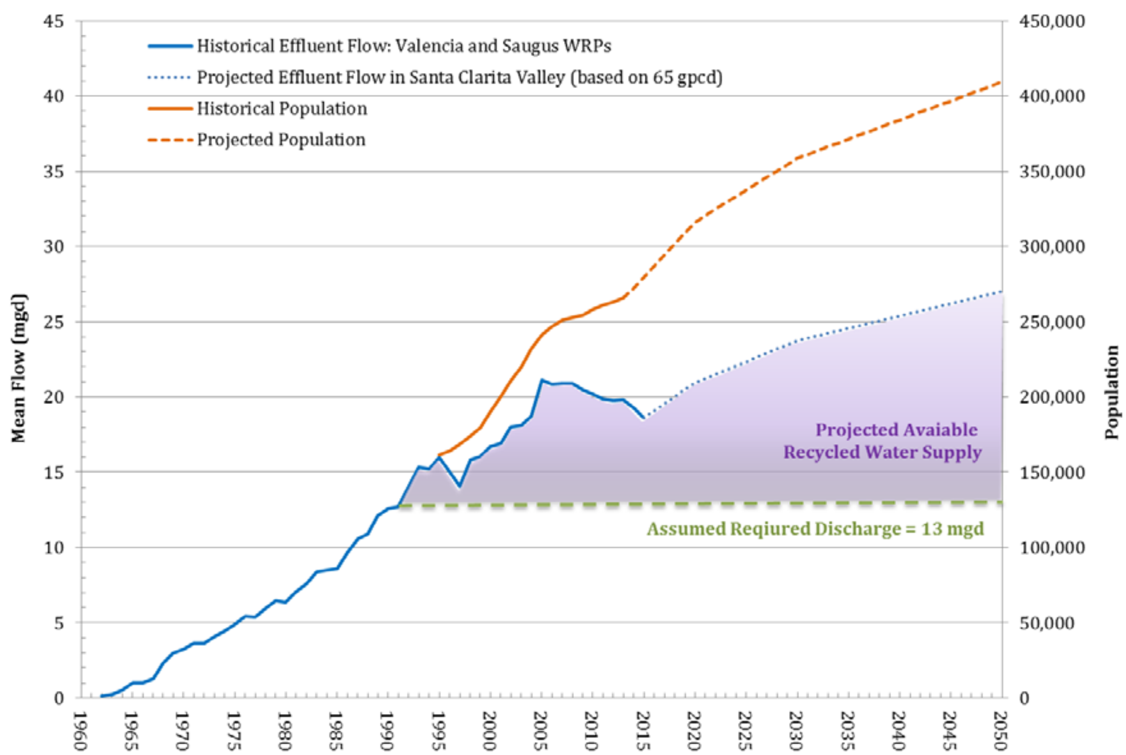
As discussed in Section 2, it is assumed that the SCVSD will be required to maintain a minimum of 13 mgd discharge to the Santa Clara River to sustain biological resources (LACSD 2013). For the purpose of this study, it is assumed that 8.5 mgd of discharge must be maintained at the Valencia WRP and 4.5 mgd at the Saugus WRP. Recycled water supplies that are not discharged would be available for reuse within Santa Clarita Valley.

4.4 Projected Supply of Recycled Water

The future production of recycled water is estimated based on the projected influent wastewater flow into water reclamation facilities using a generation factor multiplied times the net projected population increase within the CLWA service area (discussed in Section 2.5). A generation rate of 65 gallons per capita daily (gpcd) was recommended by SCVSD based observed gpcd rates for the last 5 years. The projected supply of recycled water is calculated as the production minus the anticipated required discharge (Section 4.3). Figure 4-2 illustrates the total projected supply of recycled water in Santa Clarita Valley that could be available for reuse from the existing and proposed WRPs. Appendix A, Table A-1 presents the annual flow calculations.

One limitation to utilizing all of the available annual recycled water produced is the seasonal irrigation demand for recycled water, when summer recycled water production will limit volume delivered. In addition, the Saugus WRP has limited flow available after meeting the anticipated discharge requirements, which makes it a less reliable source for recycled water use.

Figure 4-2: Projected Available Recycled Water Supply



4.5 Recycled Water Rules and Regulations

The regulations governing the wholesale use of recycled water from the Valencia and Saugus WRPs are set forth in the *Joint Outfall System and Santa Clarita Valley Sanitation District - Recycled Water Users Handbook* prepared by the Sanitation Districts of Los Angeles County (LACSD) – July 1, 2008 (herein referred to as Sanitation Districts' Handbook[1]), which describe the rules and regulations for the safe use of tertiary recycled water in compliance with applicable Federal, State and local statutes, ordinances, regulations, orders and other requirements.

As the producer of recycled water, the SCVSD oversees the production and use of recycled water pursuant to permits issued by the Regional Water Quality Control Board (Regional Board). The water reclamation requirements for the Saugus and Valencia WRPs are described in Regional Board Order No. 87-49 and Order No. 87-48.

[1] http://www.lacsd.org/waterreuse/recycledresources.asp

In 2007, an ordinance was enacted that provides the Sanitation Districts' with enforcement powers over the use of recycled water in the Santa Clarita Valley. This ordinance, known as the *Santa Clarita Valley Sanitation District Recycled Water Ordinance*[2], applies to wholesalers, purveyors and users in the SCVSD receiving recycled water directly or through an intermediate party, including purveyors. Authorized sites must file an application and execute a User Agreement with the SCVSD, or through the purveyor.

The water purveyors in Santa Clarita Valley may retail the recycled water purchase through CLWA to potable water customers in their service area. VWC has been serving recycled water through the existing system for the last decade. SCWD, VWC and NCWD are currently working collaboratively with CLWA and each other to expand the existing system to reach more of their customers. The Sanitation Districts' Guidelines also include regulations governing retail provision of recycled water, which would apply in the event that CLWA provides recycled water directly to the end user.

The regulations governing the wholesale use of recycled water from water reclamation facilities not owned and operated by the Sanitation Districts', such as the planned Vista Canyon and Newhall Ranch WRPs, have not been formally adopted at this time. It is anticipated that the requirements would be similar to those established in the Sanitation Districts' Guidelines.

Existing agreements that guide the sale and use of recycled water are summarized in the *Santa Clarita Valley Recycled Water Rules and Regulations Handbook* (herein referred to as the SCV Rules and Regs Handbook) (Kennedy/Jenks 2016b).

4.6 Rights to Recycled Water

A determination of rights to treated wastewater is required prior to long-term project expenditures. Ownership of the rights to wastewater is addressed in three separate state laws or codes:

- Clean Water and Water Bond Law of 1978
- California Department of Fish and Game Code, Section 1600
- Water Code, Sections 1210, 1211, and 1702

The Clean Water and Water Bond Law of 1978 established that treated wastewater was the property of the treatment facility that produced it and that the producer could sell or transfer its rights. In addition, the rights of the treatment facility allowed the treated wastewater to be used for beneficial purposes regardless of the detriment to downstream users. However, the advice of legal counsel for individual determinations and the development of the most equitable and least detrimental projects for all affected parties are recommended.

[2] "Ordinance Providing for the Establishment and Enforcement of Regulations Pursuant to Water Recycling Requirements for Recycled Water Users" February 2007. DMS - #781170

The California Department of Fish and Game Code Section 1600 requires that "any project which will divert, obstruct or change the natural flow or bed, channel or bank of any river, stream or lake designated by the department in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit" be modified sufficiently "for the protection and continuance of the fish or wildlife resources." On the Santa Clara River, there are users of river water downstream of both the Saugus and Valencia WRPs, as well as Significant Environmental Areas that support endangered species. Potential impacts to these users and the habitat should be addressed in the environmental documents to be prepared for this proposed recycled water project.

Water Code section 1210 provides that "the owner of a wastewater treatment plant has the exclusive right to treated wastewater as against anyone who has supplied the water to the treatment plant, except as otherwise provided by agreement." However, section 1210 expressly provides that this provision does not affect the treatment plant owner's obligations to any legal user of the discharged treated wastewater. Thus, if downstream or secondary appropriators of wastewater flow are considered to be legal users, the right of producers to recycled water could be limited. Such instances have occurred, most recently in Victor Valley (*Victor Valley Wastewater Reclamation Authority, Order WR 2001-Draft)* in which a treated wastewater change petition was denied on the account of injury to third party water right holders.

Water Code section 1211 requires the SWRCB to review a proposed change in point of discharge, place of use, or purpose of use of treated wastewater in the same manner as the SWRCB would review a proposed change to an appropriative water right. As both sections 1210 and 1211 make clear, however, the Legislature did not intend to affect any rights that downstream users may have to the treated wastewater discharge under the common law. Therefore, Water Code section 1702 provides that before granting permission to make a change, the SWRCB must find "that the change will not operate to the injury of any legal user of the water involved." The statutory "no injury" rule set forth in Water Code section 1702 codifies that common law no injury rule and therefore should be interpreted consistently with case law that interprets and applies the common law rule. Generally, the common law no injury rule precludes a change in the exercise of a water right if, among other things, the change would alter the pattern or rate of return flow to the detriment of downstream water right holders (*Scott v. Fruit Growers' Supply Co., 1972).*

The first contract between SCVSD and CLWA for the use of recycled water was executed in 1996 and has since been amended to provide for temporary allotment increases to support construction activities. The existing contract (CSD Contract #3425 signed on July 24, 1996) is the basis for wholesaling recycled water in Santa Clarita Valley and makes 1,600 AFY of recycled water from the Valenica WRP available to CLWA for purchase. Contract #3118266 (signed on Oct 20, 2014) and Contract #3322936 (signed on July 23, 2015) served to temporarily increase the allotment for fiscal year 2014/15 and 2015/16, respectively, to 2,200 AFY. This increase was attributed to the need for recycled water to be used for dust control for Newhall Ranch development construction activities.

Future contracts, allotment increases and/or amendments to the wholesaling contract with the SCVSD should be approved prior to the expansion of the recycled water system beyond 1,600 AFY.

4.7 Recycled Water Quality

Effluent quality from the Valencia and Saugus WRPs is regulated by the RWQCB. Discharge permits specifying the wastewater quality requirements for effluent discharged to the Santa Clara River have been issued for each plant. Each plant also has a reclamation permit specifying recycled water quality requirements. The quality of effluent from the Valencia and Saugus WRPs has consistently been in compliance with the recycled water requirements specified in their reclamation permits.

Depending on the place and purpose of the recycled water use, the necessary treatment processes and the maximum allowable concentrations vary. These variations are addressed in the reclamation permits and recycled water uses are limited to those identified in the permits. The tertiary-treated wastewater from the Valencia and Saugus WRPs is "adequately disinfected, oxidized, coagulated, clarified, filtered wastewater" as specified for use of recycled water in non-restricted recreational impoundments, the use subject to the most stringent requirements in the permits.

Average concentrations of effluent constituents measured from 2012-2014 for each plant and associated regulatory requirements are provided in Appendix A, Table A-2. Related regulatory requirements are also listed including: (1) all Maximum Contaminant Levels in the Title 22 California Code of Regulations, (2) SNMP limits for several constituents including chloride, total dissolved salts, and sulfate and (3) the Santa Clarita Valley east groundwater basin objectives.

4.8 Existing Recycled Water System

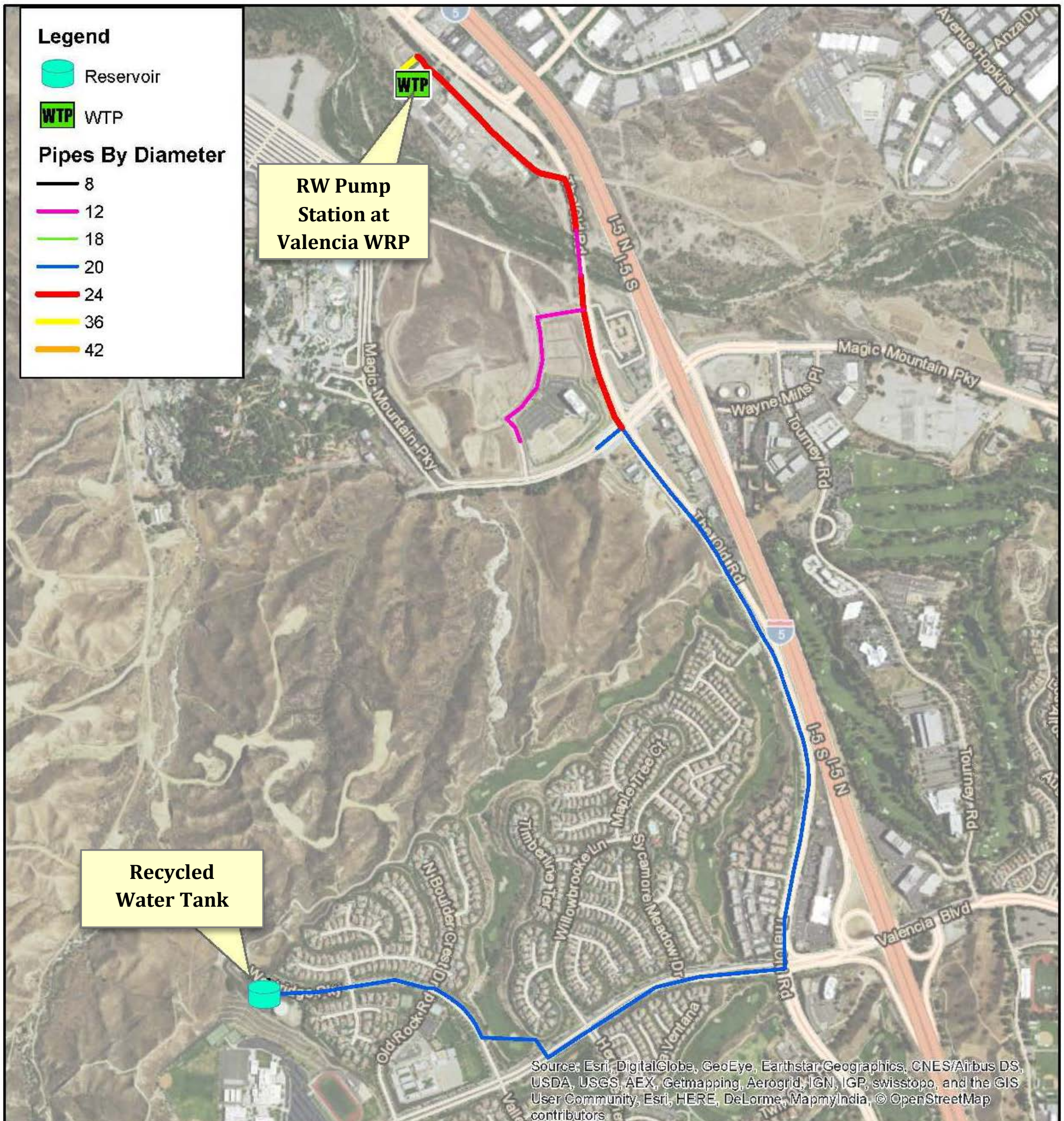
CLWA currently serves recycled water to VWC through the Recycled Water System Phase 1 facilities which include: a Recycled Water Pump Station at the Valencia WRP; a 1.5 million gallon Recycled Water Tank in the Westridge development; and approximately 15,600 feet of recycled water pipelines ranging in diameter from 8-inches to 36-inches, as shown in Figure 4-3.

Average annual recycled water usage has averaged 415 acre-feet per year (AFY) for the last 10 years. In 2015 450 AFY of recycled water was used. Appendix A, Table A-3 lists historical monthly recycled water deliveries through the existing system. Ninety percent of water use is between May and October, during the irrigation season.

The existing recycled water system was modeled and calibrated using meter data provided by CLWA. The model and calibration results are described in Appendix B. Initial results identified the following deficiencies:

1. The 12-inch pipeline across the bridge in The Old Road has a velocity reaching as high as 5.4 fps, which is acceptable for the current demands but will become higher as demands increase
2. The pressures near the Recycled Water Tank are low and it may be difficult to serve new customers in this area using the existing storage tank.

Figure 4-3: Existing Recycled Water System Configuration



Source: Draft Technical Memorandum: Recycled Water Model EPS Calibration and System Analysis (IDModeling, 2016)

References

Dexter Wilson Engineering, Inc. (Dexter Wilson), 2015. Engineering Report for the Vista Canyon Water Factory (Municipal Wastewater Treatment Facility). Carlsbad, CA.

IDModeling, 2016. Draft Technical Memorandum: Recycled Water Model EPS Calibration and System Analysis

Impact Sciences, Inc (Impact Sciences), 2010. Draft Environmental Impact Report for Vista Canyon. SCH No. 2007071039. Prepared for the City of Santa Clarita. Oct 2010.

Impact Sciences, 2011. Final Environmental Impact Report for Vista Canyon. SCH No. 2007071039. Prepared for the City of Santa Clarita. April 2011.

Kennedy/Jenks, 2016a. Castaic Lake Water Agency 2015 Urban Water Management Plan (UWMP). Draft in Progress.

Kennedy/Jenks, 2016b. Santa Clarita Valley Recycled Water Rules and Regulations Handbook. Draft in Progress.

Appendix A: Recycled Water Supply and Demands

This appendix includes supporting information for the recycled water market assessment.

Table A-1 Projected Available Recycled Water Supply

Year	Projected Wastewater Influent based on Population (mgd)[a]	Anticipated Discharge Requirement (mgd)[b]	Projected Available RW Supply (mgd)[c]	Projected Available RW Supply (AFY)[c]
2015	18.6	13	6	6,268
2016	19.1	13	6.1	6,801
2017	19.5	13	6.5	7,333
2018	20.0	13	7.0	7,865
2019	20.5	13	7.5	8,397
2020	21.0	13	8.0	8,929
2021	21.2	13	8.2	9,238
2022	21.5	13	8.5	9,546
2023	21.8	13	8.8	9,855
2024	22.1	13	9.1	10,163
2025	22.3	13	9.3	10,472
2026	22.6	13	9.6	10,780
2027	22.9	13	9.9	11,088
2028	23.2	13	10.2	11,397
2029	23.5	13	10.5	11,705
2030	23.7	13	10.7	12,014
2031	23.9	13	10.9	12,198
2032	24.1	13	11.1	12,383
2033	24.2	13	11.2	12,568
2034	24.4	13	11.4	12,752
2035	24.6	13	11.6	12,937
2036	24.7	13	11.7	13,122
2037	24.9	13	11.9	13,306
2038	25.0	13	12.0	13,491
2039	25.2	13	12.2	13,675
2040	25.4	13	12.4	13,860
2041	25.5	13	12.5	14,044
2042	25.7	13	12.7	14,229
2043	25.9	13	12.9	14,414
2044	26.0	13	13.0	14,598
2045	26.2	13	13.2	14,783
2046	26.4	13	13.4	14,968
2047	26.5	13	13.5	15,152
2048	26.7	13	13.7	15,337
2049	26.9	13	13.9	15,521
2050	27.0	13	14.0	15,706

a) Based on a 65 gpcd wastewater generation rate multiplied by the projected population

[b] Assumes that SCVSD will be required to maintain 8.5 mgd from the Valencia WRP and 4.5 mgd from the Saugus WRP
[c] Includes projected recycled water produced at the Valencia WRP, Saugus WRP, planned Newhall WRP and planned Vista Canyon Water Factory.

Table A-2 Average Effluent Water Quality from Valencia WRP and Saugus WRP

Constituent	Units	VWRP Effluent	SWRP Effluent	Regulatory Requirement
pH	-	7.43	7.50	6.0 -9.0[1]
Turbidity	NTU	0.50	0.72	2[1]
Total Coliform	org./100mL	<1	<1	2.2[1]
Temperature	°F	77.8	76.8	-
Total Suspended Solids	mg/L	<2.5	<2.5	-
Settleable Solids	mL/L	<0.1	<0.1	-
Total Dissolved Solids	mg/L	690	554	800[2]
Total BOD	mg/L	<0.6	<0.6	-
Ammonia Nitrogen	mg/L	0.95	1.26	-
Organic Nitrogen	mg/L	1.07	1.42	-
Nitrate (as nitrogen)	mg/L	2.60	4.69	10[2]
Nitrite (as nitrogen)	mg/L	0.0029	0.031	1[3]
Fluoride	mg/L	0.37	0.25	2[3]
Total Cyanide	mg/L	0.0013	<0.001	0.15[3]
Chloride	mg/L	126	123	150[2]
Sulfate	mg/L	178	107	150[2]
Total Hardness	mg/L	259	196	-
Antimony	mg/L	4.70E-04	2.47E-04	0.006[3]
Arsenic	mg/L	1.25E-04	8.17E-04	0.01[3]
Barium	mg/L	0.00995	0.0348	1[3]
Beryllium	mg/L	<5.00E-04	<5.00E-04	0.004[3]
Boron	mg/L	0.53	0.56	1[4]
Cadmium	mg/L	<2.50E-04	<2.50E-04	0.005[3]
Chromium VI	mg/L	<4.80E-06	1.49E-05	0.01[3]
Total Chromium	mg/L	<7.00E-05	<7.00E-05	0.05[3]
Copper	mg/L	0.0030	0.0076	1[5]
Iron	mg/L	0.072	0.018	0.3[5]
Lead	mg/L	<3.00E-05	<3.00E-05	0.05[1]
Mercury	mg/L	4.57E-07	5.97E-07	0.002[3]
Nickel	mg/L	0.0027	0.0011	0.1[3]
Selenium	mg/L	1.70E-04	<1.70E-04	0.01[1]
Silver	mg/L	<3.00E-05	<3.00E-05	0.05[1]
Thallium	mg/L	<2.00E-05	<2.00E-05	0.002[3]
Zinc	mg/L	0.033	0.057	5[5]
Oil and Grease	mg/L	<0.8	<0.8	-
Radioactivity (gross alpha + gross beta)	pCi/L	14.9	8.83	65[1]
Strontium-90	pCi/L	0.30	0.14	-

Constituent	Units	VWRP Effluent	SWRP Effluent	Regulatory Requirement
Diazinon	mg/L	2.54E-04	2.87E-04	0.0012[4]
1,4-Dioxane	mg/L	8.60E-04	9.83E-04	0.001[4]
Naphthalene	mg/L	<1.80E-04	<1.80E-04	0.017[4]
N-Nitrosodimethylamine (NDMA)	mg/L	1.21E-04	9.83E-05	1.00E-05[4]
N-Nitrosodi-n-propylamine	mg/L	<1.20E-04	<1.20E-04	1.00E-05[4]
1,2,3,-Trichloropropane	mg/L	<1.20E-06	<1.20E-06	5.00E-06[4]
Perchlorate	mg/L	9.43E-04	3.33E-04	0.006[3]
Total trihalomethanes (TTHM)	mg/L	0.050	0.050	0.08[6]
Bromodichloromethane	mg/L	0.020	0.019	
Bromoform	mg/L	0.0027	0.0014	
Chloroform	mg/L	0.016	0.021	
Dibromochloromethane	mg/L	0.012	NM	
Methyl-tert-butyl ether (MTBE)	mg/L	<1.60E-04	<1.60E-04	0.005[5]
Benzo(a)pyrene	mg/L	<7.00E-06	<7.00E-06	0.0002[7]
Chlordane	mg/L	<3.00E-05	<3.00E-05	0.0001[7]
2,4-D	mg/L	NM	1.49E-04	0.07[7]
Endrin	mg/L	<2.00E-06	<2.00E-06	0.002[7]
Heptachlor	mg/L	<1.00E-06	<1.00E-06	0.00001[7]
Heptachlor Epoxide	mg/L	<1.00E-06	<1.00E-06	0.00001[7]
Hexachlorobenzene	mg/L	<1.80E-04	<1.80E-04	0.001[7]
Hexachlorocyclopentadiene	mg/L	<7.50E-04	<7.50E-04	0.05[7]
Lindane	mg/L	<1.00E-06	<1.00E-06	0.0002[7]
Methoxychlor	mg/L	NM	<1.00E-06	0.03[7]
Pentachlorophenol	mg/L	<3.80E-04	<3.80E-04	0.001[7]
2,3,7,8-TCDD (Dioxin)	mg/L	<4.80E-10	<4.80E-10	3.00E-08[7]
2,4,5-TP (Silvex)	mg/L	NM	<7.10E-05	0.05[7]
Benzene	mg/L	<1.00E-04	<1.00E-04	0.001[8]
Carbon Tetrachloride	mg/L	<7.00E-05	<7.00E-05	0.0005[8]
1,2-Dichlorobenzene	mg/L	<1.20E-04	<1.20E-04	0.6[8]
1,4-Dichlorobenzene	mg/L	<7.00E-05	<7.00E-05	0.005[8]
1,1-Dichloroethane	mg/L	<7.00E-05	<7.00E-05	0.005[8]
1,2-Dichloroethane	mg/L	<9.00E-05	<9.00E-05	0.0005[8]
1,2-Dichloropropane	mg/L	*<9.00E-05*	*<9.00E-05*	0.005[8]
1,3-Dichloropropene	mg/L	<5.00E-04	<5.00E-04	0.0005[8]
Ethylbenzene	mg/L	<6.00E-05	<6.00E-05	0.3[8]
1,1,2,2-Tetrachloroethane	mg/L	<1.00E-04	<1.00E-04	0.001[8]
Toluene	mg/L	<6.00E-05	4.73E-04	0.15[8]

Constituent	Units	VWRP Effluent	SWRP Effluent	Regulatory Requirement
1,2,4-Trichlorobenzene	mg/L	<1.70E-04	<1.70E-04	0.005[8]
1,1,1-Trichloroethane	mg/L	<7.00E-05	<7.00E-05	0.2[8]
1,1,2-Trichloroethane	mg/L	<1.00E-04	<1.00E-04	0.005[8]
Foaming Agents (MBAS)	mg/L	<0.03	0.019	0.5[5]
Toxaphene	mg/L	<4.00E-05	<4.00E-05	0.003[7]
Vinyl Chloride	mg/L	<1.20E-04	<1.20E-04	0.0005[8]

Notes:

(1) Maximum limitations of recycled water as specified in RWQCB-LA Order No. 89-129 (Valencia WRP). Trace constituent concentration limits obtained from California Department of Health Services, California Administrative Code, Title 22, Division 4, Chapter 15, "Domestic Water Quality and Monitoring" (1989).

(2) *Draft* Groundwater quality objectives (GWQO) as stated in the Salt and Nutrient Management Plan (SNMP) of the Santa Clara River Valley East Subbasin, June 2015.

(3) Table 64431-A (Inorganic Chemicals) of the Title 22 California Code of Regulations.

(4) California notification limits (NLs) set by the Department of Drinking Water (DDW).

(5) Table 64449-A of the Title 22 California Code of Regulations.

(6) Table 64533-A (Disinfection Byproducts) of the Title 22 California Code of Regulations.

(7) Table 64444-A(b) (Non-Volatile Organic Chemicals) of the Title 22 California Code of Regulations.

(8) Table 64444-A(a) (Volatile Organic Chemicals) of the Title 22 California Code of Regulations.

(9) No method of detection limit (MDL) provided in WQ data, so used the reporting detection limit (RDL) to specify the non-detected concentration range.

mg/L: milligrams per liter

NTU: Nephelometric Turbidity Units

pCi/L: Picocuries per liter

Table A-3 Historical Recycled Water Demands (AFY)

Month	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Ave
Jan		1	4	14	17	4	8	7	8	22	17	21	13	11
Feb		2	2	16	14	11	3	1	12	16	20	16	12	11
Mar		24	10	6	43	39	24	2	10	25	38	26	32	23
Apr		53	36	12	38	37	39	0	38	30	51	46	40	35
May		55	46	42	58	56	30	51	41	58	58	64	40	50
Jun		58	59	66	63	34	46	56	54	64	64	58		57
Jul		64	67	75	78	26	71	54	64	68	27	64		60
Aug		61	57	63	67	63	59	60	57	67	41	60		60
Sep	31	90	66	67	55	44	17	39	54	60	37	47		51
Oct	61	26	39	33	37	38	39	22	37	32	38	40		37
Nov	11	0	20	20	25	4	18	11	10	17	9	23		14
Dec	2	14	21	12	7	1	9	5	11	2	16	0		8
Total	**107**	**448**	**427**	**426**	**501**	**358**	**364**	**307**	**396**	**462**	**416**	**465**	**137**	**416**

** To be updated with 2015 monthly data provided by VWC*

Castaic Lake Water Agency
Recycled Water Master Plan Update
ADMIN DRAFT

Status of Section by Section Reviews

Section	Scheduled Review	Status
Section 1 - Introduction	Jan 2016	Admin Submitted (1/13)
Section 2 - Study Area Characteristics	Jan 2016	Admin Submitted (1/13)
Section 3 - Water Supply Characteristics and Facilities	Feb 2016	Admin Submitted (2/17)
Section 4 - Wastewater Characteristics and Facilities	Feb 2016	Admin Submitted (2/17)
Section 5 - Treatment Requirements	Mar 2016	Included herein (3/17)
Section 6 - Recycled Water Market	Mar 2016	Included herein (3/17)
Section 7 - Project Alternatives Analysis	Apr 2016	
Section 8 - Recommended Project	May 2016	
Section 9 - Construction Financing Plan	May 2016	
Draft RWMP*	June 2016	
Final RWMP**	Sept 2016	

* The Draft RWMP will incorporate response to comments and updates to all prior sections
** The Final RWMP will incorporate response to comments and updates to the Draft RWMP

Section 5: Treatment Requirements

5.1 Recycled Water Regulations

The production, discharge, distribution, and use of recycled water are subject to federal, state, and local regulations; the primary objectives of which are to protect public health. Regulatory requirements apply for non-potable and potable uses of recycled water.

- **Non-potable reuse** refers to the use of treated municipal wastewater for specific purposes other than drinking; such as landscape irrigation, industrial uses, and agriculture or for environmental benefits. Non-potable reuse usually requires an independent "purple pipe" distribution system for conveying recycled water to customers separate from the potable supply. In California, non-potable reuse has been occurring for the last century and regulations for non-potable reuse have been in place since the 1970s.

- **Potable reuse** refers to the intended use of highly treated or purified municipal wastewater to augment a water supply that is used for drinking and all other purposes. Unplanned potable reuse, where one community draws raw water supplies downstream from discharges from wastewater treatment plants, is regulated by federal discharge requirements. Planned potable reuse involves a more formal public process and regulatory consultation program to implement and the regulations in California for the indirect and direct use of recycled water are at varying stages of development.

    - **Indirect potable reuse (IPR)** is the purposeful introduction of tertiary treated recycled water or highly purified recycled water into an untreated drinking water supply source, such as groundwater in an aquifer or surface water in a large reservoir. The recycled water may require blending with a diluent water, at a specified blending ratio for groundwater replenishment, and purified water must be added to a specified volume of surface water during reservoir augmentation. Travel time between the point of addition and eventual extraction is clearly specified for treatment at a drinking water treatment plant. In addition, reservoir augmentation requires retreatment at a drinking water treatment plant. Regulations for groundwater replenishment using recycled water became effective on June 18, 2014 and the adoption of water recycling criteria for surface water reservoir augmentation are anticipated by December 31, 2016.

    - **Direct potable reuse (DPR)** is the purposeful introduction of highly purified recycled water into a drinking water supply; immediately upstream of a drinking water treatment plant or directly into the potable water supply distribution system downstream of a water treatment plant. DPR is not yet included as an allowable use in California, though a report on the feasibility of developing uniform water recycling criteria for direct potable reuse is anticipated by December 31, 2016.

Meeting regulatory requirements is an integral part of implementing any non-potable or potable recycled water project. Appendix B summarizes the regulatory requirements and their administration, with an emphasis on regulations relating distribution and use of recycled water in California. Appendix C provides additional details about current and anticipated regulatory requirements for potable reuse.

Use of recycled water from the Valencia and Saugus WRPs is permitted under Los Angeles RWQCB Order Nos. 87-48 and 87-49, respectively. Copies of these recycled water permits along with SCVSD Ordinances and Requirements for Recycled Water Users in Santa Clarita Valley and Los Angeles County Department of Public Health (LACDPH) guidelines and inspection requirements are provided in the Santa Clarita Valley Rules and Regs Handbook (Kennedy/Jenks 2016b).

5.2 Non-Potable Customer Requirements

Recycled water quality requirements for a given project depend on the regulatory requirements, which set a minimum standard plus any additional customer requirements for the end uses. For example, though removal of total dissolved solids (TDS, a measure of salinity) is not required for recycled water by regulations, it may be desirable depending on the end use and the concentration of TDS in the source water.

Irrigation Requirements

Table 5-2 provides a summary of broadly accepted general water quality guidelines available for use of recycled water for landscape and agricultural irrigation. These guidelines are not plant-specific and therefore may be too restrictive for some plants and not restrictive enough for more sensitive plants. However, these guidelines are considered to be conservative (Tchobanoglous et al. 2004; Ayers and Westcot 1985; Tanji et al. 2007).

Table 5-1 Recycled Water Quality Guidelines for Irrigation

Constituent or Parameter	Issue of Concern	Units	Degree of Restriction on Use[(a)]			Valencia WRP Effluent
			None	Slight to Moderate	Severe	
Boron	Toxicity to Plants	mg/l	< 0.7	0.7 to 3.0	> 3.0	0.53
Chloride	Ion toxicity, Spray (Overhead) Irrigation	mg/l	< 100	>100		126
	Surface irrigation	mg/l	< 140	140 to 350	> 350	
pH	Misc. Effects	--	Normal Range 6.5 to 8.4			7.43
Residual chlorine	Leaf Burn from Spray (Overhead) Irrigation	mg/l	< 1	1 to 5	> 5	TBD
Salinity as TDS	Plant Response	mg/l	< 450	450 to 2,000	>2,000	690

Notes: TDS = total dissolved solids;
Source: Water quality objectives from 2004 *Wastewater Engineering: Treatment and Reuse* (Tchobanoglous et al.), based on Ayers and Westcot (1985) with additional information from Tanji et al. (2007).
(a) *None* – Suitable water quality as is; *Slight to Moderate* – Manageable with proper irrigation scheduling, amendments, and/or plant selection; *Severe* – Problematic, may need partial removal of the constituent.

Tertiary disinfected recycled water produced at the Valencia WRP has been used by CLWA for irrigation for the past decade and is assumed to be suitable for irrigation without further treatment. Irrigation Management strategies that can address some common irrigation issues, should they arise, include: 1) applying excess water to maintain salt balance in the root zone (flush salts), 2) maintaining adequate soil drainage, 3) avoiding spray wetting of salt-sensitive plant foliage, 4) blending saline water with less saline water, 5) adding water and soil amendments, and 6) using salt-tolerate plants in landscaping.

Non-Irrigation Requirements

Non-irrigation uses, such as toilet and urinal flushing and cooling towers that are dual-plumbed with an internal purple pipe system to separate potable water from recycled water (non-potable) may have water quality objectives beyond meeting Title 22 objectives.

For aesthetic reasons, it is preferable that recycled water used for toilet and urinal flushing is odorless and colorless. This is generally recommended by professionals in the water reuse industry. Organic and inorganic compounds in recycled water can cause discoloration and odor. Oxidizing agents such as chlorine, ozone, and hydrogen peroxide can be used for removal of color and odor, and UV light may also contribute to the removal of color. Hydrogen peroxide (H_2O_2) is an oxidant commonly used in water treatment and wastewater reclamation, including for eliminating color and odor, though it is less effective than ozone but easier to implement. Chlorine is less effective for odor and color removal compared to ozone and hydrogen peroxide and so is not specifically used for this purpose.

Cooling towers tend have specific water quality preferences depending on operational and maintenance practices. Variable water quality can be a challenge as it impacts the number of cycles and chemical requirements; additionally, ammonia concentration is of greatest concern due to the potential for corrosion. Removal of salinity and ammonia may be desirable to meet cooling tower water quality objectives. It is not uncommon for cooling towers to have small package RO plants to manage water quality from potable water sources. Thus, if cooling towers are selected as a future customer it would be important to work closely with their operators to understand their current practices and needs.

5.3 Potable Reuse Requirements

Appendix C – Potable Reuse Technology Assessment provides a detailed assessment of treatment requirements and potential treatment trains to meet existing and anticipated regulations for (1) groundwater replenishment (surface spreading and direct injection), (2) surface water augmentation (at Castaic Lake), and (3) direct potable reuse. A summary is provided herein.

Groundwater Replenishment Treatment Requirements

Groundwater replenishment requirements are described in terms of (1) surface spreading and (2) direct injection. Both of these groundwater replenishment options are governed by the Groundwater Replenishment Reuse Regulations (GRR), which were promulgated on June 18, 2014, govern surface spreading and direct injection recharge projects. Table 5-1 summarizes the GRR for spreading and direct injection.

Table 5-2 Summary of Groundwater Replenishment Reuse Regulations

Water Quality Limits for Recycled Water	Treatment and Diluent Requirements
≥ 12-log virus reduction ≥ 10-log *Giardia* cyst reduction ≥ 10-log *Cryptosporidium* oocyst reduction Drinking water MCLs (except for nitrogen) ≤ 10 mg/L total nitrogen Action levels for lead and copper TOC ≤ 0.5/RWC	**Surface Spreading with Tertiary and Diluent Water** - Oxidation, Filtration, Disinfection, Soil Aquifer Treatment - Diluent Water (based on TOC of recycled water) **Surface Spreading with FAT*** - Oxidation, Reverse Osmosis (RO), Advanced Oxidation Process (AOP) - Diluent Water (based on TOC of recycled water) **Direct Injection with FAT*** - Oxidation, RO, AOP - No Diluent water required

Other Selected Requirements

- Treatment train shall consist of at least 3 separate treatment processes to achieve the pathogenic (microorganism) control
- For each pathogen (i.e., virus, *Giardia*, or *Cryptosporidium (V/G/C)*), a separate treatment process may be credited with no more than 6-log reduction, with at least 3 processes each being credited with no less than 1.0-log reduction
- ≥ 2-month retention (response) time underground
- Initial maximum RWC ≤ 20% for spreading tertiary treated water (depending on TOC of recycled water) or up to 100% for Injection with FAT. Over time the RWC can be increased if certain requirements are met.
- For spreading, or Injection with FAT, 1-log virus reduction credit automatically given per month of subsurface retention
- For spreading, 10-log *Giardia* reduction and 10-log *Cryptosporidium* reduction credit given to disinfected tertiary effluents with at least 6 months retention time underground

Notes: MCL = maximum contaminant level, TOC = Total Organic Carbon
RWC = recycled water contribution (the quantity of recycled water applied at the recharge site divided by the sum of the quantity of recycled water applied at the site and diluent water)
FAT = Full Advanced Treatment
* The treatment technologies listed do not include the full range of advanced treatment processes available to achieve FAT (i.e. Microfiltration (MF), ozone, decarbonation, etc.). Also, an alternative treatment approach to meeting the GRR may be approved if the project can demonstrate to DDW that the proposed alternative can reliably meet all water quality objectives and assures at least the same level of protection of public health.

Surface Spreading Treatment Requirements

In **surface spreading**, recycled water is discharged into spreading basins, where it percolates through the vadose (unsaturated) zone until it joins native groundwater and travels horizontally (saturated zone). Physical (filtration), chemical, and biological processes treat water through the vadose and saturated zones. This geopurification system is known as soil aquifer treatment (SAT). Per the GRR, the wastewater needs to be treated to meet the criteria for Title-22 RW unrestricted use (e.g. disinfected tertiary recycled water). Implementation of any surface spreading project requires blending recycled water with a diluent water such as surface water, stormwater, native groundwater or imported water. The potential sources of diluent water are discussed in Section 6.

Both Valencia and Saugus WRPs have the appropriate level of treatment to meet the GRR for surface spreading and further treatment is therefore not explicitly required. However, the inclusion of additional treatment could be required to meet specific regulatory limits or to allow more water to be spread, as discussed further in Appendix C.

The SCVSD, as part of their chloride compliance project, is currently designing an Advanced Water Treatment Facility (AWTF) at the Valencia WRP that includes membrane filtration (MF), enhanced brine concentration (EBC), reverse osmosis (RO), and ultraviolet (UV) light for disinfection. The EBC process is designed to pretreat the water prior to RO to reduce certain target constituents that commonly foul RO membranes including calcium, magnesium, and other salts while allowing chloride to pass through to be removed by the RO. The EBC process consists of nanofiltration (NF), ion exchange (IX) and pH control. The brine from the reverse osmosis process will be trucked to the LACSD's Joint Water Pollution Control Plant in Carson for disposal. SCVSD intends to blend tertiary recycled water with the advanced treated water at a ratio of approximately 70:30 (herein referred to as “Valencia Blend”) to meet the chloride requirements. When there is excess capacity in the AWTF, SCVSD would be willing to provide Valencia Blend water for groundwater recharge. Based on discussions with SCVSD, for the purpose of this evaluation, it is assumed that up to 5,000 AFY of Valencia Blend water would be available to CLWA (at a higher cost than the tertiary recycled water) for surface spreading. The potential quantity of Valencia Blend water for a surface spreading project is discussed in the alternative analysis in Section 7.

Direct Injection Treatment Requirements

In **direct injection**, recycled water that has gone through a full advanced treatment (FAT) process is directly injected into the saturated groundwater zone. The implementation of FAT (i.e. MF, RO and an advanced oxidation process (AOP)) allows for the use of up to 100% recycled water (e.g. no dilution requirement) and as little as a 2-month minimum retention time, if the 12-10-10 microbial requirements are met.

The GRR has specific requirements for the RO and AOP technologies in the FAT train. The RO membranes must achieve a minimum and average sodium chloride rejection of 99.0% and 99.2%, respectively. The initial RO permeate TOC must be less than 0.25 mg/L and not exceed 0.5 mg/L over the long term, based on a 20-week running average of all TOC results and the average of the last four TOC results. Any advanced treatment train constructed as part of a direct injection GRR project will undergo the same set of challenges regarding brine disposal as those faced by SCVSD. As a result, a modified version of the treatment train selected by SCVSD is assumed for implementation of a direct injection project (as described in Appendix C).

Alternative treatment process trains are considered by the DDW if all water quality objectives can be reliably met and comparable protection of public health can be proven.

Surface Water Augmentation Treatment Requirements

A **surface water augmentation** (SWA) project is defined as a project that plans to use recycled municipal wastewater for the purpose of augmenting a reservoir that is designated as a source of domestic water supply. In the most recent draft SWA regulations, the requirements include achieving:

(1) a dilution requirement in the reservoir of 100:1 (or 10:1 with an additional 1-log microbial pathogen treatment) and
(2) a retention time of at least six months (calculated as total volume divided by total outflow).

Currently no alternative permitting process is included in the draft SWA regulations, thus if both of these requirements cannot be met then the project would be considered a direct potable reuse project.

The treatment requirements for SWA look very similar to the GRR, particularly with regard to pathogenic microorganism control. The size of the Castaic Lake reservoir and the anticipated project flow is such that at least 10:1 dilution can likely be achieved in the reservoir; thus, the pathogenic microorganism control requirement for CLWA's SWA project is likely to require additional treatment to achieve 13/11/11 log removal requirement for V/G/C (for further information see Appendix C). Where treatment credits are concerned, the principal difference between groundwater recharge and reservoir augmentation is the availability of treatment credit in the conventional drinking water treatment plant. The proposed treatment system concept for SWA at Castaic Lake would be to achieve the required 12/10/10 log removal requirement for V/G/C through an AWTF and rely on drinking water treatment that is located on the downstream side of the reservoir storage to meet the incremental increase to 13/11/11 log removal requirement for V/G/C. For this application, a similar FAT train is suggested as for the direct injection approach.

The ability to achieve the six month retention time requirement is independent of treatment and is discussed in Section 6.

Direct Potable Reuse Treatment Requirements

A **direct potable reuse (DPR)** project is defined as the planned introduction of recycled water either directly into a public water system or into a raw water supply immediately upstream of a water treatment plant. Thus, DPR has a spectrum of alternatives with significant differences in the 'directness' they seek. A reservoir that is too small to comply with the SWA criteria would be considered a DPR project that introduces recycled water into the raw water supply. SB918 has as its final requirement that DDW assess the feasibility of developing regulations for DPR by the end of 2016. It is important to note that SB 918 does not require the development of regulations, but only an assessment of whether or not it is feasible to do so. There is no mandated timeline for the state to develop a formal DPR regulatory framework.

The concept of DPR is fairly new untested in California. As a result, there is very little data on DPR design, performance, and safety. The WateReuse Research Foundation (WRRF) has created a keystone project that seeks to tie together many of the findings from the last six years of potable reuse research. This project is WRRF 14-12, entitled "Demonstrating Redundancy and Monitoring to Achieve Reliable Potable Reuse". This project utilized a 1.6-MGD demonstration project at the City of San Diego's North City Water Reclamation Plant. WRRF 14-12 has developed a DPR conceptual process train that further augments both the treatment protection and the monitoring to provide continuous and demonstrable performance of a DPR train. The treatment train used in WRRF 14-12 was modified to mirror the SCVSD chloride compliance project with the addition of ozone and biologically activated carbon (BAC) as pretreatment (for further information see Appendix C)

Section 6: Recycled Water Market

6.1 Non-Potable Reuse Market Survey

Title 22 of the California Code of Regulations identifies approved recycled water uses and treatment requirements for non-potable applications (Appendix B illustrates the water recycling criteria for each category of use). Based on discussions with CLWA and the purveyors, this RWMP focused on landscape irrigation and golf courses in Santa Clarita Valley primarily due to the ease and lower cost of converting irrigation only meters to recycled water. Other uses discussed include toilet and urinal flushing in dual-plumbed facilities, cooling (commercial and industrial) and construction activities (dust control, consolidation, etc.).

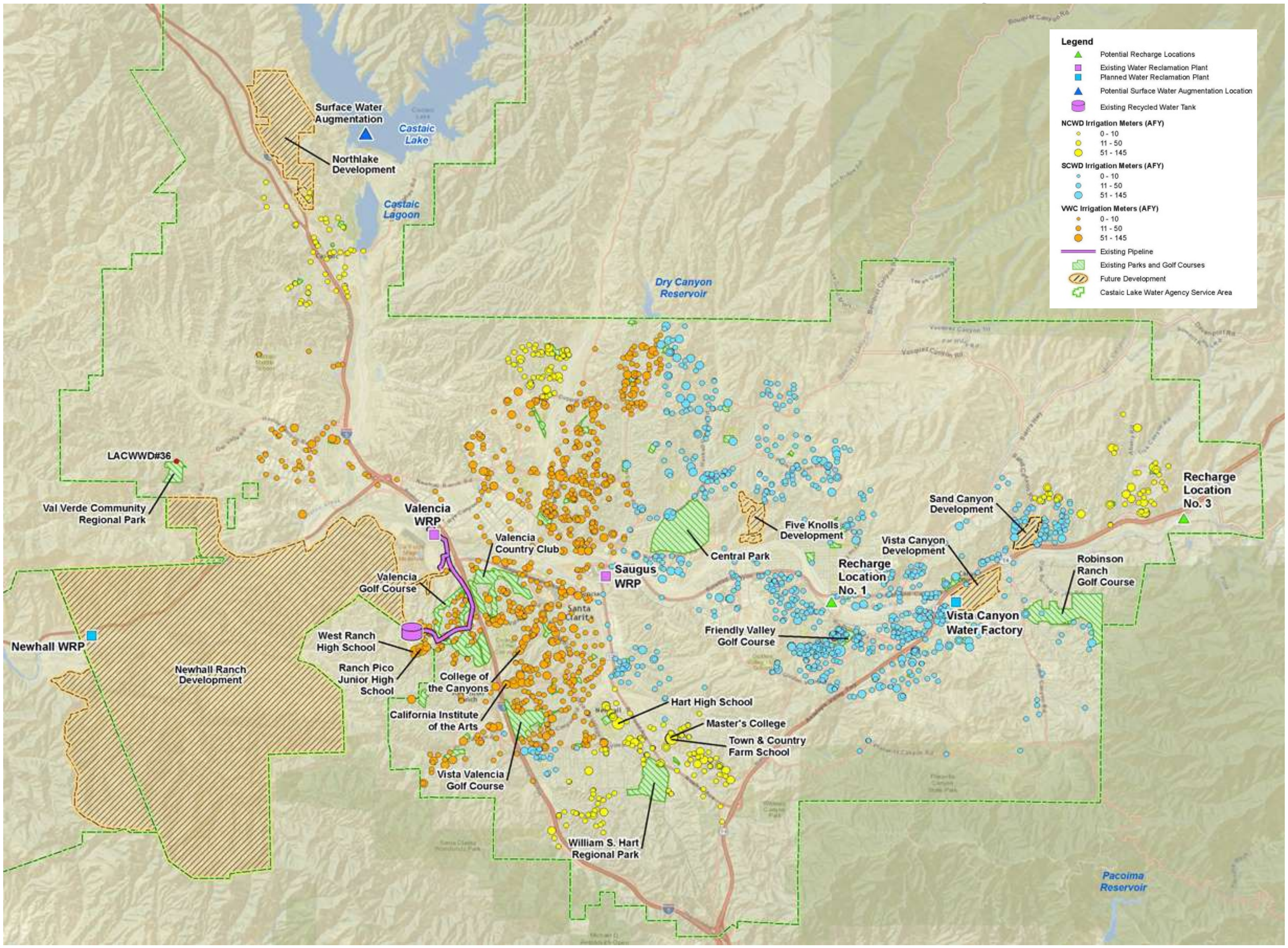
Existing recycled water demands for the Santa Clarita Valley were estimated using 2014 meter data provided by CLWA and the purveyors. In most case, dedicated irrigation meter data was used to estimate demands. Mixed use demands were estimated based on percent irrigable land and average annual uses for the identified land use. Golf course irrigation demands were based on annual usage estimates provided by VWC. Golf course irrigation demand for Valencia Golf Course is based on deliveries from a shared well with VWC and demand for Vista Valencia Golf Course is estimated based on non-potable VWC well used exclusively by Vista Valencia that is not connected to the VWC water system. Table 6-1 summarizes the potential recycled water demands associated with landscape irrigation in Santa Clarita Valley. The market survey map shown in Figure 6-1 illustrates the location of existing irrigation meters, by purveyor, and relative demand (as indicated in the legend).

Table 6-1 Potential Recycled Water Demand for Existing Irrigation

Purveyor	Irrigation Demands (AFY)
VWC	6,070
SCWD	4,444
NCWD	1,942
LACWD36	50
Total Existing Demand	**12,506**

Specific meters that would be served by potential future recycled water alignments are identified in Section 7 - Project Alternatives Analysis and listed in Appendix A.

Figure 6-1 Recycled Water Market Survey



The potential recycled water demands for planned future developments was estimated based on information provided by planning documents and discussions with the purveyors. The majority of assumed reuse at planned developments is intended to meet irrigation demands. Some indoor use is assumed at proposed dual-plumbed facilities. Table 6-2 lists estimated recycled water demands associated with proposed future developments in Santa Clarita Valley included anticipated implementation dates. The location of these developments is also shown on Figure 6-1.

Table 6-2 Potential Recycled Water Demands for Future Developments

Planned Development (Purveyor)	Estimated Demands (AFY)	Projected Implementation Date
Vista Canyon (SCWD)	137	Projected Use by 2020
Five Knolls (SCWD)	152	Unknown
Sand Canyon (SCWD)	95	Unknown
Newhall Ranch / Westside Communities (VWC)	265	Projected Use by 2020
	2,471	Additional Use by 2025
	2,474	Additional Use by 2030
	1,974	Additional Use by 2034
North Lake (NCWD)	800	Unknown
Total Future Demand	**8,418**	

The projected available supply of recycled water in Santa Clarita Valley, previously discussed in Section 4.4, would remain relatively constant year-round while irrigation demands peak in the summer months. Table 6-3 and Figure 6-2 provides a comparison of the total projected available recycled water supply in Santa Clarita Valley and potential demand for recycled water.

Table 6-3 Comparison of Available Supply and Potential Demand in Peak Summer Months

	SCV Available Supply[1,2]	Potential Existing RW Demands	Potential Future RW Demand	Potential Supply Shortfall[4]
Current Supply and Demand (2015)				
Annual (AFY)	6,300	12,506		-6,206
Peak Summer Month[3] (AFM)	525	1,751		-1,226
Projected Future Supply and Demand (2050)				
Annual (AFY)	17,100	12,506	8,418	-3,824
Peak Summer Month[3] (AFM)	1,425	1,751	1,179	-1,504

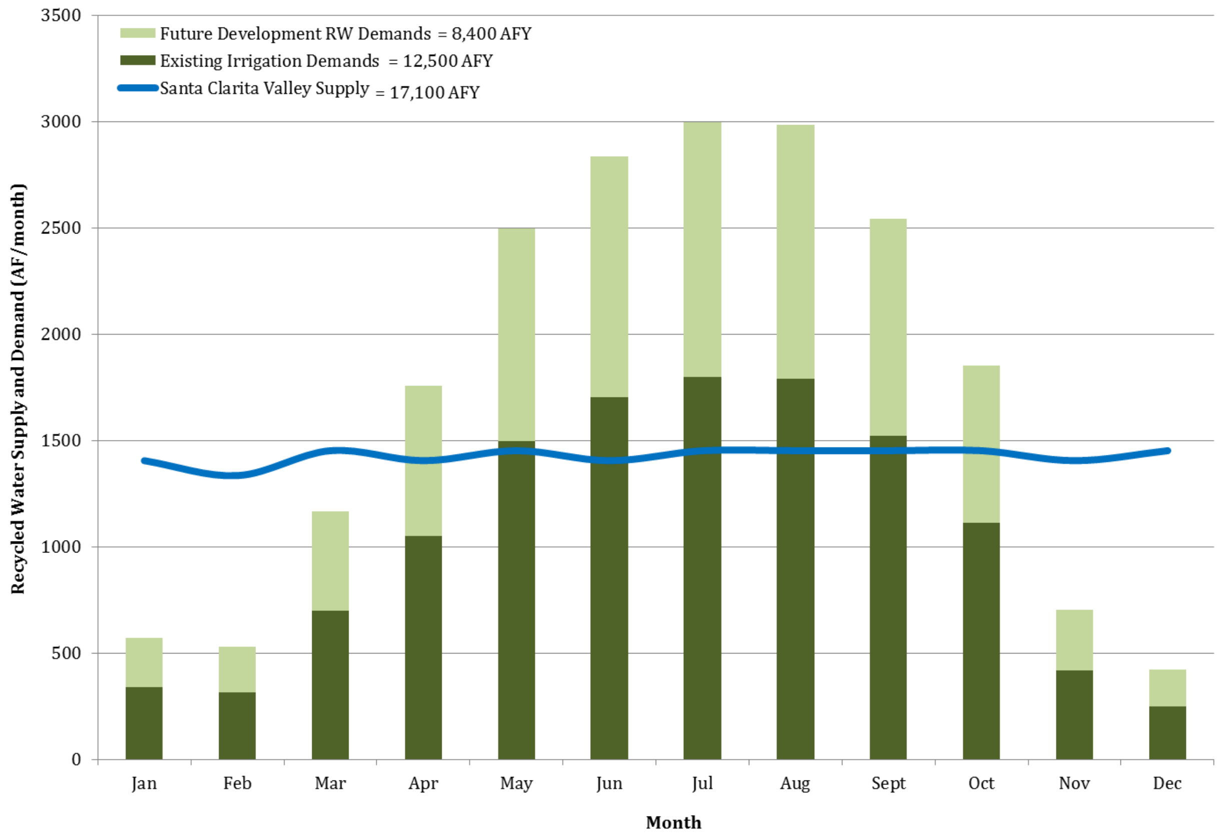
[1] Includes projected recycled water produced at the Valencia WRP, Saugus WRP, planned Newhall WRP and planned Vista Canyon Water Factory less required discharge to the Santa Clara River

[2] Assumes relatively constant year-round production of recycled water.

[3] Peak summer irrigation demand based on historical monthly demand distribution for Phase 1 system (14% of demand occurs in the peak summer month).

[4] Calculated as supply minus demand.

Figure 6-2 Recycled Water Supply and Potential Demand in Santa Clarita Valley (2050)



As shown in Table 6-3, the Santa Clarita Valley is supply limited, both annually and during the peak irrigation months now and in the future. Figure 6-2 clearly illustrates that only half of the summertime demand for existing and future irrigation needs could be met. In addition, the geographic distribution of the dedicated irrigation meters, shown in Figure 6-1 , would make it cost prohibitive to serve many of these potential customers due to the significant amount of conveyance infrastructure that would be required. Identification of potential customers, the appropriate source of recycled water, infrastructure and a proposed phasing plan to align supply and demand over time is evaluated in Section 7 – Project Alternatives Analysis.

6.2 Potable Reuse Market Survey

The potable reuse concepts investigated within the Santa Clarita Valley for this study include groundwater recharge, surface water augmentation and direct potable reuse. A market survey for potable reuse is not associated with meters; but rather a more holistic approach to assess opportunities to beneficially reuse the recycled water for potable uses directly or indirectly. Some of the potential benefits and challenges associated with potable reuse in Santa Clarita Valley are summarized below:

Potential Benefits of Potable Reuse in Santa Clarita Valley:

- Develop a local, drought-proof and sustainable water supply
- Reduce reliance on imported water
- Use of available recycled water flows in the winter and off-peak irrigation months
- Reduce discharges to the Santa Clarita River (after meeting instream flow requirements)
- Repurpose unused capacity in the SCVSD AWTF designed to remove chloride
- Recharge groundwater basin(s) (via groundwater recharge)
- Maintain lake levels (via surface water augmentation)
- Provide an integrated approach solving multiple issues (storm water, chloride removal, GW recharge, flood control, open space, etc.), which could bring together a number of stakeholders in Santa Clarita Valley.

Potential Challenges of Potable Reuse in Santa Clarita Valley:

- Higher costs associated with advanced treatment and brine disposal
- Higher costs associated with pumping and conveyance (for GRR and SWA projects)
- Additional regulatory requirements (i.e. permitting, monitoring, and reporting)
- Public acceptance
- Development of partnerships and agreements (with LA County Flood Control District for GRR, Metropolitan Water District for SWA and others)
- Regulatory uncertainty related to SWA and DPR requirements

Section 5.3 introduced potable reuse concepts and their treatment requirements. The following sections describe how potable reuse concepts could be implemented in Santa Clarita Valley. The infrastructure and flows for specific potable reuse alternatives are presented in Section 7.

Indirect Potable Reuse

The Recon Study (Carollo, 2015) provided an initial assessment of groundwater recharge with recycled water through surface spreading into the alluvial aquifer and aquifer storage and recovery via groundwater injection into and extraction from the deeper Saugus formation. These options were explored in greater detail to assess the potential for recharge of excess available recycled water in the winter and off-peak irrigation months.

Surface Spreading

The Recon Study identified three recharge locations (shown in Figure 6-2) as potential spreading basins based on the six-month retention time requirement used in the GRR to achieve 10-log removal of Cryptosporidium and Giardia.

Figure 6-3 Potential Recharge Locations

Source: Recon Study (Carollo, 2015)

Based on further evaluation for this RWMP:

- **Recharge Location #1** is shifted to an off-stream location just upstream of the location shown in Figure 6-2 to avoid the need for a National Pollutant Discharge Elimination System (NPDES) permit for discharges to a water of the United States and challenges associated with maintaining the spreading facility during storm events and preventing discharge to the river itself.
- **Recharge Location #2** was eliminated as an option in the Recon Study due to its proximity to existing drinking water wells, which would result in retention times below 6-months. No further analysis on this location was considered as part of the RWMP effort.
- **Recharge Location #3** is included at the same location as an in-river option. An off-stream spreading option is not available near this location.

The following initial design assumptions were made to evaluate the size, timing and quantity of recycled water that could be recharged at Recharge Locations #1 and #3:

- Use of city owned parcels where available.
- Assumed infiltration rate of 3 feet per day.
- Recycled water allocated for irrigation would take priority over recharge (i.e. GRR would be limited by the seasonal availability of recycled water.)
- Stormwater capture would be prioritized over recycled water (i.e. during heavier months of rainfall, spreading RW would be limited.)

To determine the retention times associated with Recharge Location #1 and Recharge Location #3, groundwater modeling was performed by GSI Water Solutions, Inc. (GSI). The modeling results show that there is sufficient subsurface travel time to meet the required pathogenic microorganism control log removals. See Appendix C for additional description of the model assumptions and findings.

An important parameter in any surface spreading project is the municipal recycled wastewater contribution (RWC) and its closely related TOC requirement in the GRR. The RWC is defined as:

$$RWC = \frac{Recycled\ Water\ Applied}{Recycled\ Water\ Applied + Diluent\ Water}$$

Diluent water is defined as the pre-existing surface flow (e.g. rainfall, stormwater, or irrigation runoff), subsurface flow (e.g. native groundwater) available to blend with the RW. In the case where surface flow data is absent, such as in Recharge Location #1 and Recharge Location #3, native groundwater (herein referred to as "groundwater underflow") is relied upon as the dilution water. The available groundwater underflow was modeled by GSI as part of the Recon Study and is based on Darcy's Law, which consists of the hydraulic conductivity, cross sectional area, and hydraulic gradient of the desired recharge basin. A conservative calculation of groundwater underflow, based on the use of the cross-sectional area of the recharge basin, results in 16.1 MGD and 4.5 MGD of modeled diluent water at Recharge Locations #1 and #3 respectively.

Per the GRR, at the beginning of the project, the initial maximum RWC cannot exceed 20% unless specifically pre-approved. For the initial RWC of 20%, a maximum total organic carbon (TOC) concentration of 2.5 mg/L must be achieved in the percolated water from a surface spreading project, as calculated in the following equation:

$$TOC_{max} = \frac{0.5\ mg/L}{RWC} = \frac{0.5\ {}^{mg}/_{L}}{20\%} = 2.5\ {}^{mg}/_{L}$$

The TOC concentration may therefore limit the quantity of water that can be recharged. For planning purposes, SCVSD provided an average TOC value of 4.7 mg/L for the Valencia and Saugus WRPs. This is above the 2.5 mg/L for an initial 20% RWC and as such two mitigation efforts would need to be utilized to meet the TOC requirement: 1) blending of tertiary wastewater with AWTF water to lower the TOC above ground and 2) receiving credit for the TOC removal that naturally occurs via SAT by monitoring TOC levels in water after percolation but before blending with native groundwater.

Assuming the TOC requirement is able to be met through the mitigation efforts presented, a 20% initial RWC would result in a recycled water application of 4.0 MGD and 1.1 MGD for Recharge Locations #1 and #3, respectively based on the modeled groundwater underflow. The diluent volume limitation of Recharge Location #3 is noticeable in the low amount of recycled water that can be spread in the initial startup of the groundwater replenishment project. Once an IPR spreading project is underway and has shown itself to be protective of public health and the environment, the sponsor (CLWA or purveyor) can petition DDW to increase the RWC, up to a value of 50% for non-advanced treated source water.

There are a number of other considerations that would influence the amount of recycled water that could ultimately be recharged at each site, including the:

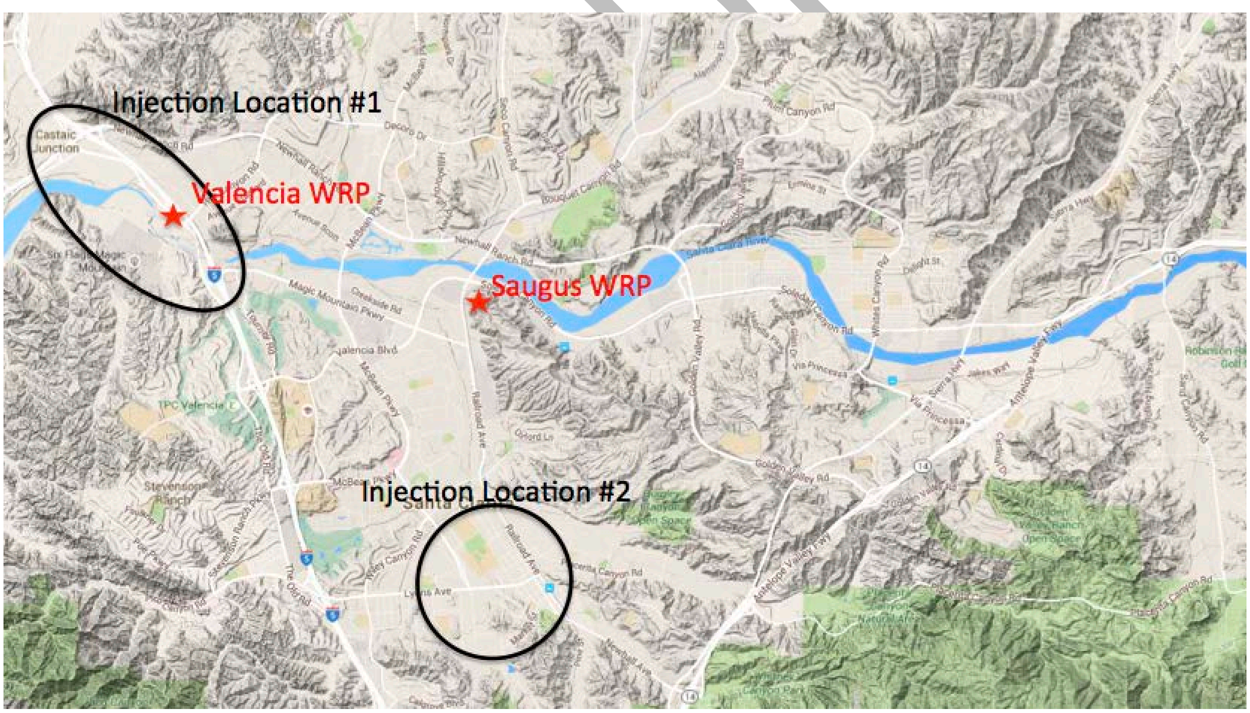
- source of recycled water (Valencia WRP or Saugus WRP)
- quantity of Valencia Blend water available
- available recycled water supply after meeting non-potable demands
- operational criteria for stormwater recharge imposed by LACFCD

These concepts are described in greater detail in Appendix C and in Section 7 – Project Alternatives Analysis. A more detailed feasibility study would be required to confirm the assumptions about the volume of recycled water that could be recharged and recovered based on current regulations, source water quality, operational and cost considerations.

Direct Injection

The Recon Study identified two potential locations for injection wells to introduce RW into either the Saugus Formation or the Alluvial Aquifer in the Valley's groundwater basin, as shown in Figure 6-3.

Figure 6-4 Potential Direct Injection Locations



Source: Recon Study (Carollo, 2015)

To minimize additional costs, this RWMP assumes that the injection wells could be located at Injection Location #1 in the vicinity of the Valencia WRP, along with the AWTF. SCVSD indicated that they were uncertain if there would be available footprint, so additional conveyance costs are possible if the AWTF and injection well would need to be located further away from the Valencia WRP.

For direct injection, the GRR mandates a minimum retention time in the groundwater basin of 2 months, though no existing facilities currently operate with a retention time under 6 months. For this study, it was assumed that a travel time of 6-months could be identified within the aquifer nearby the Valencia WRP. Similar to surface spreading, additional consideration of this concept should include a detailed analysis of groundwater travel times in a follow-on feasibility study.

The direct injection of recycled water is not restricted by the RWC, as the GRR allows for 100% RWC upon commencement of the project (rather than the 20% initial RWC for surface spreading). Therefore, a direct injection project is not limited by the availability of diluent water. A direct injection project is also not hindered by inclement weather as water can be injected into the ground regardless of the weather conditions. As such, all of the available recycled water could be utilized by a direct injection project. Furthermore, given the capital investment required for the AWTF, maximizing the usage of all available recycled water would be critical for creating the most economical alternative possible. Therefore, direct injection is presented in Section 7 that includes an AWTF designed to treat all available recycled water for potable reuse.

Surface Water Augmentation

The SWA concept would require an AWTF to treat 100% of the available recycled water from the SCVSD, delivery to Castaic Lake and brine disposal via truck hauling. As discussed in Section 5.3.2, the size of the Castaic Lake and the anticipated project flow is such that at least 10:1 dilution can likely be achieved in the reservoir. The draft regulations also stipulate that a reservoir used for SWA must have a minimum theoretical retention time of 6 months, to be measured on a monthly basis. The California Department of Water Resources tracks the flow out of the Castaic Lake Reservoir and over the past 10-years an average of 475 MGD leaves the reservoir per year (DWR, 2015). Using the low water level previously discussed, the calculated theoretical retention time is 2 months (for further information see Appendix C). Because of the large outflows from the reservoir for other purposes, reduction of project flow would not enable this project to qualify as a SWA project based on the criteria in the draft SWA regulations.

Unlike the groundwater regulations, there is no stipulation in the draft SWA regulations that allows for a project sponsor to petition the DDW for an alternative permitting process for the reservoir criteria. Currently, discussions regarding this alternative permitting process are ongoing as other potential project sponsors are finding themselves in a similar situation with a lower retention time than stipulated in the draft regulations. A decision will be made later in 2016 whether to allow some flexibility in this requirement.

Despite the regulatory uncertainty, a SWA is included in the RWMP alternatives. Similar to direct injection, the SWA alternative is not restricted by the RWC and therefore, the AWTF would be designed to treat all available recycled water. The total volume available for SWA and the associated conveyance facilities is presented in Section 7.

Direct Potable Reuse

A DPR concept could potentially utilize all recycled water not already allocated for non-potable reuse, and would require full advanced treatment of the recycled water from SCVSD, brine disposal via truck hauling and only minimal conveyance requirements. The DPR alternative would treat 100% of the available recycled water from the SCVSD at an AWTF and the purified water would be blended with the raw water entering the Rio Vista Filtration Plant (an existing drinking water treatment plant) for further treatment prior to distribution. For the purpose of this study, the treatment train would be similar to the treatment provided for direct injection or SWA but with the addition of ozone and BAC pretreatment, as previously discussed in Section 5.3.

It is important to note that this alternative is speculative as there is neither a developed framework for regulations nor any established timeframe for promulgating DPR regulations. CLWA and the purveyors should track direct potable reuse developments in California and revisit the feasibility DPR if a goal to achieve 100% re-use of available wastewater is desirable. The total volume available for DPR and the associated conveyance facilities is presented in Section 7.

Section 5&6 References

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Appendix A: Recycled Water Supply and Demands

This appendix includes supporting information for the recycled water market assessment.

Table A-1 Projected Available Recycled Water Supply

Year	Projected Wastewater Influent based on Population (mgd)[a]	Anticipated Discharge Requirement (mgd)[b]	Projected Available RW Supply (mgd)[c]	Projected Available RW Supply (AFY)[c]
2015	18.6	13	5.6	6,268
2016	18.8	13	5.8	6,510
2017	19.0	13	6.0	6,752
2018	19.2	13	6.2	6,993
2019	19.5	13	6.5	7,235
2020	19.7	13	6.7	7,477
2021	20.1	13	7.1	7,954
2022	20.5	13	7.5	8,432
2023	21.0	13	8.0	8,909
2024	21.4	13	8.4	9,387
2025	21.8	13	8.8	9,865
2026	22.2	13	9.2	10,341
2027	22.7	13	9.7	10,817
2028	23.1	13	10.1	11,293
2029	23.5	13	10.5	11,769
2030	23.9	13	10.9	12,245
2031	24.3	13	11.3	12,666
2032	24.7	13	11.7	13,087
2033	25.1	13	12.1	13,507
2034	25.4	13	12.4	13,928
2035	25.8	13	12.8	14,349
2036	26.0	13	13.0	14,533
2037	26.1	13	13.1	14,716
2038	26.3	13	13.3	14,899
2039	26.5	13	13.5	15,083
2040	26.6	13	13.6	15,266
2041	26.8	13	13.8	15,451
2042	27.0	13	14.0	15,636
2043	27.1	13	14.1	15,821
2044	27.3	13	14.3	16,006
2045	27.5	13	14.5	16,191
2046	27.6	13	14.6	16,374
2047	27.8	13	14.8	16,558
2048	27.9	13	14.9	16,741
2049	28.1	13	15.1	16,925
2050	28.3	13	15.3	17,108

a) Based on a 65 gpcd wastewater generation rate multiplied by the projected population
b) Assumes that SCVSD will be required to maintain 8.5 mgd from the Valencia WRP and 4.5 mgd from the Saugus WRP
c) Includes projected recycled water produced at the Valencia WRP, Saugus WRP, planned Newhall WRP and planned Vista Canyon Water Factory.

Table A-3 Historical Recycled Water Demands (AFY)

Month	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Ave
Jan		1	4	14	17	4	8	7	8	22	17	21	13	11
Feb		2	2	16	14	11	3	1	12	16	20	16	12	11
Mar		24	10	6	43	39	24	2	10	25	38	26	32	23
Apr		53	36	12	38	37	39	0	38	30	51	46	40	35
May		55	46	42	58	56	30	51	41	58	58	64	40	50
Jun		58	59	66	63	34	46	56	54	64	64	58	61	57
Jul		64	67	75	78	26	71	54	64	68	27	64	47	60
Aug		61	57	63	67	63	59	60	57	67	41	60	63	60
Sep	31	90	66	67	55	44	17	39	54	60	37	47	49	51
Oct	61	26	39	33	37	38	39	22	37	32	38	40	48	37
Nov	11	0	20	20	25	4	18	11	10	17	9	23	32	14
Dec	2	14	21	12	7	1	9	5	11	2	16	0	18	8
Total	**107**	**448**	**427**	**426**	**501**	**358**	**364**	**307**	**396**	**462**	**416**	**465**	**455**	**416**

** Note to Reviewers - The following tables will be included with the Admin Draft submittal for Section 7 - Project Alternatives Analysis in April.*

Table A-4 Existing Phase 1 Recycled Water Meters and Demands

Table A-5 Anticipated Phase 2A Recycled Water Demands

Table A-6 Anticipated Phase 2B Recycled Water Demands

Table A-7 Anticipated Phase 2C Recycled Water Demands

Table A-8 Anticipated Phase 2D Recycled Water Demands

Table A-9 Potential Future Alignment Recycled Water Demands

Appendix B: Summary of Recycled Water Regulations

B.1. Federal Requirements

Federal requirements relevant to the discharge of recycled water, or wastewater, and any other liquid wastes to “navigable waters” are contained in the 1972 amendments to the Federal Water Pollution Control Act of 1956, commonly known as the federal Clean Water Act (CWA) (Public Law 92-500). The CWA created the U.S. Environmental Protection Agency (USEPA) and established the National Pollutant Discharge Elimination System (NPDES), a permit system for discharge of contaminants to navigable waters. NPDES requires that all municipal and industrial dischargers of liquid wastes apply for and obtain a permit prior to initiating discharge.

There are no federal regulations governing water reuse in the United States, thus regulations (or guidelines) for recycled water are developed and implemented at the state government level. The lack of federal regulations has resulted in differing standards among states that have developed recycled water regulations (WateReuse 2009). This appendix focuses on recycled water regulations in the State of California.

Recognizing the need to provide national guidance on water reuse regulations and program planning, the U.S. Environmental Protection Agency (USEPA) has developed comprehensive, up-to-date water reuse guidelines in support of regulations and guidelines developed by states, tribes, and other authorities (USEPA 2012). The 2012 USEPA Guidelines for Water Reuse provides support for both project planners and state regulatory officials by providing a national overview of the status of reuse regulations and clarifying some of the variations in the regulatory frameworks that support reuse in different states and regions of the United States

B.2. State Requirements

In the State of California, recycled water requirements are administered by the State Water Resource Control Board (SWRCB) - Division of Drinking Water (DDW), formerly under California Department of Public Health (CDPH), and individual Regional Water Quality Control Boards (RWQCBs). The regulatory requirements for recycled water projects in California are contained in the following sources[1,2]:

- California Code of Regulations (CCR) -Title 22 and Title 17
- California Health and Safety Code
- California Water Code.

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[1] State requirements for production, discharge, distribution, and use of recycled water are contained in the California Water Code, Division 7-Water Quality, Sections 1300 through 13999.16 (Water Code); the California Administrative Code, Title 22-Social Security, Division 4 Environmental Health, Chapter 3-Reclamation Criteria, Sections 60301 through 60475 (Title 22); and the California Administrative Code, Title 17-Public Health, Chapter 5, Subchapter 1, Group 4-Drinking Water Supplies, Sections 7583 through 7630 (Title 17).

[2] Applicable excerpts from Title 22, Title 17, and the Health and Safety Code are documented in “The Purple Book”, which provides a single source of guidelines and requirements for recycled water use in California (CDPH 2001).

Title 22 State Clean Water Act (CWA)

In 1975, Title 22 was prepared by the California Department of Public Health (now DDW[3]) in accordance with the requirements of Division 7, Chapter 7 of the Water Code. In 1978, Title 22 was revised to conform with the 1977 amendment to the federal CWA. The requirements of Title 22, as revised in 1978, 1990, and 2001, regulate production and use of recycled water in California.

The DDW regulates the treatment, quality, and use of recycled water, as well as the proper separation of recycled water and drinking water systems. Title 22 stipulates the levels of treatment for different uses of recycled water, permissible types of reuse, and minimum recycled water quality requirements. Water meeting these standards is considered safe for non-drinking purposes. Routine monitoring is required to ensure that the intended quality is consistently being produced.

Figure A.1 illustrates the allowable uses of recycled water for each level of treatment. Most recycled water used in California meets the Title 22 standards for "disinfected tertiary recycled water", which has the most stringent requirements for non-potable reuse. "Disinfected tertiary recycled water" means a filtered and subsequently disinfected wastewater that meets certain total coliform concentration, turbidity, and disinfection requirements. A lower degree of treatment, "disinfected secondary recycled water", is allowed for specified irrigation, non-irrigation and environmental uses, and is less frequently used. In some cases, a higher degree of treatment beyond Title 22 requirements is performed to meet more stringent requirements for salt and nutrient-sensitive uses.

[3] The Drinking Water Program for CDPH moved to the SWRCB and was renamed the Division of Drinking Water (DDW) as of July 1, 2014.

Figure B.1 Non-Potable Recycled Water Uses Allowed[1] in California

This summary is prepared by WateRuse Association of California, from the December 2, 2000, Title 22 adopted **Water Recycling Criteria**, and supersedes all earlier versions.

Recycled Water Use	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 23 Recycled Water	Undisinfected Secondary Recycled Water
Irrigation for:				
Food crops where recycled water contacts the edible portion of the crop, including all root crops	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Parks and playgrounds				
School grounds				
Residential landscaping				
Unrestricted-access golf courses				
Any other irrigation uses not specifically prohibited by other provisions of the ***California Code of Regulations***				
Food crops, surface-irrigated, above-ground edible portion, not contacted by recycled water		ALLOWED		
Cemeteries			ALLOWED	
Freeway landscaping				
Restricted-access golf courses				
Ornamental nursery stock and sod farms with unrestricted public access				
Pasture for milk animals for human consumption				
Nonedible vegetation with access control to prevent use as a park, playground or school grounds				
Orchards with no contact between edible portion and recycled water				ALLOWED
Vineyards with no contact between edible portion and recycled water				
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest				
Fodder and fiber crops and pasture for animals not producing milk for human consumption				
Seed crops not eaten by humans				
Food crops undergoing commercial pathogen-destroying processing before consumption by humans				
Ornamental nursery stock, sod farms not irrigated less than 14 days before harvest				
Supply for impoundment:				
Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms	ALLOWED[2]	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Restricted recreational impoundments and publicly accessible fish hatcheries	ALLOWED	ALLOWED		
Landscape impoundments without decorative fountains			ALLOWED	
Supply for cooling or air conditioning:				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	ALLOWED[3]	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	ALLOWED	ALLOWED	ALLOWED	

Recycled Water Use	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 23 Recycled Water	Undisinfected Secondary Recycled Water
Other Uses:				
Groundwater Recharge	ALLOWED under special case-by-case permits by RWQCB[4]			
Flushing toilets and urinals	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Priming drain traps	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that may contact workers	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Structural fire fighting	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Decorative fountains	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Commercial laundries	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Consolidation of backfill material around potable water pipelines	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Artificial snow making for commercial outdoor use	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Commercial car washes, not heating the water, excluding the general public from the washing process	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that will not come into contact with workers	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Industrial boiler feed	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Nonstructural fire fighting	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Backfill consolidation around nonpotable piping	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Soil compaction	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Mixing concrete	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Dust control on roads and streets	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Cleaning roads, sidewalks and outdoor work areas	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Flushing sanitary sewers	ALLOWED	ALLOWED	ALLOWED	ALLOWED

1 Refer to the full text of the version of California Department of Public Health's "Regulations Related to Recycled Water", published on January 1, 2009. This chart is only an informal summary of uses allowed in that publication. The most current Title 17 and Title 22 regulations can be downloaded from: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20150625.pdf

2 With "conventional tertiary treatment." Additional monitoring for two years or more is necessary with direct filtration.

3 Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

4 Refer to the June 18, 2014 final Groundwater Recharge Guidelines, available from the DDW website at: http://www.cdph.ca.gov/services/DPOPP/regs/Pages/DPH14-003EGroundwaterReplenishmentUsingRecycledWater.aspx

In addition to recycled water uses and treatment requirements, Title 22 addresses sampling and analysis requirements at the treatment plant, preparation of an engineering report prior to production or use of recycled water, general treatment design requirements, reliability requirements, and alternative methods of treatment.

Title 17 State Drinking Water Code

The focus of Title 17 is protection of drinking (potable) water supplies through control of cross-connections[4] with potential contaminants, including non-potable water supplies such as recycled water. Title 17, Group 4, Article 2 - Protection of Water System, Table 1, specifies the minimum backflow protection required on the potable water system for situations in which there is potential for contamination to the potable water supply. Recycled water is addressed in Title 17 as follows:

- An **air-gap separation** is required on "Premises where the public water system is used to supplement the recycled water supply."
- A **reduced pressure principle backflow prevention device** is required on "Premises where recycled water is used…and there is no interconnection with the potable water system."
- A **double-check valve assembly** may be used for "Residences using recycled water for landscape irrigation as part of an approved dual plumbed use area established pursuant to Sections 60313 through 60316 unless the recycled water supplier obtains approval for the local public water supplier, or (DDW) if the water supplier is also the supplier of the recycled water, to utilize an alternative backflow prevention plan that includes an annual inspection and annual shutdown test of the recycled water and potable water systems pursuant to subsection 60316(a)."

Title 17 specifies the minimum backflow protection on the potable water system for situations in which there is potential for contamination to the potable water supply. In conjunction with local health agencies, DDW reviews and approves final onsite (customer) system plans for cross-connection control in accordance with Title 17, and inspects each system prior to operation. Backflow prevention and cross-connection testing would be performed for each site in accordance with DDW requirements before the recycled water supply is connected to that site.

B.3. State Guidelines

To assist in compliance with Title 22, DDW has prepared a number of guidelines for production, distribution, and use of recycled water. Additionally, DDW recommends use of guidelines prepared by the California-Nevada Section of the American Water Works Association (AWWA). These guidelines are summarized below.

Guideline for the Preparation of an Engineering Report on the Production, Distribution, and Use of Recycled Water. According to Title 22, prior to implementation of a water reclamation project (production, distribution, or use) an engineering report must be prepared and submitted to DDW. This guideline, prepared by DDW and dated March 2001, specifies the contents of an engineering report. The report should describe the production process, including the treated

[4] A cross-connection is an unprotected actual or potential connection between a potable water system used to supply water for drinking purposes and any source or system containing unapproved water or a substance that is not or cannot be approved as safe, wholesome, and potable, which in this case will be recycled water. By-pass arrangements, jumper connections, removable sections, swivel or changeover devices, or other devices through which backflow could occur, shall be considered to be cross-connections

(effluent) water quality, the raw water quality, the treatment process; the plant reliability features the supplemental water supply, the monitoring program, and a contingency plan to prevent distribution of inadequately treated water. The report should include maps of the distribution system and describe how the system will comply with DDW and AWWA guidelines and Title 17. The report should include maps of proposed use areas and should describe the use areas, the types of uses proposed, the people responsible for supervising the uses, the design of the user systems, and the proposed user inspection and monitoring programs.

Manual of Cross Connection Control/Procedures and Practices. This manual, dated July 1981, focuses on establishing a cross-connection control program to protect the public against backflow and back-siphonage of contamination. Main elements of the manual include areas where protection is required; causes of backflow; approved backflow preventers; procedures, installation, and certification of backflow preventers; and water shutoff procedures (for conditions which pose a hazard to the potable water supply).

Guidelines for the Distribution of Nonpotable Water. These guidelines were prepared by the California-Nevada Section of AWWA in 1992. The purpose of these guidelines is to provide guidance for planning, designing, constructing, and operating non-potable water systems, including recycled water systems. Distribution lines, storage and supply, pumping, on-site (user) applications, and system management are discussed. DDW guidelines reference these guidelines.

Guidelines for the On-Site Retrofit of Facilities Using Disinfected Tertiary Recycled Water. The California-Nevada Section of AWWA prepared these guidelines in 1997 to provide guidance on modifying existing on-site facilities for conversion to use of recycled water, including recommendations for signage, backflow prevention, and separation standards, for landscape irrigation, agricultural irrigation, industrial uses, and impoundments.

B.4. State Recycled Water Policy

The SWRCB adopted a Recycled Water Policy (RW Policy) in 2009 to establish more uniform requirements for water recycling throughout the State and to streamline the permit application process in most instances. The RW Policy includes a mandate that the State increase the use of recycled water over 2002 levels by at least 200,000 AFY by 2030. Also included are goals for stormwater reuse, conservation, and potable water offsets by recycled water. The onus for achieving these mandates and goals is placed both on recycled water purveyors and potential users. Absent unusual circumstances, the RW Policy puts forth that recycled water irrigation projects that meet DDW requirements and other State or Local regulations be adopted by Regional Boards within 120 days. These streamlined projects will not be required to include a monitoring component.

The RW Policy requires that salt/nutrient management plans be developed for every basin in California and adopted as Basin Plan Amendments by 2015. These Management Plans are to be developed by local stakeholders and funded by the regulated community.

The RW Policy also required the formation of a Blue-Ribbon Advisory Panel (Panel) to guide future actions with respect to contaminants of emerging concern (CECs). CECs include chemicals and other substances that have no regulatory standard, have recently been "discovered" in natural streams, and potentially cause deleterious effects in aquatic life at environmentally relevant concentrations. The Panel was convened in May 2009 and completed in May 2010. A final report was issued in June 2010. The recommendations of the Panel resulted in the finalization of the Groundwater Recharge and Reuse Regulations in June 2014, which incorporated the Panel's recommendations.

B.5. Indirect Potable Reuse Regulations

The California Water Code addresses the use of recycled water for IPR via groundwater recharge and reservoir augmentation.

Groundwater Recharge Reuse Regulations

Regulations for groundwater replenishment using recycled water became effective on June 18, 2014. These regulations define full advanced treatment (FAT) as the treatment of an oxidized wastewater (wastewater in which the organic matter has been stabilized) using a RO and oxidation treatment process meeting certain minimum criteria. FAT (also referred as Advanced Water Purification (AWP)) is required in the case of groundwater replenishment via injection (subsurface application), but not necessarily for surface spreading. Key aspects of these regulations are summarized Appendix C: Potable Reuse Evaluation.

Reservoir Augmentation Regulations

A recycled water reservoir augmentation project is defined as a project that plans to use recycled municipal wastewater for the purpose of augmenting a reservoir that is designated as a source of domestic water supply. A significant degree of regulatory uncertainty exists with respect to the overall implementation of a reservoir augmentation project. Chief among these uncertainties is the fact that (1) DDW regulations for such a project have not yet been developed, and (2) DDW has not yet convened the required expert panel to assess reservoir augmentation public safety needs. Appendix C discusses probable DDW reservoir augmentation requirements.

B.6. Direct Potable Reuse Regulations

The California Water Code was modified by legislative statute to require DDW, in consultation with the SWRCB, to investigate and report on the feasibility of developing uniform water recycling criteria for DPR by December 31, 2016. Preliminary DPR regulations may not be available in California until 2020. In addition to FAT or AWP of the recycled water, an "engineered buffer" (storage tank) would need to be provided for a DPR project to ensure that water quality leaving the facility always met regulatory standards. Future DPR regulations, compared to IPR, are anticipated to include additional monitoring and/or treatment requirements to ensure the overall reliability of the treatment scheme, with a focus on acute risks (i.e., pathogens), critical control points, and continuous verification of treatment performance (NWRI 2014). The two major alternatives for the safe design of DPR are 1) focus on the engineered storage buffer that provides time for sample analysis, such as real-time pathogen log reduction monitoring, to ensure water meets quality requirements before distribution, or 2) emphasis on increased advanced treatment to meet the same goals (i.e., treatment redundancy). The required treatment technologies may be similar to the IPR regulations, i.e., RO and AOP. Appendix C provides additional information on potential DPR regulations.

Appendix A References

DDW. 2001. California Health Laws Related to Recycled Water "The Purple Book" Excerpts from the Health and Safety Code, Water Code, and Titles 22 and 17 of the California Code of Regulations. California Department of Public Health [Available at: http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/Purplebookupdate6-01.PDF, accessed June 30, 2014].

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USEPA. 2012. Guidelines for Water Reuse. EPA/600/R-12/618. United States Environmental Protection Agency and National Risk Management Research Laboratory. http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf

WateReuse Association. 2009. Manual of Practice – How to Develop a Water Reuse Program. Principal authors: Thomas Holliman, Richard Atwater, Dr. James Crook and Lois Humphreys.

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Appendix C: Potable Reuse Technical Assessment

The following study "Potable Reuse Technical Assessment" (Trussell Technologies, 2016) was developed to support the evaluation of:

(1) groundwater replenishment (surface spreading and direct injection),
(2) surface water augmentation (at Castaic Lake), and
(3) direct potable reuse.

** Note to Reviewers - The Draft Potable Reuse Technical Assessment includes the alternative analysis and treatment costs for the potable reuse projects, and is currently being updated to reflect the revised supply and demand information recently received. Thus it will be included with the Admin Draft submittal of Section 7 - Project Alternatives Analysis in April.*

Castaic Lake Water Agency
Recycled Water Master Plan Update
ADMIN DRAFT

Status of Section by Section Reviews

Section	Scheduled Review	Status
Section 1 - Introduction	Jan 2016	Admin Submitted (1/13)
Section 2 - Study Area Characteristics	Jan 2016	Admin Submitted (1/13)
Section 3 - Water Supply Characteristics and Facilities	Feb 2016	Admin Submitted (2/17)
Section 4 - Wastewater Characteristics and Facilities	Feb 2016	Admin Submitted (2/17)
Section 5 - Treatment Requirements	Mar 2016	Admin Submitted (3/17)
Section 6 - Recycled Water Market	Mar 2016	Admin Submitted (3/17)
Section 7 - Project Alternatives Analysis	Apr 2016	Included herein (4/28)
Section 8 - Recommended Project	May 2016	
Section 9 - Construction Financing Plan	May 2016	
Draft RWMP*	June 2016	
Final RWMP**	Sept 2016	

***** The Draft RWMP will incorporate response to comments and updates to all prior sections
** The Final RWMP will incorporate response to comments and updates to the Draft RWMP

Section 7: Alternatives Analysis

This section describes the alternatives considered and lists the planning and design criteria applied to analyze each project in a given alternative. A summary of uses, demands and facilities are provided for each project, including a project map. The potential for repurposing existing infrastructure, consideration of seasonal storage and customer retrofits are also discussed. Capital, operating and life-cycle costs are provided for each alternative in the last section.

7.1 Alternatives Evaluated

Four alternatives are explored as part of the alternatives evaluation:

- **Alternative 1 - Non-Potable Reuse Expansion (Phase 2):** looks at near-term opportunities to expand recycled water use for non-potable uses (i.e. irrigation, commercial, etc.). This alternative focuses on the Phase 2 expansion, which extends alignments beyond the existing Phase 1 system and supports upcoming design work and the pursuit of currently available grants and loans for recycled water projects.

- **Alternative 2 - Non-Potable Reuse Expansion (Future Phases):** assess mid-term opportunities to expand recycled water use for non-potable uses. This alternative considers future alignments extensions beyond Phase 2 for landscape irrigation as well as service to the planned new development for the Westside Communities.

- **Alternative 3 - Groundwater Recharge (Surface Spreading):** assess mid-term opportunities to expand recycled water use for non-potable uses while implementing a groundwater recharge project via surface spreading.

- **Alternative 4 - Advanced Treatment for Potable Reuse:** considers long-term opportunities to implement a potable reuse project. This alternative considers both indirect and direct potable reuse projects that require advanced treatment to meet regulatory requirements, including: (1) groundwater recharge via direct injection near the Valencia WRP, (2) surface water augmentation at Castaic Lake and (3) direct potable reuse by blending with the raw water supply at the Rio Vista Water Treatment Plant (WTP).

Each alternative consists of a group of projects; some can be constructed independent of other projects, while others would build on previous phases and require upsizing of facilities to meet increased future flows. A discussion of general planning and design criteria applicable to all projects is provided in Section 7.2.

7.2 Planning and Design Criteria

7.2.1 Conveyance Facility Evaluation

Conveyance facilities are sized to meet hydraulic requirements and customer demands for each alternative based on the demand information developed in the Market Assessment (Section 6) and input from CLWA and purveyors regarding the potential future development demands. General assumptions include:

- Conveyance facilities (pipeline and pump stations) sized to meet the peak hour demand
- Operational storage sized for approximately 75% of the peak day demand
- New Pipelines: 8”-dia to 20”-dia buried “purple” high-pressure PVC
  > 20”-dia buried steep or ductile iron
- Maximum design velocity: 6 feet per second (fps)
- Maximum system pressure: 215 pounds per square inch (psi)
- Minimum delivery pressure: 55 psi
- Optimum delivery pressure: 55 to 150 psi
- Elevation contour data provided by CLWA

Pipeline Evaluation

All new recycled water customers (beyond Phase 1 customers currently being served with recycled water) would be served by new distribution pipelines. Customers served are based on Hydraulic modeling performed to evaluate the minimum pipeline sizes required to meet a max day peaking factor of 2.25, as described in Appendix D.

Pipelines design considerations should include the following:

- Minimum cover of 3.5 to 4 feet to protect the pipeline from live loads while minimizing dewatering costs. When the minimum cover requirements cannot be met, the pipe trench loading should be further analyzed. In such cases, the use of concrete or slurry encasement may be necessary.
- As established by the Division of Drinking Water (DDW), the minimum separation for existing water mains and new pipelines carrying tertiary-treated recycled water shall be in conformance with Section 64572 of Title 22 California Code of Regulation. There shall be at least a 4-foot horizontal separation where lines are running parallel and a 1-foot vertical separation (water line above recycled water line) where the lines cross each other. When these criteria cannot be met, special permission must be obtained from DDW.
- A minimum clearance of at least 12 inches (when paralleling) and 6 inches (when crossing) electric lines is required by the Southern California Edison Underground Structures (UGS-100) and the California Public Utilities Commission General Order (GO-128).
- Appurtenances shall be installed appropriately to protect the pipeline from water hammer, collapse, and vacuum and to isolate and/or drain the pipe. Appurtenances shall include air and vacuum release valves, blowoff/pumpouts, and valves. All appurtenances shall comply with applicable AWWA standards.

Pump Station Evaluation

Distribution pump stations are sized to meet customer instantaneous peak demands and pressure service requirements. New pump stations would include vertical turbine pumps with two to three operating pumps capable of delivering the required combined capacity, and one pump would operate as a standby unit. The pump configuration type is similar to those used at several pump stations throughout CLWA's potable and recycled water systems, including the Valencia WRP pump station.

Pump station total dynamic head (TDH) is estimated in order to provide conceptual level estimates of pump station capital and operating costs (Section 7.8) for the purpose of alternative comparison. Ground and water surface elevations were estimated using GIS mapping data when available and system operating pressure is assumed to be 80 psi. The hydraulic grade line (HGL) for the selected scenario should be confirmed with hydraulic modeling during preliminary pump station design and pump selection.

Pump Station design considerations should include the following:

- A pump control valve for each pump.
- A pressure relief / surge control valve on the discharge header.
- Butterfly valves on the discharge piping for isolating the pumps.
- A magnetic type flowmeter installed above grade on the discharge header.
- Air release valves for the pump discharge.
- An emergency power standby generator.
- Appropriate instrumentation and controls.

7.2.2 Operational Storage Evaluation

Storage is used to meet peak customer demands and diurnal demand fluctuations while allowing for constant recycled water treatment production rate. Storage requirements were modeled on an hourly time-step over a 24-hour period, as described in Appendix D. It is assumed that additional storage would not be provided for backup service in the event of a partial or complete treatment plant shutdown. Instead, standby service would be provided from potable water via air-gap connections at the storage reservoir.

Additional assumptions used for the storage sizing evaluation include:

- Treatment facilities will operate 24 hours per day to produce recycled water at a constant rate.
- Service to recycled water customers would be provided at the peak hour demand rate.
- A 25% contingency for storage volume is desirable to allow for actual peak demand times and flow rates that might be different from the estimates and assumptions used herein.
- A backup potable supply would be provided at each of the recycled water storage tanks to maintain flow through the distribution system during interruption of recycled water production to meet customer demands.
- A connection to the potable water system would require an air gap separation to protect the potable water system from cross connection to the recycled water system.

7.2.3 Treatment Facility Evaluation

An evaluation of treatment requirements was presented in Section 5. The assumptions related to sizing of treatment facilities are based on the type of use and source of recycled water.

Non-potable reuse alternatives: would rely on tertiary treated recycled water provided by existing or planned facilities. No additional tertiary treatment facilities would be constructed.

Indirect and direct potable reuse alternatives: would require additional treatment provided by the SCVSD's planned AWTF or a new AWTF. Due to the limited supply of recycled water available in Santa Clarita Valley (as discussed in Section 6), the indirect and direct potable reuse alternatives can take advantage of excess recycled water flows available during the winter and shoulder months when irrigation demands are low. Additional information about advanced treatment processes is provided in Appendix C.

- **Groundwater spreading alternatives** would rely on tertiary treated recycled water blended with demineralized advanced treated water provided by SCVSD (previously described in Section 5). No additional tertiary or advanced treatment facilities would be constructed.
- **Direct injection alternatives** would require construction of a new AWTF sized to meet the peak day demand during the winter months.
- **Surface water augmentation alternatives** would require construction of a new AWTF sized to meet the peak day demand during the winter months.
- **Direct potable reuse alternatives** would require additional treatment provided by a new AWTF.

7.2.4 Overview of Hydraulic Model Approach

A hydraulic model of the recycled water system alternatives is utilized to provide facility sizes and verify hydraulic feasibility. An extended period simulation is utilized to evaluate system pressures and pipeline velocities under maximum day demand (MDD) conditions for Alternatives 1 and 2, and winter day demand (WDD) conditions for Alternative 3. Facility sizes are determined based on meeting the design criteria described in Section 7.2. Alternative 4 is not analyzed with the hydraulic model; facility sizes are determined using Excel calculations.

For Alternatives 1 and 2, which consist of expansion of the non-potable reuse system, the hydraulic model simulation utilizes MDD conditions, which include application of an MDD peaking factor of 2.25 for annual average demand and application of an 8-hour irrigation window from 10 p.m. to 6 a.m. on a daily basis. Effectively, the peak hour demand is three times the MDD demand.

Note that hydraulic model simulations are provided for only Phase 2A and Phase 2B. As shown in Table 7-2, three different alignments are analyzed for Phase 2A: Bouquet Canyon Road, Central Park South without Tank, and Central Park South with Tank. Facility sizes are provided for each alignment, as shown in Appendix D. One alignment is analyzed for Phase 2B.

Facility sizes for Phase 2C and Phase 2D were analyzed independent of the RWMP and hydraulic models were developed under separate projects. The modeling components have been assimilated into the overall hydraulic model and the recommended facility sizes are incorporated in this report.

Alternative 3 consists of groundwater recharge via surface spreading options. As described in Section 7.5, groundwater recharge would occur in winter months when non-potable reuse demand is low. The hydraulic model simulation utilizes WDD conditions for non-potable reuse demand, which includes a WDD peaking factor of 0.2 for annual average demand and application of an 8-hour irrigation from 10 p.m. to 6 a.m. on a daily basis. The WDD peaking factor is based on historical monthly demand data for CLWA's existing recycled water system.

The groundwater recharge demand is based on the anticipated maximum month delivery and is assumed to be constant over a 24-hour period. Note that hydraulic model simulations are provided for only 'Phase 2A + Spreading Site #1' and 'Phase 2A + Spreading Site #3a'. Facility sizes for the other options of Alternative 3 are based on the results of these two simulations.

Results of the hydraulic model simulations are provided in Appendix D. A figure is provided for each simulation showing recommended pipe sizes and pump station capacities.

7.3 Alternative 1 – Non-Potable Reuse Expansion (Phase 2)

Four projects planned to expand recycled water use within Santa Clarita Valley, which are collectively known as Phase 2, are depicted in Figure 7-1, and are currently in various stages of design. Phase 2A, 2C and 2D would use recycled water from the Valencia WRP and Phase 2B would use recycled water produced at the Vista Canyon Water Factory, which is being constructed to treat flows from the planned Vista Canyon Development.

A summary of Alternative 1 key customers, anticipated annual demands, and construction completion dates and purveyors for each phase are listed in Table 7-1. A map of each Alt 1 – Phase 2 project is provided in Figure 7-2 through Figure 7-5. Appendix A lists the anticipated recycled water demands by meter and Appendix D summarizes the hydraulic modeling results. Costs are summarized in Section 7.9 and detailed cost sheets are provided in Appendix E.

Phase 2A – consists of a new transmission main from the Valencia WRP to Central Park. The alignment runs north on Rye Canyon Road from the Valencia WRP to Newhall Ranch Road, then east on Newhall Ranch Road to Bouquet Canyon Road. At this juncture, three alignments alternatives are analyzed: Bouquet Canyon Road, Central Park South without Tank, and Central Park South with Tank. The Bouquet Canyon Road alignment runs north on Bouquet Canyon Road from Newhall Ranch Road to Central Park. The Central Park South without Tank alignment runs east on Newhall Ranch Road from the intersection of Newhall Ranch Road and Bouquet Canyon Road, then north on a service road to Central Park. The Central Park South with Tank alignment is an identical alignment, but includes a storage tank south of Central Park. The Central Park South alignments are able to serve non-potable reuse demand from the River Village area and is conducive to expansion of the recycled water system, as described in Alternatives 2 and 3.

Phase 2B – consists of a new transmission main from the proposed Vista Canyon Water Factory south to a new storage tank close to existing Cherry Willow potable water storage tanks. The backbone main runs along Cherry Willow Drive and a distribution main runs along Lost Canyon Road from Medley Ridge Drive to Wren Drive. The system will also serve non-potable reuse demands within the proposed Vista Canyon development.

Phase 2C – consists of a new transmission main from a connection to the existing recycled water system at the intersection of Valencia Boulevard and The Old Road and terminates at Newhall Elementary School. The alignment runs east on Valencia Boulevard, then south on Rockwell Canyon Road to McBean Parkway. At this juncture, two alignments are analyzed: McBean and Drainage. The McBean alignment continues east on McBean Parkway, south on Orchard Village Road, east on 16th Street, then south on Newhall Avenue. The Drainage alignment runs south on Tournament Road, east on a stormwater drainage channel, south on Orchard Village Road, east on 16th Street, and then south on Newhall Avenue.

Phase 2D – consists of a new pump station located adjacent to the existing Recycled Water Storage Tank No. 1 and a new transmission main that extends east on Westridge Parkway, south on Old Rock Road, and west on Valencia Boulevard. This phase can potentially tie in to the proposed non-potable reuse system for the Westside Communities.

Figure 7-1: Alternative 1 – Non-Potable Reuse Expansion (Phase 2)

** See PDF **

Table 7-1 Summary of Alternative 1 - Demands and Customers

Alt 1 Projects	RW Demand (AFY)	Purveyor Demand (AFY)			Anticipated Construction Completion Date	Key Customers
		SCWD	VWC	NCWD		
Phase 2a	560	224	336	-	2025	Central Park and irrigation customers along the pipeline alignment
Phase 2b	300	300	-	-	2020	Proposed Vista Canyon Development and nearby irrigation customers
Phase 2c	1,374	-	1,125	249	2022	West Ranch High School, Valencia Country Club, Vista Valencia Golf Course, College of the Canyons, California Institute of the Arts, Hart High School, and Newhall Elementary School
Phase 2d	186	-	186	-	2019	Ranch Pico Junior High School and customers along the way

Table 7-2 Summary of Alternative 1 Facilities

Alternative 1 - Facility Components	Alt 1 - Non-Potable Reuse Expansion (Phase 2)					
	Phase 2A			Phase 2B	Phase 2C	Phase 2D
	Bouquet Canyon Road	Central Park South w/o Tank	Central Park South w/ Tank	Combined SCWD + Vista Canyon	VWC + NCWD Extensions	VWC Extension
Total Pipeline Length (ft)	31,500	36,900	36,900	24,000	32,000	5,100
Storage (MG)	hydro tank	-	1.0	1.0	-	-
Pump Station (gpm)	750	1,250	1,250	270	4,400	1,000
	-	-	-	-	5,200	-
Site Retrofit (# of Sites)	42	51	51	17	66	14

Figure 7-2: Alternative 1 – Phase 2a

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Figure 7-3: Alternative 1 – Phase 2b

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Figure 7-4: Alternative 1 – Phase 2c

** See PDF **

Figure 7-5: Alternative 1 – Phase 2d

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7.4 Alternative 2 – Non-Potable Reuse Expansion – Future Phases

Future recycled water use expansion beyond Phase 2 would include extensions off the Phase 2 alignments to utilize available effluent from the Valencia WRP and serving the Westside Communities development, which would use recycled water from the planned Newhall Ranch WRP supplemented by Valencia WRP recycled flows.

A summary of Alternative 2 key customers, anticipated annual demands, and construction completion dates and purveyors are listed in Table 7-3. A map of each Alt 3 project is provided in Figure 7-6 through Figure 7-9. Appendix A lists the anticipated recycled water demands by meter and Appendix D summarizes the hydraulic modeling results. Costs are summarized in Section 7.9 and detailed cost sheets are provided in Appendix E.

Alignment A – consists of a new transmission main from the termination of Phase 2C to a new storage tank near the intersection of Placerita Canyon Road and Sierra Highway. The alignment runs east on 13th Street and Placerita Canyon Road.

Alignment B - consists of a new transmission main from the termination of Phase 2C to a new storage tank in William S. Hart Park. The alignment runs south on Newhall Avenue.

Alignment C – consists of a new transmission main from the intersection of McBean Parkway and Rockwell Canyon Road, runs west on McBean Parkway, south on the Old Road, west on Pico Canyon Road, and terminates at Whispering Oaks Drive.

Alignment D – consists of a new transmission main loop encompassing Valencia Boulevard, McBean Parkway, and Arroyo Park Drive.

Alignment E – consists of a new transmission main that serves the Tesoro Del Valle development from a connection to the Phase 2A system at Newhall Ranch Road and runs along Copper Hill Drive. A new storage tank is provided in the biomedical park at Rye Canyon Loop.

Alignment F – consists of a new transmission main from the intersection of Newhall Ranch Road and McBean Parkway, runs north on McBean Parkway, east on Decoro Drive, and terminates at Arroyo Seco Junior High.

Alignment G – building off of Alignment F, consists of a new transmission main from the intersection of McBean Parkway and Decoro Drive, runs north on McBean Parkway, runs east on Copper Hill Drive, then terminates at a new storage tank at Kenton Lane.

Alignment H – consists of a new transmission main from the terminus of Phase 2A, runs east on Newhall Ranch Road, south on Golden Valley Road, east on Soledad Canyon Road, south on Rainbow Glen Road, east on Avenue of the Oaks, and terminates at the Friendly Valley Golf Course.

Figure 7-6: Alternative 2 – Non-Potable Reuse Expansion (Future Phases)

** See PDF **

Table 7-3 Summary of Alternative 2 - Demands and Customers

Alt 2 Projects	RW Demand (AFY)	Purveyor Demand (AFY)			Anticipated Construction Completion Date	Key Customers
		SCWD	VWC	NCWD		
Phase 2A + Alignments E-H	1,904	643	1,041	220	2025	Phase 2A + Future Expansion North of the Santa Clara River
Phase 2C + Alignments A-D	2,391	0	1,719	672	2025	Phase 2C + Future Expansion South of the Santa Clara River
Westside Communities	7,164	-	7,164	-	2024	Mission Village, Landmark Village, Entrada South, VCC (PM 18108), Homestead South, Legacy Village, Homestead North, Entrada North Potrero

Table 7-4 Summary of Alternative 2 Facilities

Alternative 2 - Facility Components	Alternative 2 - Non-Potable Reuse Expansion (Future Phases)		
	Phase 2A + Alignments E-H	Phase 2C + Alignments A-D	Westside Communities
Total Pipeline Length (ft)	102,300	85,700	161,300
Storage (MG)	1.0	1.0	8.3
Pump Stations (gpm)	6,000	1,000	7 Pump Stations: 300 to 7700
	1,100	5,200	
	1,000	-	
	1,800	-	
Site Retrofit (# of Sites)	212	159	54

Figure 7-7: Alternative 2 – Phase 2A + Alignments E-H

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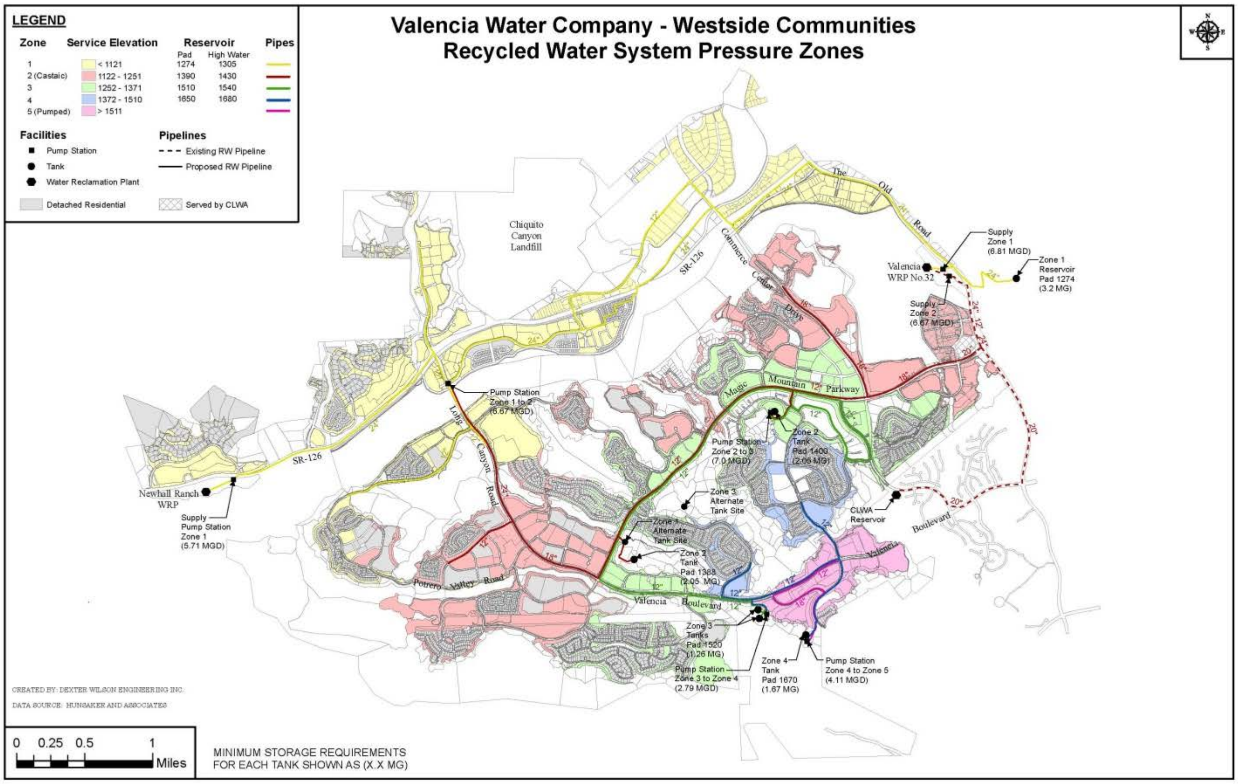
Figure 7-8: Alternative 2 – Phase 2C + Alignments A-D

** See PDF **

Figure 7-9: Alternative 2 – Westside Communities



Source: *Recycled Water Master Plan for Westside Communities (Dexter Williams, 2015)*

7.5 Alternative 3 – Groundwater Recharge via Surface Spreading

Alternative 3 includes five projects that use of recycled water to recharge groundwater via surface spreading. Each project would extend off the Phase 2A system, and require upsizing the pipeline capacity of most of the Phase 2A pipeline to maximize deliveries of recycled water to one or more spreading basin(s) during the winter and shoulder months. For all of the Alternative 3 projects, the amount of recycled water that can be recharged is limited by the available supply because (1) irrigation demands for Phase 1, Phase 2 and future customers use all available summer supplies that are not required for discharge and (2) operation of a recharge basin to prioritize stormwater capture further limits the volume of recycled water that can be delivered in the winter months. A more detailed discussion of the regulatory and water quality considerations and assumptions related to spreading restrictions is discussed in Section 2.3 of Appendix C.

It is assumed that each of the Alternative 3 projects would be implemented in partnership with the LACFCD to capture and recharge stormwater from the Santa Clara River during rain events. Anticipated stormwater recharge volumes are not included in estimated recharge volume for this study. Additional hydrologic studies would be needed to confirm the combined recycled water and stormwater recharge potential at each site. Additional hydrogeologic studies would also be needed to confirm the groundwater management approach to optimize extraction of the recharged water.

It is also assumed that the facilities would be designed to enhance passive recreation and habitat restoration, providing additional environmental and social benefits.

A summary of key considerations for Alternative 3 projects is provided below. Additional details about anticipated reuse volumes and facilities are listed in Table 7-5 and Table 7-6 respectively. Appendix D summarizes the hydraulic modeling results and costs are summarized in Section 7.9 with detailed cost sheets provided in Appendix E.

Phase 2A + Spreading Site #1- this off-stream spreading site is located near the intersection of Whites Canyon Road and Via Princessa, on the south side of the Santa Clara River (Figure 7-10). The site is located on City-owned parcels. A 24-inch-diameter pipeline and additional pumping capacity at the Valencia WRP would be required to convey a peak flow of 9.7 mgd to the spreading basin during the winter months on days when no rain is predicted. An inflatable dam diversion in the Santa Clara River would convey river water to a one acre settling basin, which would be hydraulically connected to a 20 acre recharge basin. The dam could be deflated during low flow periods and inflated when needed to capture anticipated storm flows. Recharged water would be extracted using existing SCWD and VWC wells. New monitoring wells would be installed to meet regulatory requirements.

Phase 2A + Spreading Site #3a - this in-stream spreading site is located upstream of Land Station Road, near the intersection of Soledad Canyon Road and Antelope Valley Freeway (14) (Figure 7-11). The site is located on County-owned parcels. A 24-inch-diameter pipeline, additional pumping capacity at the Valencia WRP and a booster pump station at or near Central Park would be required to convey a peak flow of 9.7 mgd to the spreading basin during the winter months on days when no rain is predicted. An inflatable dam diversion in the Santa Clara River would retain recycled water flows as well as some streamflow for recharge. The dam could be deflated periodically to allow deposited sediment to be transported downstream. It is assumed that when rain is predicted, recycled water deliveries would cease to free up capacity for stormwater capture. Recharged water would be extracted using existing SCWD and NCWD wells. New monitoring wells would be installed to meet regulatory requirements.

Phase 2A + Spreading Site #3b - this off-stream spreading site is located upstream of Site #3a, at the mouth of Bee Canyon (Figure 7-11). The site is located on privately owned parcels. A 24-inch-diameter pipeline, additional pumping capacity at the Valencia WRP and a booster pump station at or near Central Park would be required to convey a peak flow of 9.7 mgd to the spreading basin during the winter months on days when no rain is predicted. An inflatable dam diversion in the Santa Clara River at the mouth of Bee Canyon would be used to provide sufficient backwater to pump stormwater flow to the recharge basin during storm events. The dam could be deflated during low flow periods and inflated when needed to capture anticipated storm flows. It is assumed that when rain is predicted, recycled water deliveries would cease to free up capacity for stormwater capture. Recharged water would be extracted using existing SCWD and NCWD wells. New monitoring wells would be installed to meet regulatory requirements.

Spreading site #3a was identified by the LACFCD in the *Santa Clara River Watershed Water Conservation Feasibility Study* (LACFCD, 2007) as a potential location for in-river recharge. This concept includes the construction of earthen levees in the river to redirect flows to the outer banks and small recharge basins and finger levees along the outer banks to slow flows and increase recharge in this stretch of the river. It was recognized that during high flows, the levees would wash out and the permit would need to include provisions for regular maintenance and allow the levees to be rebuilt. It was also noted that sediment deposit may become a problem, and removal of sediment would need to be addressed. The Recon Study (Carollo, 2015) provided an initial assessment of this site and Appendix C further analyzed the viability of recharging recycled water to meet the Title 22 GRR regulations. **Spreading Site #3b** was added as an alternate location as part of the alternatives analysis due to concerns related to the viability of an in-stream basin. The two sites are assumed to have similar hydrogeologic characteristics and similar spreading areas (Figure 7-11), though additional modeling would need to be performed to confirm these assumptions. Due to the preference to present an off-stream spreading site, the remaining Alternative 3 projects assume the use of Spreading Site #3b.

Phase 2A + Spreading Site #3b (Repurpose Infrastructure) – this project would seek to repurpose existing infrastructure to reduce costs and impacts associated with constructing new pipelines. Figure 7-12 illustrates two potential pipeline alignments that could be repurposed to convey recycled water to Spreading Site #3b:

(1) **Honby Lateral**, which consists of a 30-inch-diameter segment (dashed line on map) built in 2005 and a 33-inch-diameter segment (built in 1978) crossing the Santa Clara River. The total length of these segments is approximately 6,000 feet. This alignment terminates near the Honby Pump Station/Sand Canyon Pump station at the corner of Santa Clara St and Furnivall Ave. This pipeline is currently being used to convey potable water, but would be available once the Honby Parallel is constructed. Design of the Honby Parallel is scheduled to begin in 2017. It is assumed that a short new section of pipeline on the east side would be required to connect to a new pump station facility for the recycled water project located at the Honby Pump Station site. Reuse of the Honby Lateral would eliminate the need for a new pipeline crossing the Santa Clara River.

(2) **Honby Pipeline**, which is approximately 5 miles of abandoned 14-inch diameter pipeline along Soledad Canyon Road. The condition of this pipeline is currently unknown. It is assumed that this pipeline could be repurposed to convey recycled water if the appropriate repairs were implemented (i.e. slip lining or replacing segments). The amount of recycled water that could be delivered through the Honby Pipeline is limited by the rehabilitated pipeline's inside diameter, which would likely be less than 12-inch diameter, depending on the method used.

Due to the smaller capacity in rehabilitated Honby Pipeline, the peak flow delivered to the Site #3b may be less than 3 mgd to the spreading basin during the winter months, which would reduce the annual recharge volume for this project to approximately 1,100 AFY.

Phase 2A + Spreading Sites #1 and #3b (Repurpose Infrastructure) – this project would deliver recycled water to both Spreading Sites #1 and #3b for recharge and repurpose existing infrastructure to reduce costs and impacts associated with constructing new pipelines. Similar to the previously described project, the Honby Lateral and a portion of the Honby Alignment would be repurposed to convey recycled water to Spreading Site #3b. However, a new segment of 24-inch diameter pipe would be constructed from the Honby Pump Station to Spreading Site #1 to be able to maximize the annual recharge volume for this project.

Table 7-5 Summary of Alternative 3 – Anticipated Irrigation and Recharge Volumes

Alt 3 Projects	Annual Irrigation Deliveries (AFY)	Initial Annual Recharge Volume [1] (AFY)	Ultimate Annual Recharge Volume [2] (AFY)	Average Annual Reuse [3] (AFY)	Anticipated Construction Completion Date
Phase 2A + Spreading Site #1	560	2,000	3,700	3,410	**2025**
Phase 2A + Spreading Site #3a	560	1,200	3,700	3,010	**2025**
Phase 2A + Spreading Site #3b	560	1,200	3,700	3,010	**2025**
Phase 2A + Spreading Site #3b (Repurpose Infrastructure)	560	1,100	1,100	1,660	**2025**
Phase 2A + Spreading Sites #1 & #3b (Repurpose Infrastructure)	560	2,000	3,700	3,410	**2025**

[1] The initial annual recharge volume is based on the 2025 available recycled water flows from the Valencia WRP, an initial maximum RWC of 20% (See Appendix C Section 2.3.8) and rain limitations which prioritize stormwater capture during rain events.
[2] The ultimate annual recharge volume is based on the 2050 available recycled water flows from the Valencia WRP and rain limitations which prioritize stormwater capture during rain events. The RWC does not limit recharge in 2050; rather the amount of recycle water available limits the ultimate recharge potential.
[3] Calculated as annual irrigation deliveries + average (initial 2025 recharge volume, ultimate 2050 recharge volume).

Table 7-6 Summary of Alternative 3 Facilities

Alternative 3 – Facility Components	Alternative 3 - Groundwater Recharge (Surface Spreading)				
	Phase 2A + Spreading Site #1	Phase 2A + Spreading Site #3a	Phase 2A + Spreading Site #3b	Phase 2A + Spreading Site #3b (Repurpose Infrastructure)	Phase 2A + Spreading Sites #1 & #3b (Repurpose Infrastructure)
Recycled Water Quality for irrigation in summer	Tertiary in Summer (Jun-Aug)	Tertiary in Summer (Jun-Aug)	Tertiary in Summer (Jun-Aug)	Tertiary in Summer (Jun-Aug)	Tertiary in Summer (Jun-Aug)
Recycled Water Quality for spreading and irrigation in non-summer months	50% Tertiary 50% Blend	50% Tertiary 50% Blend	100% Blend	100% Blend	100% Blend
Total Pipeline Length (ft)	55,400	85,900	91,500	60,100	70,100
Spreading Basin Area (acre)	20	28	28	28	48
Storage (MG)	1.0	1.0	1.0	1.0	1.0
Pump Stations (gpm)	7,000	7,000	7,000	2,100	7,000
	-	7,000	7,000	2,100	2,100
	-	-	3,400	3,400	3,400
Site Retrofit (# of Sites)	51	51	51	51	51
Groundwater/Monitoring (# wells)	3	3	3	3	3

Figure 7-10: Alternative 3 – Phase 2A + Spreading Site #1

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Figure 7-11: Alternative 3 – Phase 2A + Spreading Site #3a/b

** See PDF **

Figure 7-12: Alternative 3 – Phase 2A + Spreading Sites #1 and #3b (Repurpose Infrastructure)

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7.6 Alternative 4 – Advanced Treatment for Potable Reuse

Alternative 4 includes three projects that require advanced treated for potable reuse (1) direct injection into the groundwater basin, (2) surface water augmentation at Castaic Lake, and (3) direct potable reuse by blending with the raw water supply entering the Earl Schmidt Filtration Plant. Similar to Alternative 3, the amount of recycled water that can be advanced treated for potable reuse is limited by the available supply because irrigation demands for Phase 1, Phase 2 and future customers use all available summer supplies that are not required for discharge. However, since these projects would not limited by stormwater capture prioritization, the total volume of water available in winter and shoulder months could be utilized. A more detailed discussion of the regulatory and water quality considerations is discussed in Sections 2.4, 3 and 4 of Appendix C.

Direct Injection –this project would deliver advanced-treated recycled water to the Saugus Formation in the vicinity of the Valencia WRP (as discussed in Section 6.2.1 and previously shown in Figure 6-3). It is assumed that an advanced water treatment facility (AWTF) for this project would be located at or near the Valencia WRP and would be similar to the SCVSD's Chloride Compliance Project treatment train, and would consist of MF, enhanced brine concentration (EBC), RO and UV for disinfection with the addition of high doses of advanced oxidation (AOP) to meet regulatory requirements for direct injection. (see Appendix C Section 2.4.2). New conveyance pipelines would constructed to deliver the advanced-treated recycled water to seven new injection wells (locations and alignments were not identified for this project) and truck hauling would be the method used for brine disposal. Additional hydrogeologic analysis is necessary to identify the preferred placement of injection wells to achieve a travel time of 6-months before extraction of recharged water using existing wells.

Surface Water Augmentation –this project would deliver advanced-treated recycled water to augment surface water stored in Castaic Lake. The treatment train would be similar to the process suggested for direct injection (described above and in Appendix C Section 2.4.2) and it is assumed that the AWTF would be located either at the Valencia WRP or at the Earl Schmidt Filtration Plant. New conveyance pipelines and would constructed to deliver the advanced-treated recycled water to Castaic Lake near the boat ramp, as shown by the solid line on Figure 7-13. The dashed pipeline extension would only be constructed if required by DDW to increase retention time; however, even with this extension the theoretical retention time would be less than 6 months and thus this project would not qualify under the current draft regulations. Additional hydrodynamic modeling and operational studies would be necessary to confirm the permitability of this project.

Direct Potable Reuse –this project involves sending the advanced treated water from Valencia WRP to the Rio Vista Water Treatment Plant for further treatment prior to distribution. The treatment train would be similar to the process suggested for direct injection and SW Augmentation (described above and in Appendix C Section 2.4.2) with the addition of ozone and BAC pre-treatment to offer two new and different mechanisms to control the wide diversity of potential chemical and microbiological threats. It is assumed that the AWTF would be located either at the Valencia WRP or at the Rio Vista Water Treatment Plant. Figure 7-14 shows the conveyance concept, which would require 24-inch-diameter pipeline and additional pumping capacity at the Valencia WRP to convey a peak flow of 9.7 mgd to the Rio Vista Water Treatment Plant. It is important to note that this alternative is speculative as there is neither a developed framework for regulations nor any established timeframe for promulgating DPR regulations.

Additional details about anticipated reuse volumes and facilities are listed in Table 7-7 and Table 7-8 respectively and costs are summarized in Section 7.9 with detailed cost sheets provided in Appendix E.

Table 7-7 Summary of Alternative 4 – Anticipated Use of Advanced Treated Water

Alt 4 Projects	Annual Irrigation Deliveries	Average Annual IPR/DPR	Total Average Annual Reuse	Peak Delivery	Anticipated Construction Completion Date
	(AFY)	(AFY)	(AFY)	(mgd)	
Direct Injection	0	4,250	4,250	9.7	**2026**
Surface Water Augmentation	0	4,250	4,250	9.7	**2032**
Direct Potable Reuse + Phase 2A	560	4,250	4,810	9.7	**2037**

Table 7-8 Summary of Alternative 4 Facilities

Alternative 4 – Facility Components	Alternative 4 - Advanced Treatment for Potable Reuse		
	Direct Injection	Surface Water Augmentation	Direct Potable Reuse +Phase 2A
Advanced Water Treatment Facility Capacity (mgd)	9.7	9.7	9.7
Pipelines	6,100	45,000	37,900
Storage (MG)	-	-	6.0
Pump Stations (gpm)	7,000	7,000	7,000
	7,000[1]	7,000	3,000
Groundwater/Monitoring (# wells)	10	-	-
Discharge Facility (mgd)	-	4.9	-
Site Retrofit (# of Sites)	-	-	51

[1] Represents seven 1,000 gpm pump stations at each injection well

Figure 7-13: Alternative 4 – Surface Water Augmentation

** See PDF **

Figure 7-14: Alternative 4 – Direct Potable Reuse

** See PDF **

7.7 No Project Alternative

The No Project Alternative would include the continued operation and maintenance of CLWA's existing Phase 1 recycled water system with the potential to increase non-potable reuse through the addition of infill customers located near existing recycled water pipeline alignments. No new major conveyance infrastructure would be constructed, though small service laterals could be installed to connect identified infill customers to the recycled water distribution system. CLWA is currently in communication with potential customers to increase the Phase 1 deliveries by 40 AFY. It is possible that the additional Phase 1 demand could be as high as 100 AFY if the majority of nearby customers are converted to recycled water in the future.

7.8 Other Considerations

7.8.1 Repurposing Existing Infrastructure

CLWA and the purveyors have identified some existing assets that could be repurposed for recycled water. For the purpose of the RWMP and associated programmatic EIR, the alternatives presented in the prior sections assume construction of new facilities (with the exception of the last two projects in Alternative 3). This section summarizes potential opportunities and challenges to repurpose the following stranded or underutilized assets, described below and shown in Figure 7-15. With all of these facilities, additional investigations and studies are required to ascertain the viability of repurposing them for use with the future recycled water system.

Groundwater transmission main: There is an existing unutilized16-inch to 20-inch treated groundwater transmission main that extends from a groundwater treatment facility on Bouquet Canyon Road near Newhall Ranch Road to the intersection of Newhall Ranch Road and Santa Clarita Parkway. This pipeline can potentially be repurposed as part of the Phase 2A system.

Honby Lateral: The Honby Lateral is a 30-inch to 33-inch pipeline that crosses the Santa Clara River at Golden Valley Road. The pipeline can potentially be repurposed as part of Alternative 2 or Alternative 3. However, the planned 60-inch Honby Parallel Pipeline must be installed prior to repurposing the Honby Lateral, so that CLWA's transmission system remains connected.

Honby Pipeline: The 14-inch Honby Pipeline extends from the Honby Pump Station, located near the intersection of Santa Clara Street and Honby Avenue, traverses Soledad Canyon Road and terminates at Sand Canyon Road. The pipeline, originally built by NCWD, has been inactive since the CLWA Sand Canyon Pipeline was built. It can potentially be repurposed as part of Alternative 3. The 'Phase 2A + Spreading Site #3b' and 'Phase 2A + Spreading Sites #1 and #3b' options specifically integrate the Honby Lateral and Honby Pipeline.

Honby Pump Station: Similar to the Honby Pipeline, the Honby Pump Station was originally for the NCWD distribution system and has been inactive since the CLWA Sand Canyon Pump Station was built, adjacent to the Honby Pump Station. CLWA evaluated viability of rehabilitating the pump station in 2009, with the *Honby Pump Station Rehabilitation Assessment Project*, prepared by Lee & Ro, Inc. The conclusion of the project technical memorandum was that it was feasible to rehabilitate and repurpose the pump station for use in a recycled water system. The pump station can potentially be used as part of Alternative 2, specifically with Alignment H, or Alternative 3.

Figure 7-15: Potential to Repurpose Existing Assets for Recycled Water Expansion

** See PDF **

7.8.2 Seasonal Storage

To maximum unused water supply in the winter months when demand is lower, water can be stored for use in the summer months when demand is higher. This is known as seasonal storage. Based on the evaluation of monthly supply of recycled water, less recharge to the Santa Clara River and once irrigation demands utilize all available summer supply, there would be approximately 5,500 AFY of recycled water is available to store seasonally in the year 2050 to allow for further expansion of recycled water for irrigation. Note that this is the same volume considered to be available for potable reuse in Alternatives 3 and 4. Nine reservoirs (Figure 7-16) within the CLWA service area were identified as potential sites for seasonal storage. Concept level estimates of storage capacity, operational capacity, dam height and crest length are summarized in Table 7-9. This table also shows a very high-level estimate of construction costs for the dam based on concept level dam dimensions and cost curves for cubic-yards of roller-compacted concrete.

Figure 7-16: Potential Seasonal Storage Sites

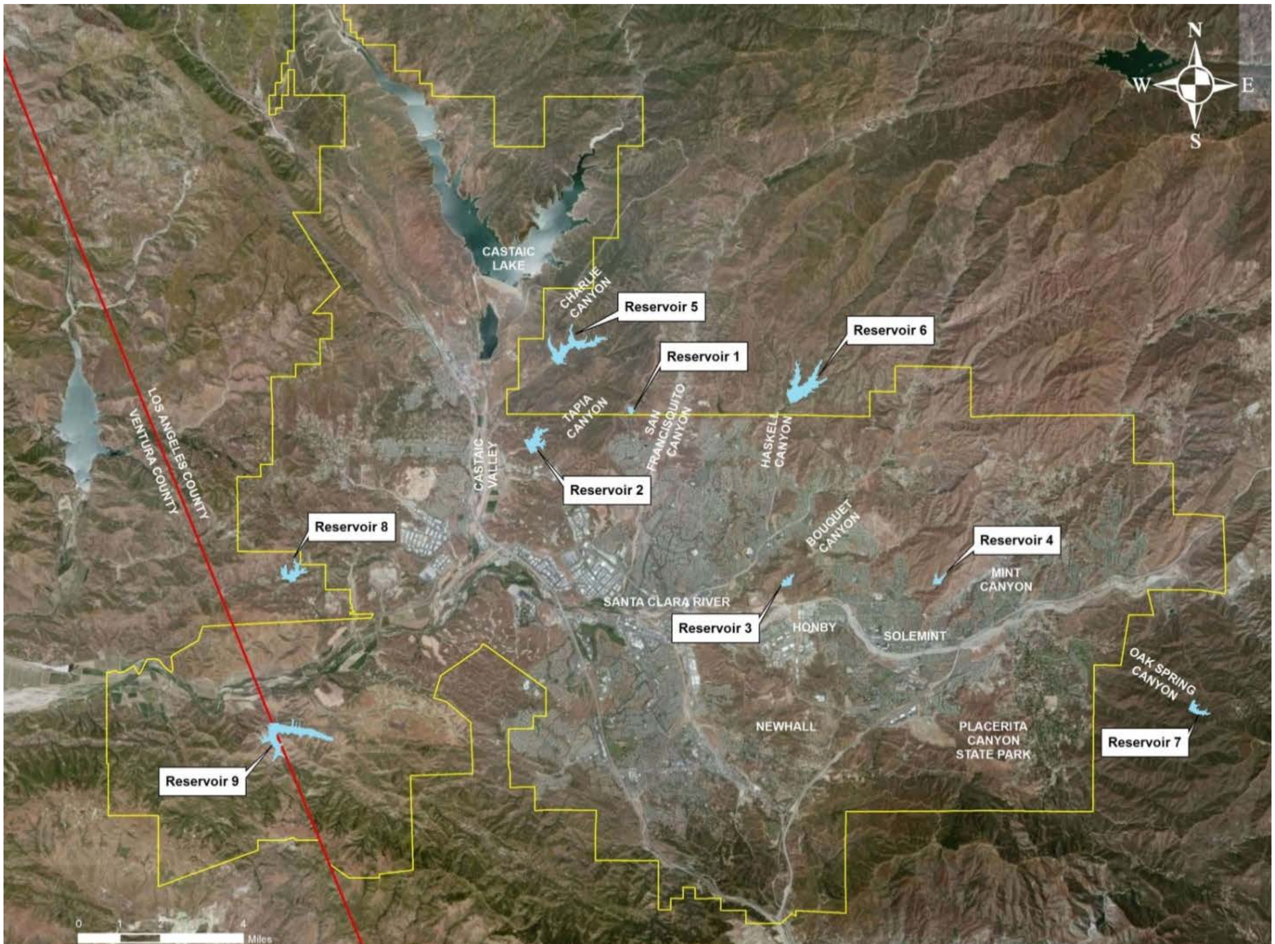


Table 7-9 Summary of Potential Seasonal Storage Sites

Reservoir #	Storage Capacity (AFY)	Operational Capacity (AFY)[a]	Estimated Height of Dam (ft)	Estimated Crest Length of Dam (ft)	Concept-Level Costs for Dam Construction ($mil)
1	1,000	850	150	800	$79
2	4,760	4,160	160	1,730	$252
3	1,160	920	110	1,090	$94
4	1,110	920	140	780	$80
5	7,890	6,430	150	1,050	$158
6	9,240	7,580	150	1,130	$155
7	1,870	1,600	150	900	$115
8	3,710	3,320	150	640	$68
9	9,930	8,430	150	930	$133

[a] Operational Storage assumes that maximum draw down for each reservoir is 50% of depth.

A high level evaluation of the reservoir sites is presented in Table 7-10. Only three reservoirs (1, 2, and 8) are close to the Valencia WRP and Reservoir 7 is the furthest from the plant. Four reservoirs (5, 6, 8, and 9) have low relative cost, two with medium relative costs, and four have high relative costs. Four reservoirs (2, 3, 4, and 9) are located inside the CLWA boundary and five reservoirs are located outside of the CLWA service area. Only Reservoirs 5 and 9 are not within close proximity to existing potential users; however, Reservoir 9 is within a planned development (Westside Communities) which could share the cost of a pipeline from the reservoir to the WRP.

Table 7-10 Storage Reservoirs Evaluation Matrix

Reservoir #	Distance to Valencia WRP[a]	Relative Unit Capital Cost[b]	Service Area	Proximity to Users	Within Planned Development
1	Low	High	Outside	Yes	No
2	Low	Medium	Inside	Yes	No
3	Medium	High	Inside	Yes	No
4	Medium	High	Inside	Yes	No
5	Medium	Low	Outside	No	No
6	Medium	Low	Outside	Yes	No
7	High	Medium	Outside	Yes	No
8	Low	Low	Outside	Yes	No
9	Medium	Low	Inside	No	Yes

[a] Distances less than 5 miles are designated as "short," distances longer than 5 miles and shorter than 10 miles are designated as "medium," and distances longer than 10 miles are designated as "long"
[b] Unit Capital Costs (Capital $/Operational Storage AFY); less than $25,000 are designated as "low," costs higher than $25,000 and lower than $75,000 are designated as "medium," and costs higher than $75,000 are designated as "high"

Reservoirs 2, 6, 8, and 9 have the best combination of a short distance to the Valencia WRP, low relative cost, within the CLWA service area, close proximity to existing potential users, and within a planned development. None of these four reservoirs has the highest rating in all the categories. Should seasonal storage be identified as a desirable option to pursue in the future, CLWA and the purveyors would need to explore the feasibility of these sites in greater detail. The feasibility of surface seasonal storage would depend on availability of land, construction costs for reservoir, pipelines and pump stations to fill the reservoir, conveyance costs to serve new customers, permitting and environmental mitigation costs, water quality requirements, public acceptance, and ability to finance.

7.8.3 Customer Retrofits

Most of the landscape irrigation systems in the Santa Clarita Valley are metered separately from the potable system and could be retrofitted to receive recycled water by following the guidelines in Title 17 of the CCR. Mixed meters that serve both the irrigation and potable system are more complex to retrofit; however for larger users such as schools or commercial/industrial areas with significant landscaping demands, it can still be cost effective. Existing buildings that have not been constructed with dual-plumbing systems can be complex and expensive to retrofit , and therefore, such sites would only be considered potential customers if a high demand use, such as a cooling tower which can be easily separated from the potable water system.

For the purpose of the alternatives analysis, the following assumptions were made:

- Existing irrigation lines would be retrofitted to connect to a recycled distribution main.
- For retrofits, meter capacity would be sized to match existing or sized to accommodate historical water use.
- Design of irrigation facilities would include isolation of existing service, cross-connection prevention, and proper tag identification to properly execute a conversion from an irrigation system served by potable water to one served with recycled water.
- Unit costs for retrofits were developed using a cost equation based on the irrigated area in square feet per a retrofit study conducted for the VWC (Dexter Williams, 2012) which was deemed conservative for planning large scaled recycled water system.

7.9 Engineers Opinion of Probable Costs

The engineers opinion of probable cost is based on a conceptual level estimate of the capital and operating costs for each alternative considered for the RWMP. Planning-level opinions of capital, operations and maintenance (O&M), and lifecycle costs are developed to facilitate an economic comparison of the projects within each alternative. Capital and operating costs are estimated for each alternative at a Class 5 level representing Planning to Feasibility level information with an estimated accuracy range between -30 percent and +50 percent, using assumptions stated herein. Costs then are converted to annualized lifecycle costs using basic assumptions about discount rates and life expectancy of project components. Total costs are divided by the recycled water delivery over the life of the project to obtain a uniformly derived unit cost of water in dollars per acre-foot ($/AF). Appendix E includes detailed opinions of probable cost for each alternative.

7.9.1 Capital Costs

The following assumptions are applied to estimate facility costs:

- **Distribution Pipelines:** Pipeline costs are based on a unit cost for each pipe size (i.e. dollar per inch-diameter linear foot) using conventional dry trenching techniques based on recently bid projects and professional experience. Costs include material and labor for total pipe segment. Special crossings, such as major intersections and jack-and-bore for river crossings are included at a higher unit cost.
- **Pump Stations:** Pumping costs were estimated based on brake horsepower requirements, assuming a redundancy factor, and outside pumps with an enclosed control building. Land acquisition costs for pump stations were not included in the cost estimate.
- **Operational Storage:** The unit cost for storage tanks (concrete and steel) is based on cost curves from RS Means, recently constructed projects in California and from professional experience.
- **Spreading Basins:** Constructing earthen off-stream storage ponds are estimated at approximately $30,000 per AF of storage created. Construction of levees for in-stream storage

ponds is based on a unit cost per linear feet for a typical level with 3:1 horizontal to vertical slopes that is 5 to 8 feet tall.

- **Advanced Water Treatment Facility:** Cost estimates for AWTF treatment trains were based on information provided in the SCVSD chloride compliance project EIR. These costs represent processes selected to minimize brine generation, including an RO train with an anticipated recovery of 99%.
- **Site Retrofit Costs: A**s described in Section 7.8.3, unit costs for retrofits were developed using a cost equation based on the irrigated area in square feet.
- **Wells:** Estimated cost for monitoring wells include cost for drilling and construction of a 400-600 ft monitoring well based on recent project experience. Costs for new extraction wells are not included since existing wells are assumed to be sufficient to extract recharged water.
- **Inflatable Rubber Dam: T**o facilitate stormwater capture of river flows with operational flexibility to periodically flush sediment, an inflatable rubber dam is proposed and a unit cost per linear feet is developed based on project data in California. The cost assumes materials and installation of a rubber bladder, foundation and necessary control features.
- **Discharge Facility:** Based on a unit cost for a standard bank outfall with erosion protection and energy dissipation.
- **Repurposing Existing Infrastructure:** There is considerable uncertainty related to the capital costs required to repurpose existing infrastructure. For the purposes of this high level cost estimate, it is assumed that abandoned pipelines would require slip lining with HDPE pipeline, receiving/insertion pits every 1,000 linear feet and a reduction in the inside diameter to withstand pumping pressure. Costs for repurposing infrastructure that is currently in use is assumed include appurtenances and new pipeline extensions as needed.

The following allowances, contingencies and non-contract cost percentages are applied to the **Subtotal Facility Costs:**

- **Additional Facility Capital Costs:** The following percentages are applied to subtotal of treatment, pump station, storage and discharge costs: site development costs at 5%, yard piping at 5% and Electrical, I&C, and SCADA Control at 25%.
- **Taxes:** 9% is applied to materials (estimated at 40% of the total facility cost).

The following allowances, contingencies and non-contract cost percentages are applied to the **Subtotal Additional Facility Costs**:

- **Allowance for Unlisted Items: A** markup of 5% for mobilization, bonds and permits and 15% for Contractor Overhead and Profit are applied to the subtotal additional facility capital costs.
- **Estimate Contingency: A** markup of 30 percent of the total Subtotal Cost was added to pay contractors for overruns on quantities, changed site conditions, change orders, etc. Contingencies are considered as funds to be used after construction starts and not for design changes or changes in project planning.

The resulting **Subtotal with Contractor Markups and Contingency** is increased by 2% per year to reflect escalation to midpoint of construction based on project implementation timeline assumptions. **The Project Capital Cost** includes all facility costs, allowances, markups, contingencies and the escalation to the midpoint of construction.

7.9.2 O&M Costs

Operations and maintenance (O&M) costs are estimated to include the following items:

- Energy costs for pumping based on a unit cost for electricity based on commercial electricity rates in Santa Clarita at $0.12/kWh
- Advanced Water Treatment Facility costs, including energy, labor, chemicals, materials and replacement costs by process type based on average operating flow over the year (as dictated by each Alternative) based on the SCVSD Chloride EIR for near zero discharge system, including brine disposal facilities
- Maintenance Costs based on 5% of direct facility costs for pipelines, injection and monitoring wells, including a 10% contingency
- Labor Costs based on full time salary of $100,000 per year

O&M costs also include costs for purchasing recycled water from SCVSD based on:

- Tertiary RW Rate = $200/AF
- Demineralized (MF/RO) Rate = $1,430 (based on preliminary estimate from SCVSD)
- Valencia Blend Rate = $569 (based on a 70:30 blend of Tertiary: Demineralized flow)

For Alternative 1 and 2 projects only tertiary recycled water would be purchased to serve non-potable demand. For Alternative 3, a blend of tertiary and demineralized water would be purchased depending on the recharge location. Spreading Site #1 would receive a 50/50 mix of Valencia tertiary and demineralized blended water. Spreading Site #3a/b would receive 100% demineralized blended water. Flows during the peak summer months, for Alternative 3, would be tertiary recycled water since all available supplies would be used to serve non-potable demands. Alternative 4 would only purchase tertiary recycled water because all additional treatment would occur at the AWTF.

7.9.3 Annualized Unit Costs

An annualized unit cost is developed for each alternative to compare the cost per acre foot to build and operate a given project. An annualized capital cost is calculated based on a project life of 30 years and an interest rate of four percent. The annualized capital cost is added to the annual O&M costs to estimate the total cost per year to construct and operate the project over the life of the project. The annual cost per year is then divided by the average annual volume of recycled used over the life of the project to calculate an annualized unit cost per acre foot.

7.9.4 *Summary of Capital, O&M and Annualized Unit Costs*

The engineer's opinion of capital, O&M and annualized unit costs for each alternative are summarized in Figure 7-17 through 7-20. An overall summary of demands and costs for Alternatives 1-4 is provided in Table 7-11.

Figure 7-17: Summary of Costs for Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

Facility Component	Alternative 1 - Non-Potable Reuse Expansion (Phase 2)					
	Phase 2A			Phase 2B	Phase 2C	Phase 2D
	Bouquet Canyon Road	Central Park South w/o Tank	Central Park South w/ Tank	Combined SCWD + Vista Canyon	VWC + NCWD Extensions	VWC Extension
Pipelines	$13,610,000	$15,170,000	$16,440,000	$2,540,000	$14,420,000	$1,470,000
Storage or Hydro-pneumatic Tank	$480,000	$480,000	$1,730,000	$2,510,000	$0	$0
Pump Station	$2,300,000	$3,680,000	$3,680,000	$680,000	$12,990,000	$2,120,000
Site Retrofit Costs	$1,950,000	$2,360,000	$2,360,000	$750,000	$3,010,000	$560,000
Total Construction Cost ($)	**$18,340,000**	**$21,690,000**	**$24,210,000**	**$6,480,000**	**$30,420,000**	**$4,150,000**
Estimated Construction Cost ($mil)	**$18.3**	**$21.7**	**$24.2**	**$6.5**	**$30.4**	**$4.2**
Annualized Cosntruction Cost ($mil/yr)	$1.1	$1.3	$1.4	$0.4	$1.8	$0.2
Ave Annual Demand (AFY)	482	560	560	300	1,374	186
Annualized Unit Cosntruction Cost ($/AF)	**$2,200**	**$2,200**	**$2,500**	**$1,200**	**$1,300**	**$1,300**
Annual O&M Cost ($mil/yr)	$0.2	$0.3	$0.3	$0.1	$0.7	$0.5
Annual O&M Cost ($/AF)	$440	$480	$560	$250	$370	$380
Total Annual Cost ($/AF)	**$2,640**	**$2,680**	**$3,060**	**$1,450**	**$1,670**	**$1,680**

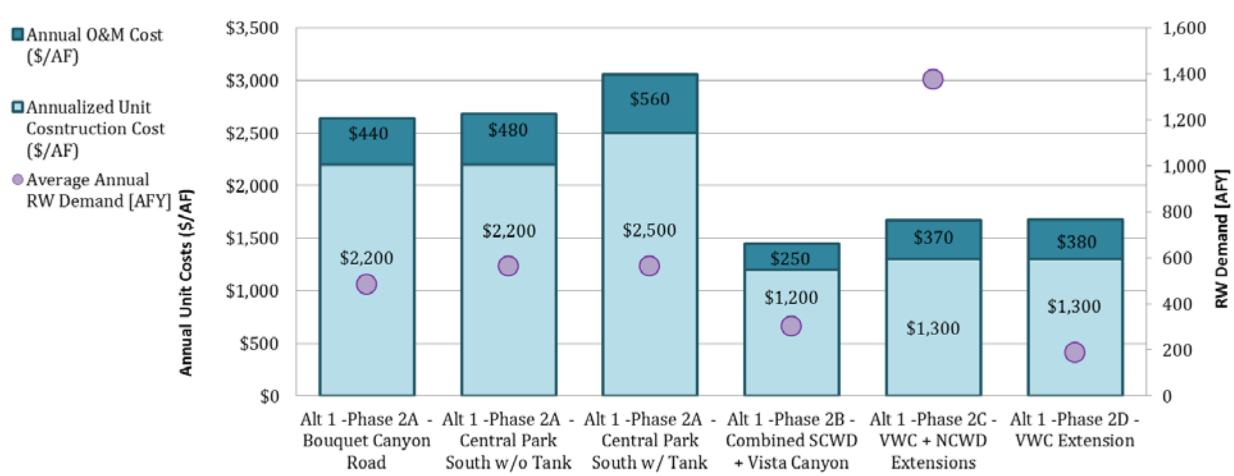
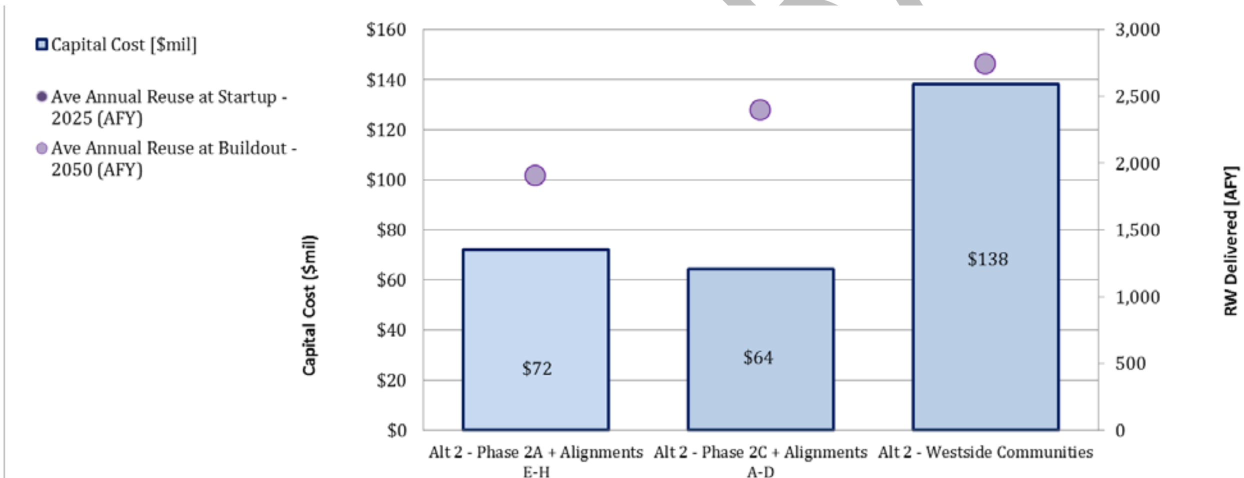


Figure 7-18: Summary of Costs for Alternative 2 - Non-Potable Reuse Expansion (Future Phases)

Facility Component	Alternative 2 - Non-Potable Reuse Expansion (Future Phases)		
	Phase 2A + Alignments E-H	Phase 2C + Alignments A-D	Westside Communities
Treatment	$0	$0	$0
Pipelines	$41,630,000	$35,130,000	$80,690,000
Spreading Basin or Storage Tank	$1,730,000	$2,390,000	$20,220,000
Pump Station	$19,080,000	$19,080,000	$34,680,000
Site Retrofit Costs	$9,650,000	$7,730,000	$2,490,000
Total Construction Cost ($)	**$72,090,000**	**$64,330,000**	**$138,080,000**
Estimated Construction Cost ($mil)	**$72**	**$64**	**$138**
Annualized Cosntruction Cost ($mil/yr)	$4.2	$3.7	$8.0
Ave Annual Reuse at Startup - 2025 (AFY)	1,904	2,391	2,740
Ave Annual Reuse at Buildout - 2050 (AFY)	1,904	2,391	2,740
Annualized* Buildout Unit Construction Cost ($/AF)	**$2,200**	**$1,600**	**$2,900**
*based on average flow over 25 years			
Annual O&M Cost ($mil/yr)	$1.4	$1.3	$2.5
Annual O&M Cost ($/AF)	$700	$550	$350
Total Annual Cost at Buildout - 2050 ($/AF)	**$2,900**	**$2,150**	**$3,250**



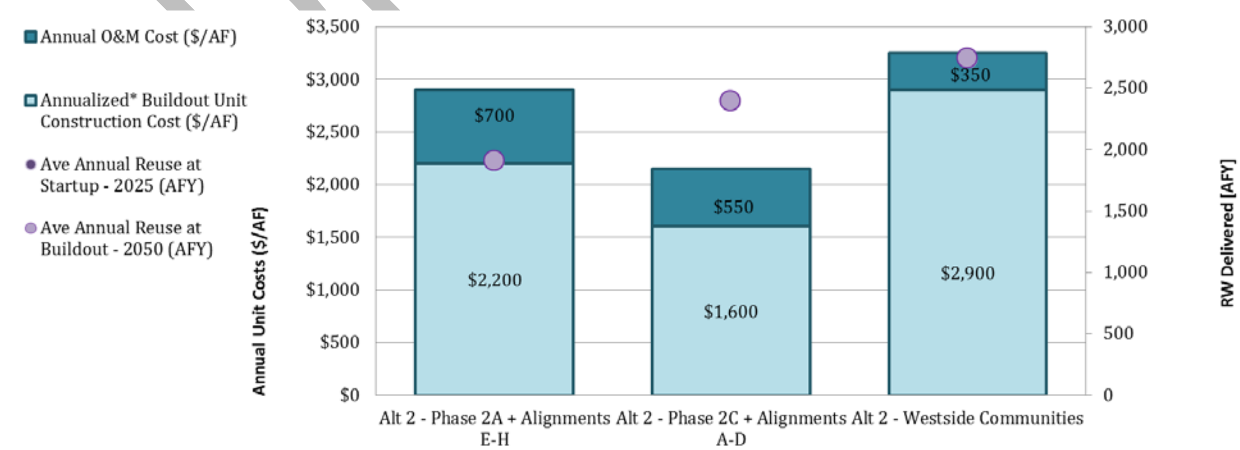


Figure 7-19: Summary of Costs for Alternative 3 - Groundwater Recharge (Surface Spreading)

Facility Component	Alternative 3 - Groundwater Recharge (Surface Spreading)				
	Phase 2A + Spreading Site #1	Phase 2A + Spreading Site #3a	Phase 2A + Spreading Site #3b	Phase 2A + Spreading Site #3b (Repurpose Infrastructure)	Phase 2A + Spreading Sites #1 & #3b (Repurpose Infrastructure)
Treatment	$0	$0	$0	$0	$0
Pipelines	$44,010,000	$66,120,000	$69,710,000	$29,950,000	$45,850,000
Spreading Basin or Storage Tank	$17,610,000	$7,720,000	$13,280,000	$13,280,000	$31,110,000
Pump Station	$16,460,000	$30,230,000	$31,590,000	$11,940,000	$22,670,000
Site Retrofit Costs	$2,400,000	$2,400,000	$2,400,000	$2,400,000	$2,400,000
Groundwater/Monitoring Well	$1,170,000	$1,170,000	$1,170,000	$1,170,000	$1,170,000
Total Construction Cost ($)	**$81,650,000**	**$107,640,000**	**$118,150,000**	**$58,740,000**	**$103,200,000**
Estimated Construction Cost ($mil)	**$82**	**$108**	**$118**	**$59**	**$103**
Annualized Cosntruction Cost ($mil/yr)	$4.7	$6.2	$6.8	$3.4	$6.0
Ave Annual Reuse at Startup - 2025 (AFY)	2,560	1,760	1,760	1,660	2,560
Ave Annual Reuse at Buildout - 2050 (AFY)	4,260	4,260	4,260	1,660	4,260
Annualized* Buildout Unit Construction Cost ($/AF)	**$1,400**	**$2,100**	**$2,300**	**$2,000**	**$1,800**
*based on average flow over 25 years					
Annual O&M Cost ($mil/yr)	$2.8	$3.8	$3.9	$1.4	$3.6
Annual O&M Cost ($/AF)	$700	$900	$900	$900	$900
Total Annual Cost at Buildout - 2050 ($/AF)	**$2,100**	**$3,000**	**$3,200**	**$2,900**	**$2,700**

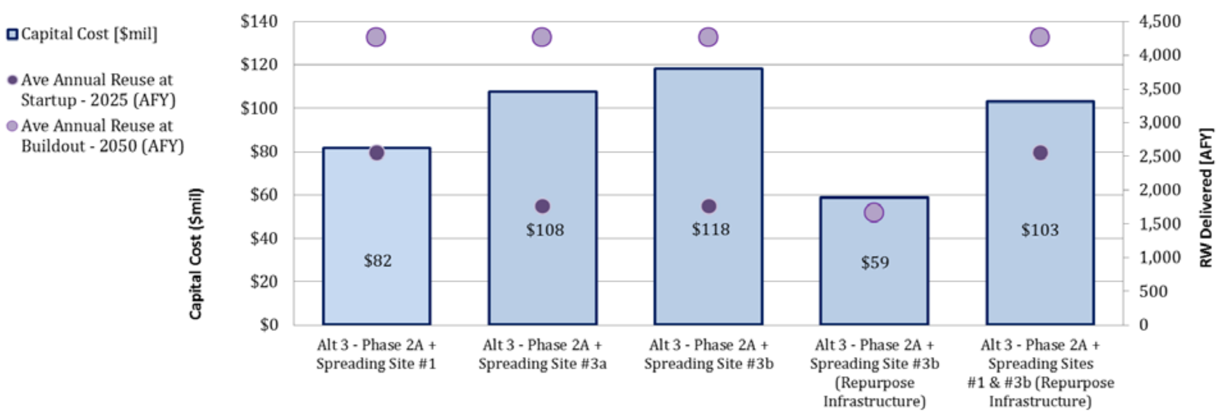


Figure 7-20: Summary of Costs for Alternative 4 - Advanced Treatment for Potable Reuse

Facility Component	Alternative 4 - Advanced Treatment for Potable Reuse		
	Direct Injection	Surface Water Augmentation	Direct Potable Reuse + Phase 2A
Treatment	$260,220,000	$220,500,000	$243,300,000
Pipelines	$4,350,000	$27,100,000	$26,900,000
Spreading Basin or Storage Tank	$0	$0	$5,100,000
Pump Station	$7,170,000	$19,000,000	$14,800,000
Groundwater/Monitoring Well	$19,380,000	$0	$0
Discharge Facility	$0	$3,500,000	$0
Total Construction Cost ($)	**$291,120,000**	**$270,100,000**	**$290,100,000**
Estimated Construction Cost ($mil)	**$291**	**$270**	**$290**
Annualized Cosntruction Cost ($mil/yr)	$16.8	$15.6	$16.8
Ave Annual Reuse at Startup - 2025 (AFY)	3,000	3,000	3,560
Ave Annual Reuse at Buildout - 2050 (AFY)	5,500	5,500	6,060
Annualized* Buildout Unit Construction Cost ($/AF)	**$4,000**	**$3,700**	**$3,500**
*based on average flow over 25 years			
Annual O&M Cost ($mil/yr)	$7.7	$9.2	$7.9
Annual O&M Cost ($/AF)	$1,400	$1,700	$1,400
Total Annual Cost at Buildout - 2050 ($/AF)	**$5,400**	**$5,400**	**$4,900**

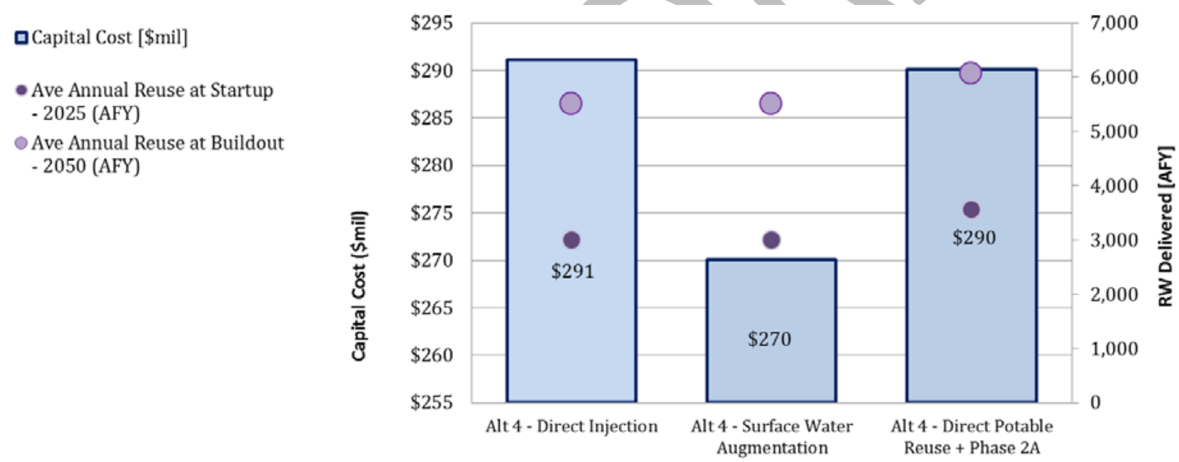


Table 7-11 Summary of Demands and Costs for Alternatives 1 through 4

Alternative	Project	Description	Ave Annual Demand (AFY)	Estimated Construction Cost ($mil)	Annualized Construction Cost ($mil/yr)	Annualized Unit Construction Cost ($/AF)	Annual O&M Cost ($/AF)	Total Annual Cost ($/AF)
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)	Phase 2A	Bouquet Canyon Road	482	$18	$1.1	$2,200	$440	$2,640
		Central Park South w/o Tank	560	$22	$1.3	$2,200	$480	$2,680
		Central Park South w/ Tank	560	$24	$1.4	$2,500	$560	$3,060
	Phase 2B	Combined SCWD + Vista Canyon	300	$6	$0.4	$1,200	$250	$1,450
	Phase 2C	VWC + NCWD Extensions	1,374	$30	$1.8	$1,300	$370	$1,670
	Phase 2D	VWC Extension	186	$4	$0.2	$1,300	$380	$1,680
Alternative 2 - Non-Potable Reuse Expansion (Future Phases)	Phase 2A + Alignments E-H	Includes Phase 2A and Future Expansion North of the Santa Clara River	1,904	$72	$4.2	$2,200	$700	$2,900
	Phase 2C + Alignments A-D	Includes Phase 2C and Future Expansion South of the Santa Clara River	2,391	$72	$4.2	$2,200	$700	$2,900
	Westside Communities	Non-potable demands for proposed developments, independent of Phase 1 & 2	2,740	$138	$8.0	$2,900	$350	$3,250
Alternative 3 - Groundwater Recharge (Surface Spreading)	Phase 2A + Spreading Site #1	Includes Phase 2A costs and maximizes deliveries to Off-Stream Spreading Site #1	3,410	$82	$4.7	$1,400	$700	$2,100
	Phase 2A + Spreading Site #3a	Includes Phase 2A costs and maximizes deliveries to In-Stream Spreading Site #3a	3,010	$108	$6.2	$2,100	$900	$3,000
	Phase 2A + Spreading Site #3b	Includes Phase 2A costs and maximizes deliveries to Off-Stream Spreading Site #3b	3,010	$118	$6.8	$2,300	$900	$3,200
	Phase 2A + Spreading Site #3b (Repurpose Infrastructure)	Includes Phase 2A costs and reuses Honby lateral and Honby pipeline to deliver to In-Stream Spreading Site #3b	1,660	$59	$3.4	$2,000	$900	$2,900
	Phase 2A + Spreading Sites #1 & #3b (Repurpose Infrastructure)	Includes Phase 2A costs, splits deliveries between Spreading Sites #1 & #3b, and reuses Honby lateral and Honby pipeline	3,410	$103	$6.0	$1,800	$900	$2,700
Alternative 4 - Advanced Treatment for Potable Reuse	Direct Injection	Direct injection of advance-treated water near Valencia WRP	4,250	$291	$17	$4,000	$1,400	$5,400
	Surface Water Augmentation	Augment Castaic Lake with advance-treated water	4,250	$270	$16	$3,700	$1,700	$5,400
	Direct Potable Reuse + Phase 2A	Augment raw water to Rio Vista WTP with of advance-treated water (Includes Phase 2A costs). Includes Phase 2A costs.	4,250	$290	$17	$3,900	$1,400	$5,300

Section 7 References

Dexter Williams, 2012. Valencia Water Company Recycled Water Retrofit Costs. February 27, 2012.

Dexter Williams, 2015. Valencia Water Company Recycled Water Master Plan for Westside Communities. Revised November 2015.

Los Angeles County Flood Control District (LACFCD), 2007. Santa Clara River Watershed Water Conservation Feasibility Study, Los Angeles County Flood Control District, Water Resources Division, 2007. Authors: Zimmer, K., La, W., Gaplandzhyan, M.

Appendix A: Recycled Water Supply and Demands

This appendix includes supporting information for the recycled water market assessment.

Table A-1 Projected Available Recycled Water Supply

Year	Projected Wastewater Influent based on Population (mgd)[a]	Anticipated Discharge Requirement (mgd)[b]	Projected Available RW Supply (mgd)[c]	Projected Available RW Supply (AFY)[c]
2015	18.6	13	5.6	6,268
2016	18.8	13	5.8	6,510
2017	19.0	13	6.0	6,752
2018	19.2	13	6.2	6,993
2019	19.5	13	6.5	7,235
2020	19.7	13	6.7	7,477
2021	20.1	13	7.1	7,954
2022	20.5	13	7.5	8,432
2023	21.0	13	8.0	8,909
2024	21.4	13	8.4	9,387
2025	21.8	13	8.8	9,865
2026	22.2	13	9.2	10,341
2027	22.7	13	9.7	10,817
2028	23.1	13	10.1	11,293
2029	23.5	13	10.5	11,769
2030	23.9	13	10.9	12,245
2031	24.3	13	11.3	12,666
2032	24.7	13	11.7	13,087
2033	25.1	13	12.1	13,507
2034	25.4	13	12.4	13,928
2035	25.8	13	12.8	14,349
2036	26.0	13	13.0	14,533
2037	26.1	13	13.1	14,716
2038	26.3	13	13.3	14,899
2039	26.5	13	13.5	15,083
2040	26.6	13	13.6	15,266
2041	26.8	13	13.8	15,451
2042	27.0	13	14.0	15,636
2043	27.1	13	14.1	15,821
2044	27.3	13	14.3	16,006
2045	27.5	13	14.5	16,191
2046	27.6	13	14.6	16,374
2047	27.8	13	14.8	16,558
2048	27.9	13	14.9	16,741
2049	28.1	13	15.1	16,925
2050	28.3	13	15.3	17,108

a) Based on a 65 gpcd wastewater generation rate multiplied by the projected population

b) Assumes that SCVSD will be required to maintain 8.5 mgd from the Valencia WRP and 4.5 mgd from the Saugus WRP

c) Includes projected recycled water produced at the Valencia WRP, Saugus WRP, planned Newhall WRP and planned Vista Canyon Water Factory.

Table A-3 Historical Recycled Water Demands (AFY)

Month	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Ave
Jan		1	4	14	17	4	8	7	8	22	17	21	13	11
Feb		2	2	16	14	11	3	1	12	16	20	16	12	11
Mar		24	10	6	43	39	24	2	10	25	38	26	32	23
Apr		53	36	12	38	37	39	0	38	30	51	46	40	35
May		55	46	42	58	56	30	51	41	58	58	64	40	50
Jun		58	59	66	63	34	46	56	54	64	64	58	61	57
Jul		64	67	75	78	26	71	54	64	68	27	64	47	60
Aug		61	57	63	67	63	59	60	57	67	41	60	63	60
Sep	31	90	66	67	55	44	17	39	54	60	37	47	49	51
Oct	61	26	39	33	37	38	39	22	37	32	38	40	48	37
Nov	11	0	20	20	25	4	18	11	10	17	9	23	32	14
Dec	2	14	21	12	7	1	9	5	11	2	16	0	18	8
Total	**107**	**448**	**427**	**426**	**501**	**358**	**364**	**307**	**396**	**462**	**416**	**465**	**455**	**416**

Table A-4 Existing Phase 1 Recycled Water Meters and Demands

* To be included in Draft Report

Table A-5 Anticipated Phase 2A Recycled Water Demands

Purveyor	Address	Meter No.	Demand (AF)
SCWD		69496998	5.96
SCWD		1565908	2.75
SCWD		1565977	145.47
SCWD		67298978	0.25
SCWD		67298996	1.66
SCWD		67298983	15.68
SCWD		67298991	11.21
SCWD		67298986	6.80
SCWD		67298993	3.48
SCWD		67298985	4.69
SCWD		67298987	9.21
SCWD		67298984	5.62
SCWD		68837441	11.36
VWC	27931 KELLY JOHNSON PKWY	2866039028	24.10
VWC	24023 NEWHALL RANCH RD	115540039	20.00
VWC	24003 NEWHALL RANCH RD	115533486	4.39
VWC	23902 NEWHALL RANCH RD	115531358	8.85
VWC	23904 NEWHALL RANCH RD	115531357	4.24
VWC	23660 NEWHALL RANCH RD	2811071901	12.42
VWC	23650 NEWHALL RANCH RD	115531364	5.77
VWC	24156 NEWHALL RANCH RD	115538406	2.76
VWC	24158 NEWHALL RANCH RD	2811062904	2.33
VWC	27601 HILLSBOROUGH PKWY	115525602	5.83
VWC	27560 NEWHALL RANCH RD	2810067011	7.74
VWC	27260 NEWHALL RANCH RD	2810043070	2.72
VWC	28188 NEWHALL RANCH RD	2840120004	9.98
VWC	25190 RYE CYN RD	115534340	3.86
VWC	28031 NEWHALL RANCH RD	2866040016	10.57
VWC		2866006055	8.93
VWC	23518 NEWHALL RANCH RD	115531363	9.68
VWC	23528 NEWHALL RANCH RD	115531363	15.44
VWC	23410 NEWHALL RANCH RD	115531362	7.89
VWC	23657 NEWHALL RANCH RD	2811001283	11.48
VWC	23655 NEWHALL RANCH RD	115525641	26.69
VWC	27355 MCBEAN PKWY	115536329	7.97
VWC	27300 MCBEAN PKWY	115515052	13.86
VWC	27304 MCBEAN PKWY	115515050	3.81
VWC		2811032055	9.23

Purveyor	Address	Meter No.	Demand (AF)
VWC	24007 FAIRVIEW DR	2810070004	48.49
VWC	23893 FAIRVIEW DR	2810070900	2.73
VWC		115531357	4.24
VWC	25273 RYE CANYON RD	2866010006	3.27
VWC	27819 SMYTH DR	2810043081	1.30
VWC	27690 NEWHALL RANCH RD	2810043070	2.72
VWC	27751 DICKASON DR-#4742849	115525465	4.14
VWC	27879 NEWHALL RANCH RD	115540026	12.44
VWC		2866006055	4.10
VWC	24602 DICKASON DR	2810043060	0.63
VWC	27213 MCBEAN PKWY	115533487	6.97
VWC	26453 BOUQUET CYN RD	2811068021	0.63
VWC	26415 BOUQUET CYN RD	2811068036	3.85
	Phase 2A Total Demand		**560**

Table A-6 Anticipated Phase 2B Recycled Water Demands

Purveyor	Address	Meter No.	Demand (AF)
SCWD		74152096	7.16
SCWD		74152095	13.43
SCWD		74152092	18.32
SCWD		62124826	1.51
SCWD		60919566	1.34
SCWD		74152097	13.03
SCWD		74152094	19.21
SCWD		61676863	13.23
SCWD		65652278	20.20
SCWD		67298992	12.65
SCWD		67250431	1.51
SCWD		63416964	14.71
SCWD		65403696	5.65
SCWD		63843027	0.98
SCWD		65447356	2.49
SCWD		71134886	10.63
SCWD	Fair Oaks Community School [a]		7.1
SCWD	Vista Canyon Development [b]		137
	Phase 2B Total Demand		**300**

a. Fair Oaks Community School (Estimated in Phase 2B Preliminary Design Report dated 10/2015)

b. Vista Canyon Development to utilize 137 AF

Table A-7 Anticipated Phase 2C Recycled Water Demands

Purveyor	Address	Meter No.	Demand (AF)
NCWD	24607 WALNUT ST	2920404091	20.46
NCWD	24607 WALNUT ST	2920404090	20.46
NCWD	NEWHALL PARK	2920304102	16.96
NCWD	24923 NEWHALL AVE	2920304126	5.77
NCWD	NEWHALL PARK	2920304128	16.96
NCWD	NEWHALL PARK	2920304129	16.26
NCWD	24825 NEWHALL AVE	2920304228	95.13
NCWD	25017 NEWHALL AVE	0	23.31
NCWD	25017 1/2 NEWHALL AVE	0	22.81
NCWD	25015 1/2 NEWHALL AVE	0	6.06
NCWD	25015 NEWHALL AVE	0	4.37
VWC	26700 SPRINGFIELD CT - #3376444	2861060105	2.27
VWC	25752 SPRINGFIELD RD	2861060104	0.33
VWC	24928 IRONWOOD DR - #2835065	115532381	7.52
VWC	26819 WOODLANDS DR - #785865	115530882	11.96
VWC	25752 SPRINGFIELD RD - #2984633	2861060104	0.33
VWC	26700 SPRINGFIELD CT - #3376444	2861060105	2.27
VWC	26809 GOLDCREST DR #785095	2861065004	13.17
VWC	25330 SILVER ASPEN - #4380067	115536851	15.53
VWC	26650 THE OLD RD - #4380069	2826142015	3.74
VWC	25816 TOURNAMENT RD - #6201462	2858018043	1.77
VWC	25659 ORCHARD VILLAGE RD	115521866	10.03
VWC	23875 VIA JACARA	115521903	0.61
VWC	24506 MCBEAN PKY	115521765	10.48
VWC	23578 VIA BARRA - #3376528	115521894	4.02
VWC	25375 AVE RONADA - #4177390	2856001024	2.67
VWC	25372 AVE RONADA - #4804323	115521914	0.11
VWC		116621781	4.82
VWC	25840 TOURNAMENT RD - #1858488	2858018047	5.13
VWC	24710 MCBEAN PKWY - #789321	115521762	17.79
VWC	25901 TOURNAMENT RD - #3032202	2851001001	0.74
VWC	25374 AVE RONADA - #3032196	115524303	0.29
VWC	25100 VALENCIA BLVD - #12789094	2861004011	3.99
VWC	24995 VALENCIA BLVD- #3376446	2861060106	4.46
VWC	27000 TOURNEY RD #4911507	2861060012	2.81
VWC	24801 VALENCIA BLVD #3003469	115515009	9.32

Purveyor	Address	Meter No.	Demand (AF)
VWC	26100 ROCKWELL CYN RD - #1726038	2861037020	0.32
VWC	26102 ROCKWELL CYN RD - #L065270	2861040013	7.33
VWC	26002 ROCKWELL CYN RD - #1520424	2861023045	22.77
VWC	25998 ROCKWELL CYN RD - #2899169	2861005091	18.70
VWC	24699 MCBEAN PKWY - #4278919	2861004071	2.34
VWC	25800 LOCHMOOR/MEADOWS - #4149210	2858007900	14.71
VWC	23773 VIA GAVOLA	115521901	0.20
VWC	25601 AVE JOLITA	2859008010	1.20
VWC	26511 GOLDCREST DR - #5375827	115518348	23.70
VWC	24508 MCBEAN PKY	115521764	12.42
VWC	23752 VIA GAVOLA	2859008900	17.05
VWC	23723 MILL VALLEY RD	115521897	0.38
VWC	25526 LANGSTON ST	115521872	0.36
VWC	25671 FEDALA/MEADOWS	2858004900	2.20
VWC	24001 MCBEAN PKY	115518533	0.29
VWC	24405 MCBEAN PKY	115521860	6.71
VWC	25915 TOURNAMENT RD	115521849	8.32
VWC	25791 TOURNAMENT DR	116621781	4.82
VWC		2851007074	6.74
VWC	26704 Valencia Blvd #3272084		2.80
VWC	26930 The Old Rd #3272068		9.89
VWC	26104 Rockwell Cyn Rd #L065269		0.00
VWC	24712 McBean Pkwy #2984634		16.24
VWC	24700 McBean Pkwy #1280284 - Cal Arts		54.08
VWC	26455 Rockwell Cyn Rd #2083445 - COC		2.92
VWC	26455 Rockwell Cyn Rd #2082687 - COC		0.45
VWC	25000 Valencia Blvd #5083981 - COC		26.16
VWC	26851 The Old Rd #3272080		8.63
VWC	25234 Valencia Blvd #3272070		2.80
VWC	Little V Golf Course (Vista Valencia) [a]		183.17
VWC	Big V Golf Course (Valencia Golf Course) [a]		531.55
	Phase 2C Total Demand		**1,374**

a. 2015 usage from an existing groundwater well

Table A-8 Anticipated Phase 2D Recycled Water Demands

Purveyor	Address	Meter No.	Demand (AF)
VWC	26250 VALENCIA BLVD - #8043193 - Rancho Pico Jr High School	115537416	59.12
VWC	26255 VALENCIA BLVD - #5372477 - Westridge High School	2826009902	73.50
VWC	26750U WESTRIDGE PKWY - #6173013	115535213	0.96
VWC	26762 OLD ROCK RD- #4380070	115536763	0.64
VWC	26760 OLD ROCK RD - #6172254	2826156004	10.36
VWC	26775 OLD ROCK ROAD - #3272099	2826155037	3.06
VWC	26252 Valencia Blvd #4482741		0.17
VWC	26260 Valencia Blvd #3376418		0.00
VWC	26705 Old Rock Rd#3376419		1.17
VWC	26756 Old Rock Rd #3272146		4.07
VWC	26770 Westridge Pkwy #6903696		4.00
VWC	26773 Old Rock Rd #3272128		6.11
VWC	26800 Valencia Blvd #4742882		15.21
VWC	27050 Old Rock Rd #3272064		5.38
VWC	27052 Old Rock Rd #6169191		1.93
	Phase 2D Total Demand		**186**

Table A-9 Potential Future Alignment Recycled Water Demands: Alignment A

Purveyor	Address	Meter No.	Demand (AF)
NCWD		2920607086	10
NCWD		2920305123	3
NCWD		2920607026	12
NCWD		2920507065	8
NCWD		2920507052	12
NCWD		2920406011	0
NCWD		2920406010	2
NCWD		2920406013	2
NCWD		2920506073	11
NCWD		2920405016	0
NCWD		2920507044	9
NCWD		2920507043	5
NCWD		2920507040	11
NCWD		2920507039	10
NCWD		2920406033	0
NCWD		2920406032	0
NCWD		2920406030	0
NCWD		2920406023	2
NCWD		2920406024	4

Purveyor	Address	Meter No.	Demand (AF)
NCWD		2920406029	2
NCWD		2920406025	7
NCWD		2920406028	1
NCWD		2920406027	1
NCWD		2920406036	0
NCWD		2920406096	10
NCWD		2920507013	9
NCWD		2920406074	13
NCWD		2920406103	53
NCWD		2920406104	53
NCWD		2920406105	53
NCWD		2920406106	53
NCWD		0	1
NCWD		2920507088	9
NCWD		2920507095	8
	Alignment A Demands		**374**

Table A-10 Potential Future Alignment Recycled Water Demands: Alignment B

Purveyor	Address	Meter No.	Demand (AF)
NCWD		2920405228	3
NCWD		2920405229	2
NCWD		2920405120	0
NCWD		2920505112	0
NCWD		2920505010	4
NCWD		2920505011	2
NCWD		2920505013	2
NCWD		2920405072	16
NCWD		2920505114	20
NCWD		0	0
	Alignment B Demands		**49**

Table A-11 Potential Future Alignment Recycled Water Demands: Alignment C

Purveyor	Address	Meter No.	Demand (AF)
VWC	25060 SOUTHERN OAKS DR	2826131025	9.62
VWC	25619 MAGNOLIA LN	115532780	13.32
VWC	25648 MORNING MIST DR	2826124013	10.46
VWC	0 PICO CANYON MEDIAN	115538940	0.82
VWC	24880 SOUTHERN OAKS DR	115533406	9.75
VWC	25536 FOUNTAIN GLEN CT	2826085014	15.43

VWC	24979 CONSTITUTION AVE	115538961	6.58
VWC	25520 THE OLD RD	2826096011	14.32
VWC	24959 PICO CYN RD	2826085005	11.21
VWC	25932 THE OLD RD	2826095005	5.85
VWC	24979 CONSTITUTION AVE	2826085022	9.28
VWC	25950 THE OLD RD- MANIFOLD 33	2826095011	12.32
VWC	25313 PICO CANYON RD U	2826160900	13.78
VWC	25205 GLORISO LN U	115539310	8.42
VWC	25210 GLORISO LN U	115539311	11.89
VWC	25306 PICO CANYON RD U	2826133005	7.63
VWC	24800 GREENSBRIER DR	115533919	11.21
VWC	24801 GREENSBRIER DR	115533920	0.56
VWC	25051 WHISPERING OAKS DR	115535631	11.95
VWC	25790 WHISPERING OAKS RD U	115534034	3.87
VWC	24894 SOUTHERN OAKS DR U	115533313	9.49
VWC	25751 PICO CANYON RD	115535067	0.20
VWC	25790 PICO CANYON RD	2826097004	5.93
VWC	25577 HUXLEY DR	115538732	2.27
	Alignment C Demands		**206**

Table A-12 Potential Future Alignment Recycled Water Demands: Alignment D

Purveyor	Address	Meter No.	Demand (AF)
VWC	25900 BELLIS DR	115518519	30.75
VWC	23636 MAGIC MOUNTAIN PKWY - 992928	118818471	16.43
VWC	24452 VALENCIA BLVD - #1104385	2861057074	10.19
VWC	24375 VALENCIA BLVD	2861062900	1.83
VWC	26250 CITRUS STR	2861009038	1.29
VWC	24053 VALENCIA BLVD	115524488	5.03
VWC	24100 ARROYO PARK DR	2861027053	34.13
VWC	24443 ARROYO PARK DR	2861024041	10.96
VWC	23807 MAGIC MOUNTAIN PKWY	2811002063	11.10
VWC	26201 MCBEAN PKWY	115518366	28.79
VWC	26120 MCBEAN PKWY	115518393	5.08
VWC	24182 VALENCIA BLVD - #4221772	2861026020	17.55
VWC	26822 GOLDCREST DR - #782308	115530155	12.19
VWC	24442 VALENCIA BLVD - #1108706	2861057001	9.33
VWC	24184 VALENCIA BLVD	2861026021	13.78
VWC	24419 ARROYO PARK DR	2861005073	3.32
VWC	24182 DEL MONTE DR	2861051014	14.16
VWC	23920 VALENCIA BLVD	2861026909	6.19
VWC	23973 ARROTO PARK DR	2861052003	14.63

Purveyor	Address	Meter No.	Demand (AF)
VWC	24031 ARROYO PARK DR	2861029042	7.08
VWC	24095 ARROYO PARK DR	2861030065	3.82
VWC	24102 ARROYO PARK DR	2861025026	19.13
VWC	24251 ARROYO PARK DR	2861024039	14.40
VWC	24402 ARROYO PARK DR	2861024040	10.76
VWC	24421 ARROYO PARK DR	2861023063	5.25
VWC	24100 KIRSTENGEARY WY	2861030067	20.23
VWC	26110 MCBEAN PKY	2861051015	0.66
VWC	26410 MCBEAN PKY	115524649	3.30
VWC	26412 MCBEAN PKY	115524650	10.84
VWC	23977 ARROYO PARK DR	116618511	7.47
VWC	26131 MCBEAN PKY	116618509	11.83
VWC	24025 ARROYO PARK DR	116618513	16.86
VWC		2861027055	2.70
VWC		2861035140	7.26
	Alignment D Demands		**388**

Table A-13 Potential Future Alignment Recycled Water Demands: Alignment E

Purveyor	Address	Meter No.	Demand (AF)
VWC	28132 KELLY JOHNSON PKWY	115532589	10.56
VWC	28205 KELLY JOHNSON PKWY	2866048031	4.10
VWC	28188 NEWHALL RANCH RD	2840120004	9.98
VWC	27931 KELLY JOHNSON PKWY	2866039028	24.11
VWC	27926 KELLY JOHNSON PKWY	2866039023	17.94
VWC	28323 KELLY JOHNSON PKWY'	2866048022	14.45
VWC	28310 KELLY JOHNSON PKY	2866047034	10.11
VWC	28851 RIO NORTE DR	115539431	13.89
VWC	28801 RIO NORTE DR	2810111006	11.39
VWC		2810110011	3.59
VWC	25112 AURORA DR	2866039030	7.44
VWC	23449 COPPER HILL DR	115528232	3.47
VWC	23975 U COPPER HILL DR	2810118028	10.14
VWC	23500 COPPER HILL DR	115528229	1.08
VWC	23501 COPPER HILL DR	3244159068	9.14
VWC	23502 COPPER HILL DR	2810081061	12.51
VWC	23451 COPPER HILL DR	3244177034	6.55

Purveyor	Address	Meter No.	Demand (AF)
VWC	24015 COPPER HILL DR	2810119014	15.16
VWC		2810111218	5.32
NCWD		2940205004	15
NCWD		2940305118	8
NCWD		2940404090	3
NCWD		2940404091	7
NCWD		2940305459	11
NCWD		2940205003	14
NCWD		2940305117	10
NCWD		2940304294	9
NCWD		2940304043	2
NCWD		2940304044	3
NCWD		2940304046	2
NCWD		2940404019	7
NCWD		2940404021	11
NCWD		2940304113	19
NCWD		2940405165	4
NCWD		2940304170	6
NCWD		2940304365	9
NCWD		2940304011	11
NCWD		2940305010	20
NCWD		2940305052	5
NCWD		2940305389	1
NCWD		2940304012	7
NCWD		2940404022	7
NCWD		2940404020	1
NCWD		2940404018	5
NCWD		2940405008	2
NCWD		2940405162	5
NCWD		2940405160	2
NCWD		2940405159	9
	Alignment E Demands		**406**

Table A-14 Potential Future Alignment Recycled Water Demands: Alignment F

Purveyor	Address	Meter No.	Demand (AF)
VWC	27745 MCBEAN PKWY	2810071271	0.97
VWC	27370 SHELBURNE DR	2811049066	7.13
VWC	23700 DECORO DR	2811045062	10.06
VWC	27404 HILLSBOROUGH PKWY	115515086	7.04
VWC	23699 DECORO DR	115536155	8.83

VWC	27350 HILLSBOROUGH PKWY	2811050064	5.15
VWC	27216 BLUERIDGE DR	2810032031	13.16
VWC	27205 BLUERIDGE DR	115524557	7.70
VWC	23102 DECORO DR	2811051017	11.36
VWC	23100 DECORO DR	2811051016	6.25
VWC	27501 MCBEAN PKWY	115535264	2.74
VWC	27508 GRANDVIEW DR	2811047063	4.17
VWC	23700 DECORO DR	2811045062	10.06
VWC	27502 HILLSBOROUGH PKWY	115515087	16.05
VWC	27397 MCBEAN PKY	2811043037	14.84
VWC	27399 MCBEAN PKY	2811044072	12.47
VWC	27302 MCBEAN PKY	115515051	4.30
VWC	23698 DECORO DR	2810071271	56.89
	Alignment F Demands		**199**

Table A-15 Potential Future Alignment Recycled Water Demands: Alignment G

Purveyor	Address	Meter No.	Demand (AF)
VWC	22605 COPPER HILL DR	3244108018	4.21
VWC	23199 COPPER HILL DR	3244108011	2.25
VWC	23201 COPPER HILL DR	115527603	5.37
VWC	27795 MCBEAN PKWY	2810041040	14.95
VWC	27857 MCBEAN PKY	115525441	4.50
VWC	27745 MCBEAN PKWY	2810071271	0.97
VWC	28069 SUNSET HILLS DR	2810044096	4.13
VWC	27857 MCBEAN PKWY	115525441	4.50
VWC	27855 MCBEAN PKWY	2810046058	9.87
VWC	28575 SECO CANYON RD	115515204	18.08
VWC	28573 SECO CYN RD	3244027034	18.15
VWC	28600 SECO CYN RD	115515205	8.08
VWC	22650 HAZEL ST	115515202	9.79
VWC	28250 NORTHPARK DR	2810056034	12.05
VWC	27970 NORTHPARK DR	2810050021	5.88
VWC	27969 NORTHPARK DR	2810046055	6.14
VWC	27969 NORTHPARK DR	115526485	9.47
VWC	27810 AMBERWOOD LN	115526295	9.49
VWC	27810 AMBERWOOD LN	115526296	5.05
VWC	28023 NORTHPARK DR	2810044099	7.05
VWC	28113 NORTHPARK DR	115527600	6.95
VWC	28399 SECO CANYON RD	115515224	9.64
VWC	28344 SECO CANYON RD	115515227	20.42
VWC	22809 BANYAN PL	115515228	10.13

Purveyor	Address	Meter No.	Demand (AF)
VWC	22828 BANYAN PL	115515239	9.41
VWC	27915 NORTHPARK DR-#1713665	2810055013	16.50
VWC	28117 SECO CYN RD	115515241	9.12
VWC	28025 SECO CYN RD	3244070003	2.06
VWC	28122 SECO CYN RD	115515183	5.38
VWC	28048 SECO CANYON RD	111215243	1.37
VWC	27915 NORTHPARK DR	115526436	10.21
VWC	27915 NORTHPARK DR	2810055013	16.50
VWC	28053 TUPELO RIDGE DR	2810056036	2.81
VWC	28249 NORTHPARK DR	2810060021	3.50
VWC	28501 MCBEAN PKY	115536787	7.45
VWC	22591 PECAN PL	115515186	2.79
VWC	28131 TAMARACK LN	115515188	20.14
NCWD		68389255	5
NCWD		1105512	0
NCWD		1105515	0
Alignment G Demands			**319**

Table A-16 Potential Future Alignment Recycled Water Demands: Alignment H

Purveyor	Address	Meter No.	Demand (AF)
SCWD		70487889	0.13
SCWD		65652901	0.42
SCWD		67246068	0.16
SCWD		720030187	2.76
SCWD		66214836	1.22
SCWD		1623300	88.23
SCWD		62558851	0.84
SCWD		69676646	27.75
SCWD		68529604	2.28
SCWD		70237827	1.84
SCWD		71447009	1.50
SCWD		720030184	0.93
SCWD		65068863	1.10
SCWD		65068860	2.39
SCWD		68529605	1.93
SCWD		68165270	2.39
SCWD		58902560	0.25
SCWD		72030170	2.83
SCWD		70237797	0.00
SCWD		70237808	11.57

Purveyor	Address	Meter No.	Demand (AF)
SCWD		65652902	19.01
SCWD		70237807	23.46
SCWD		64244304	12.86
SCWD		70066796	9.83
SCWD		71904550	4.32
SCWD		72050863	5.45
SCWD		62699139	2.34
SCWD		67246061	5.15
SCWD		68837404	3.43
SCWD		1066379	0.00
SCWD		69568549	4.42
SCWD		71904659	12.67
SCWD		61676853	1.37
SCWD		62124816	8.71
SCWD		70066805	6.29
SCWD		62720448	8.96
SCWD		67246055	8.85
SCWD		62720446	9.77
SCWD		68837460	10.13
SCWD		62720444	7.70
SCWD		68529574	9.19
SCWD		68529589	8.48
SCWD		70237786	4.09
SCWD		70487890	6.83
SCWD		71446979	5.59
SCWD		65670328	1.05
SCWD		67250421	7.07
SCWD		68165252	8.62
SCWD		71468733	2.04
SCWD		63454356	0.79
SCWD		65651663	1.37
SCWD		71904547	4.90
SCWD		62124799	3.37
SCWD		64288169	0.98
SCWD		65651693	2.26
SCWD		63416975	14.32
SCWD		63416941	14.25
SCWD		65670324	8.85
SCWD		71367006	0.24
Alignment H Demands			**419**

Appendix B: Summary of Recycled Water Regulations

**previously submitted with Sections 5 & 6 – not included herein*

Appendix C: Potable Reuse Technical Assessment

The following study “Potable Reuse Technical Assessment” (Trussell Technologies, 2016) was developed to support the evaluation of:

(1) groundwater replenishment (surface spreading and direct injection),
(2) surface water augmentation (at Castaic Lake), and
(3) direct potable reuse.

** Note to Reviewers – This report is provided in a separate pdf file*

Appendix D: Hydraulic Model Information

This appendix includes supporting information for the hydraulic modeling.

** Note to Reviewers –Report by IDModeling to be included in Draft Report.*

Appendix E: Engineers Opinion of Probable Costs

This appendix includes detailed cost sheets for the following alternatives and projects:

Alternative 1 - Non-Potable Reuse Expansion (Phase 2): Phase 2A - Bouquet Canyon Road
Alternative 1 - Non-Potable Reuse Expansion (Phase 2): Phase 2A - Central Park South w/o Tank
Alternative 1 - Non-Potable Reuse Expansion (Phase 2): Phase 2A - Central Park South w/ Tank
Alternative 1 - Non-Potable Reuse Expansion (Phase 2): Phase 2B
Alternative 1 - Non-Potable Reuse Expansion (Phase 2): Phase 2C
Alternative 1 - Non-Potable Reuse Expansion (Phase 2): Phase 2D

Alternative 2 - Non-Potable Reuse Expansion (Future Phases): Phase 2A + Alignments E-H
Alternative 2 - Non-Potable Reuse Expansion (Future Phases): Phase 2C + Alignments A-D
Alternative 2 - Non-Potable Reuse Expansion (Future Phases): Westside Communities

Alternative 3 - Groundwater Recharge (Surface Spreading): Phase 2A + Spreading Site #1
Alternative 3 - Groundwater Recharge (Surface Spreading): Phase 2A + Spreading Site #3a
Alternative 3 - Groundwater Recharge (Surface Spreading): Phase 2A + Spreading Site #3b
Alternative 3 - Groundwater Recharge (Surface Spreading): Phase 2A + Spreading Site #3b (Repurpose Infrastructure)
Alternative 3 - Groundwater Recharge (Surface Spreading): Phase 2A + Spreading Sites #1 & #3b (Repurpose Infrastructure)

Alternative 4 - Advanced Treatment for Potable Reuse: Direct Injection
Alternative 4 - Advanced Treatment for Potable Reuse: Surface Water Augmentation
Alternative 4 - Advanced Treatment for Potable Reuse: Direct Potable Reuse + Phase 2A

** Note to Reviewers – detailed cost sheets are provided in a separate pdf file.*

Z:\Projects\CastaicLakeWaterAgency_RW\Events\20160415_Figs\Fig07-1_OverallAlt1Map.mxd printed by: marioo

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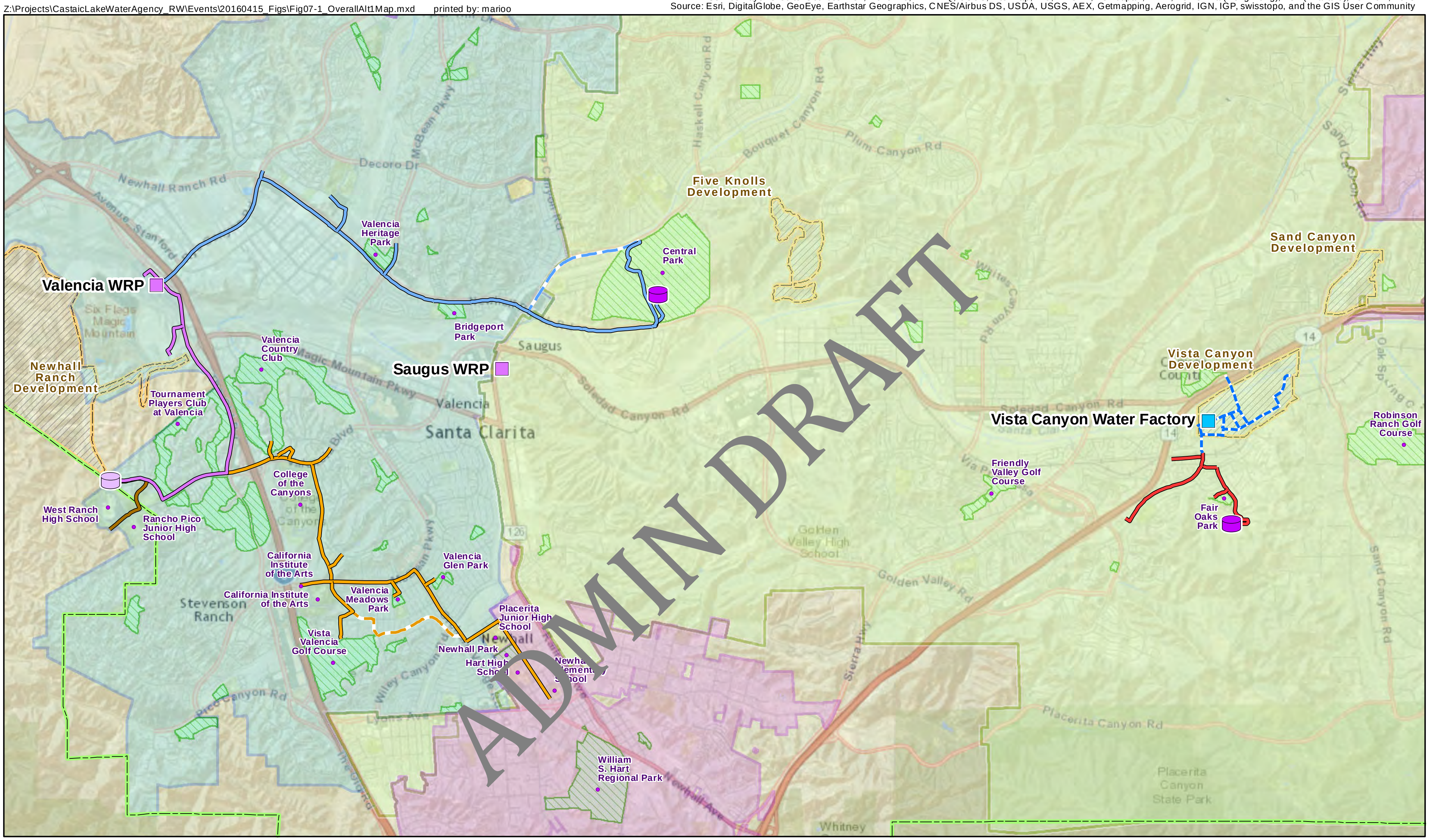

Legend

Existing Water Reclamation Plant	Existing Phase 1 Pipeline
Planned Water Reclamation Plant	Proposed Vista Canyon RW Pipeline
Existing Recycled Water Tank	Planned Phase 2A Pipeline
Proposed Recycled Water Tank	Planned Phase 2B Pipeline
	Planned Phase 2C Pipeline
	Planned Phase 2D Pipeline

- Castaic Lake Water Agency Service Area
- Newhall County Water District
- Santa Clarita Water Division
- Valencia Water Company
- Planned Developments
- Existing Parks and Golf Courses

N

0 3,000 6,000
Feet

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Santa Clarita, California

Alternative 1
Non-Potable Reuse Expansion
(Phase 2)

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Figure 7-1

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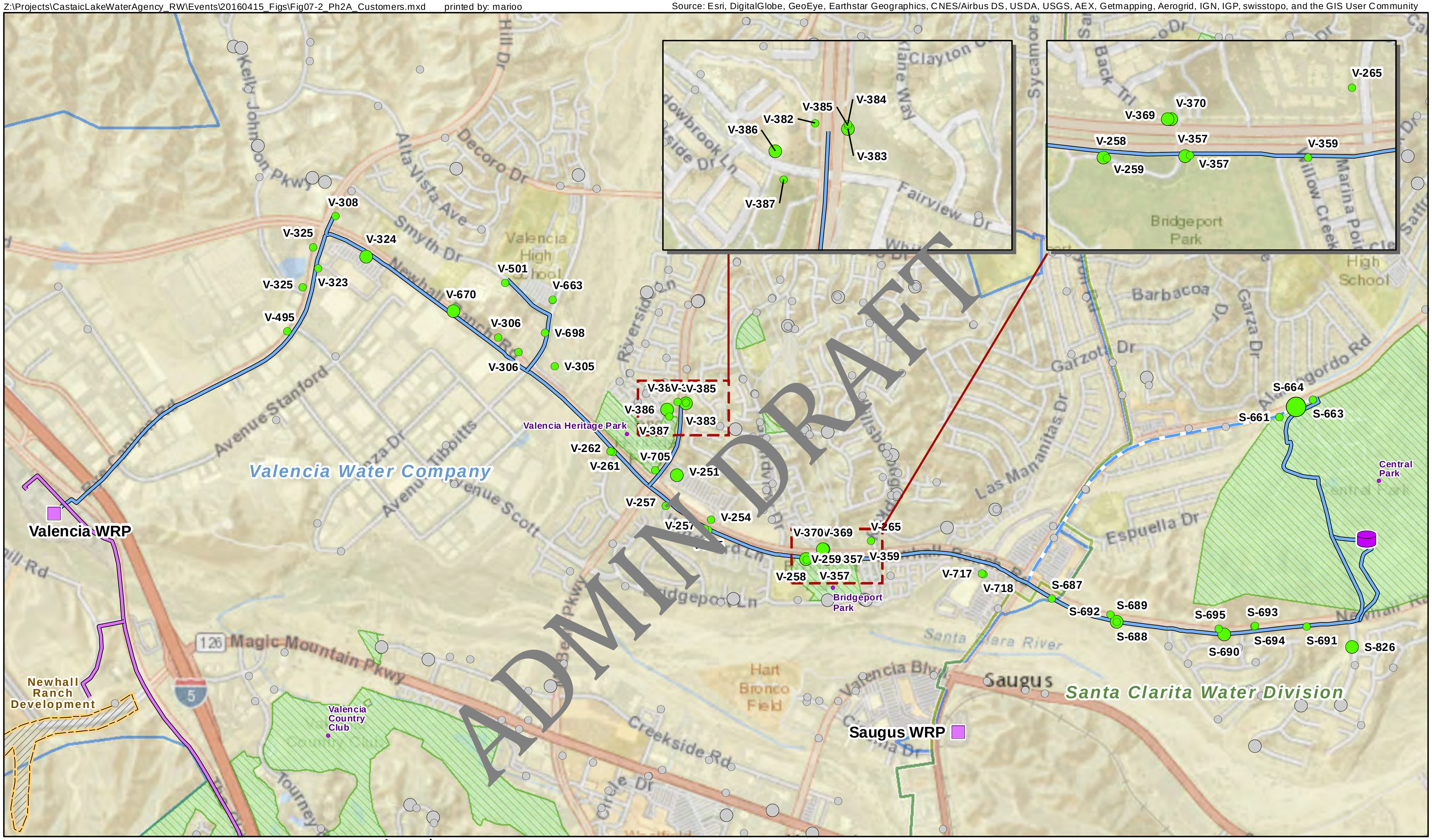

Legend

Irrigation Meters within Phase 2A (AFY)

- 0 - 10
- 11 - 50
- 51 - 145

Irrigation Meters not within Phase 2A (AFY)

- 0 - 10
- 11 - 50
- 51 - 145

- Existing Water Reclamation Plant
- Proposed Recycled Water Tank
- Existing Phase 1 Pipeline
- Planned Phase 2A Pipeline
- Castaic Lake Water Agency Service Area
- Santa Clarita Water Division
- Valencia Water Company
- Planned Developments
- Existing Parks and Golf Courses

N

0 1,150 2,300
Feet

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Alternative 1 - Phase 2A

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Figure 7-2

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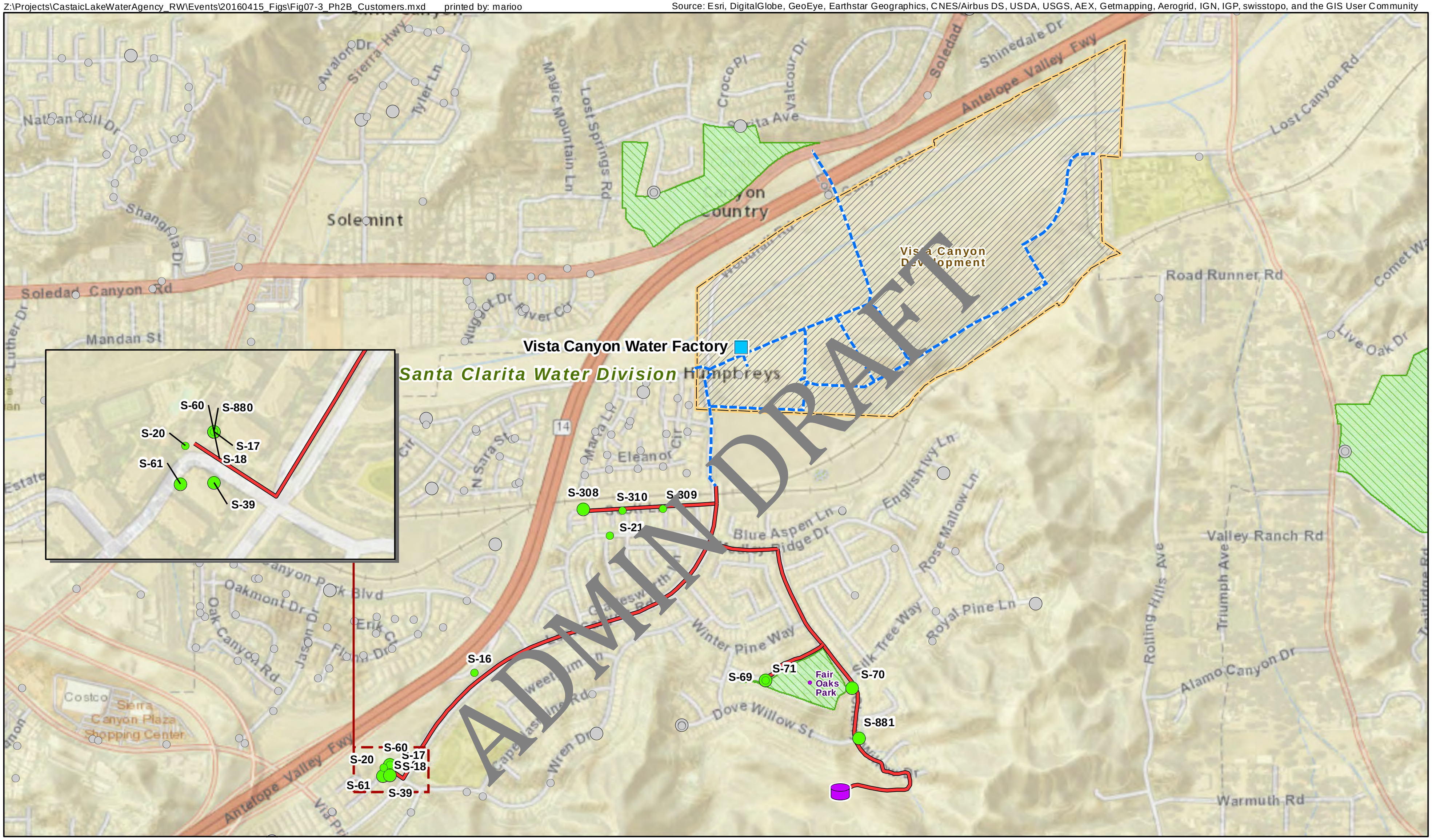
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Legend

Irrigation Meters within Phase 2A (AFY)

- 0 - 10
- 11 - 50

Irrigation Meters not within Phase 2A (AFY)

- 0 - 10
- 11 - 50

- Planned Water Reclamation Plant
- Proposed Recycled Water Tank
- Proposed Vista Canyon RW Pipeline
- Planned Phase 2B Pipeline
- Castaic Lake Water Agency Service Area
- Santa Clarita Water Division
- Planned Developments
- Existing Parks and Golf Courses

N

0 700 1,400

Feet

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Alternative 1 - Phase 2B

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Figure 7-3

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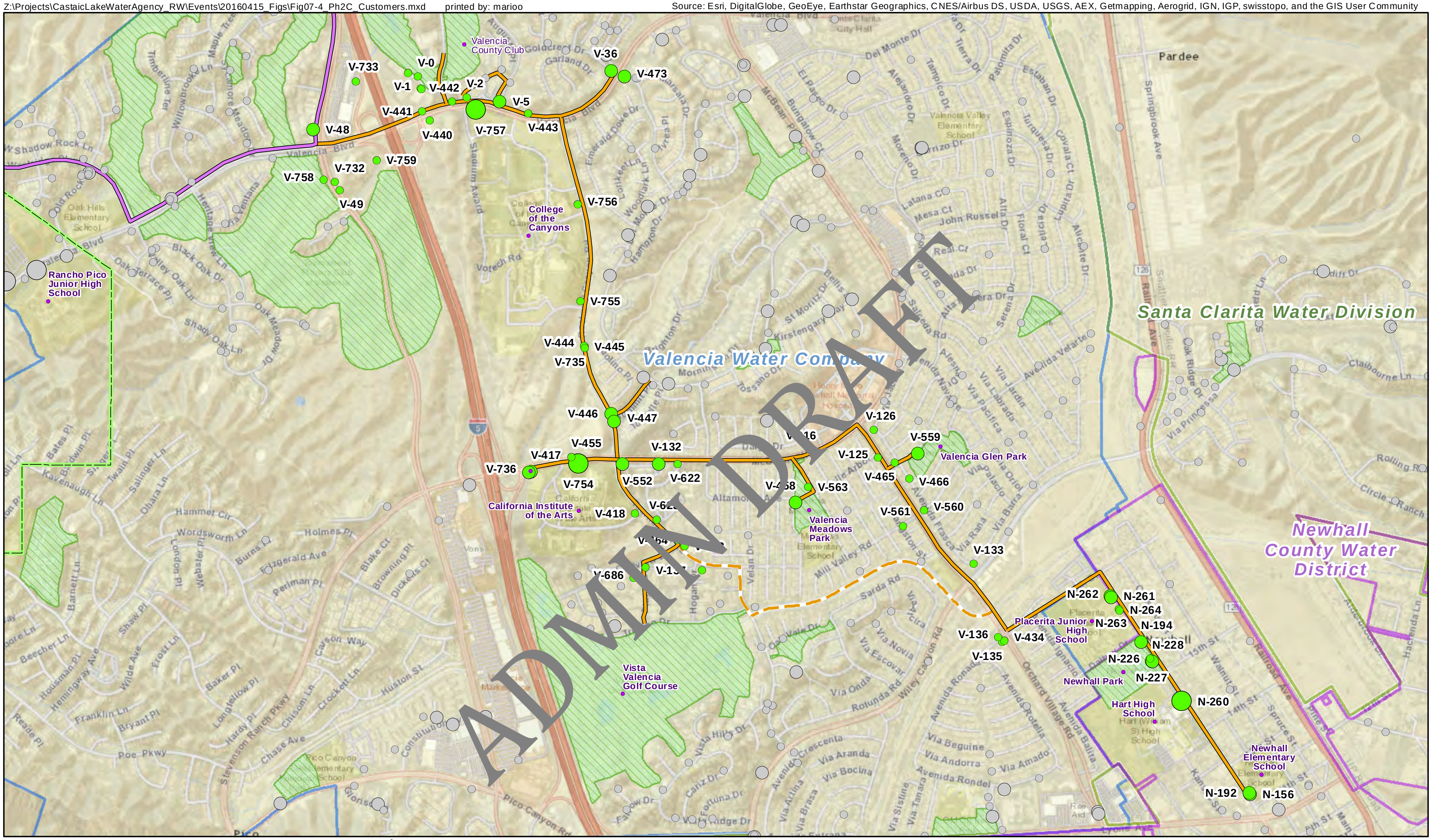
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Legend

Irrigation Meters within Phase 2A (AFY)

- 0 - 10
- 11 - 50
- 51 - 145

Irrigation Meters not within Phase 2A (AFY)

- 0 - 10
- 11 - 50
- 51 - 145

- Existing Phase 1 Pipeline
- Planned Phase 2C Pipeline
- Castaic Lake Water Agency Service Area
- Newhall County Water District
- Santa Clarita Water Division
- Valencia Water Company
- Existing Parks and Golf Courses

N

0 1,000 2,000
Feet

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Alternative 1 - Phase 2C

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Figure 7-4

Z:\Projects\CastaicLakeWaterAgency_RW\Events\20160415_Figs\Fig07-5_Ph2D_Customers.mxd printed by: marioo

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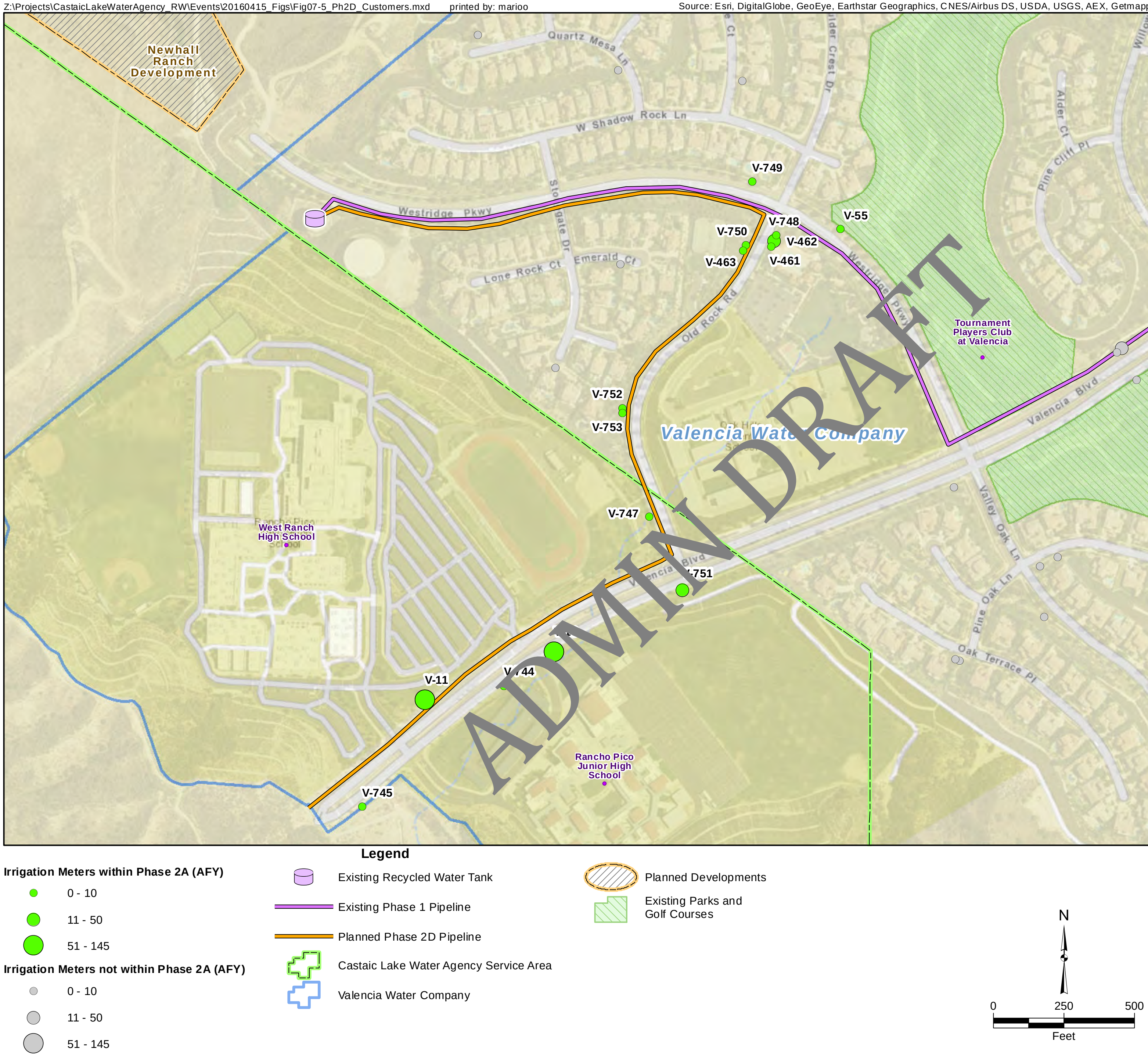

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Alternative 1 - Phase 2D

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Figure 7-5

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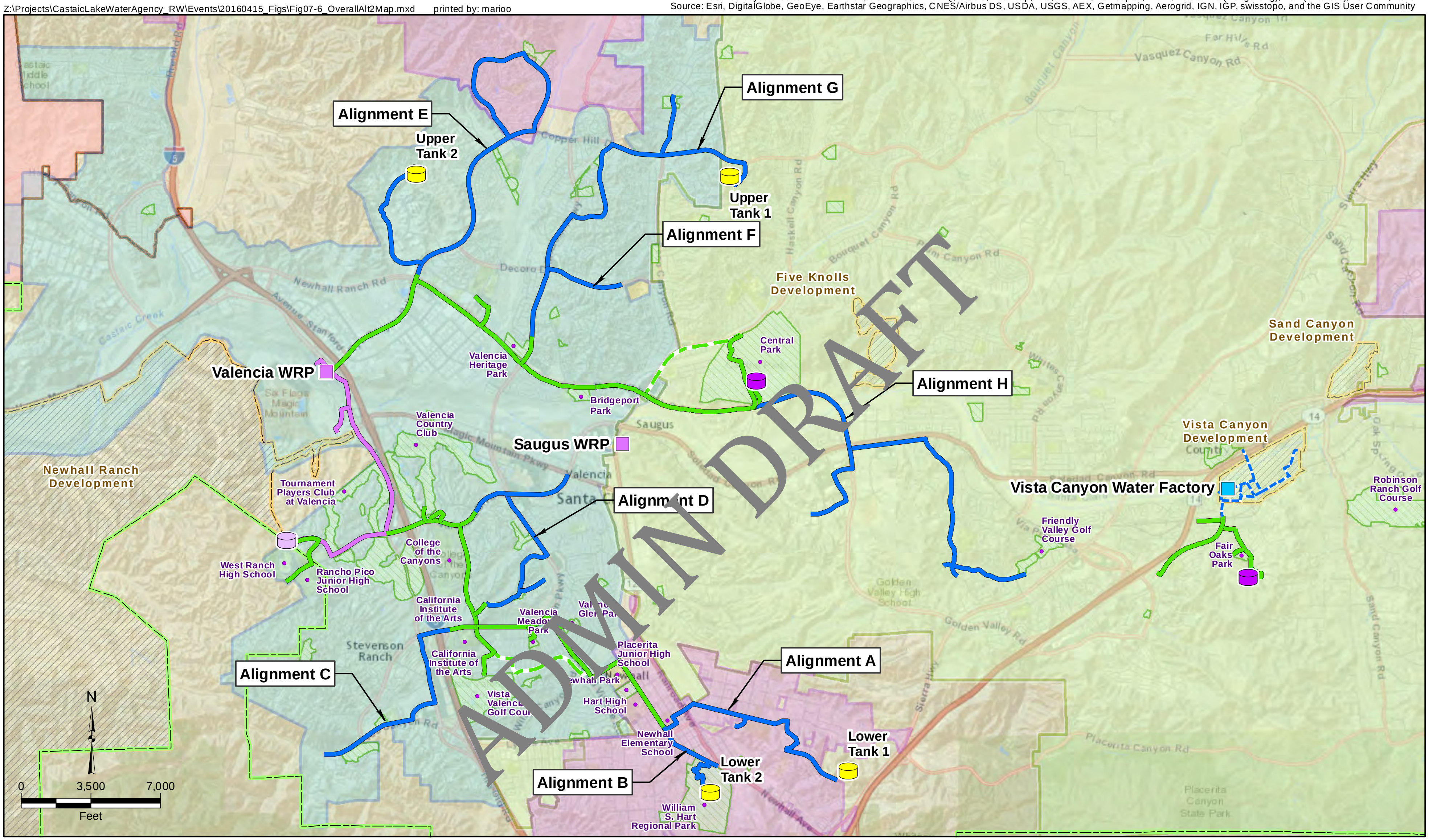

Legend

- Existing Water Reclamation Plant
- Planned Water Reclamation Plant
- Existing Recycled Water Tank
- Proposed Phase 2 Recycled Water Tank
- Proposed Phase 3 Recycled Water Tank
- Existing Phase 1 Pipeline
- Proposed Vista Canyon RW Pipeline
- Planned Phase 2 Pipeline
- Future Phase 3 Pipeline
- Planned Developments
- Existing Parks and Golf Courses
- Castaic Lake Water Agency Service Area
- Newhall County Water District
- LACOWWD36
- Santa Clarita Water Division
- Valencia Water Company

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Alternative 2
Non-Potable Reuse Expansion
(Future Phases)

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Figure 7-6

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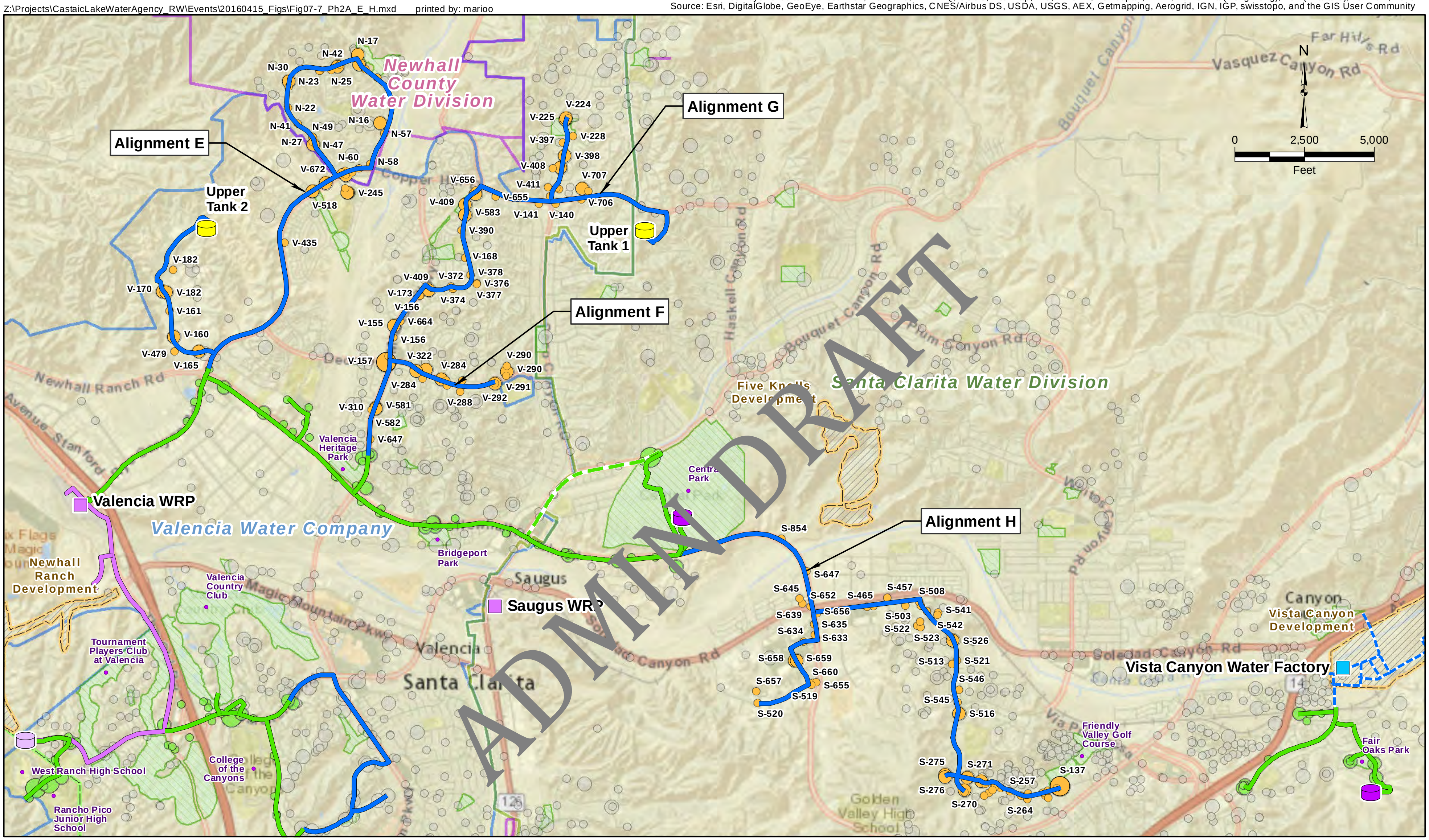

Legend

- Existing Water Reclamation Plant
- Planned Water Reclamation Plant
- Existing Recycled Water Tank
- Proposed Phase 2 Recycled Water Tank
- Proposed Phase 3 Recycled Water Tank
- Existing Phase 1 Pipeline
- Planned Phase 2 Pipeline
- Future Phase 3 Pipeline
- Planned Developments
- Existing Parks and Golf Courses
- Castaic Lake Water Agency Service Area
- Valencia Water Company
- Newhall County Water District
- Santa Clarita Water Division

Irrigation Meters (AFY) within Phase 3E - H	Irrigation Meters (AFY) within Phase 2	Irrigation Meters (AFY) USAGE_AFY
0 - 10	0 - 10	0 - 10
11 - 50	11 - 50	11 - 50
51 - 88	51 - 145	51 - 145

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Alternative 2
Phase 2A + Alignments E-H

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Figure 7-7

Z:\Projects\CastaicLakeWaterAgency_RW\Events\20160415_Figs\Fig07-8_Ph2C_A_D.mxd printed by: marioo

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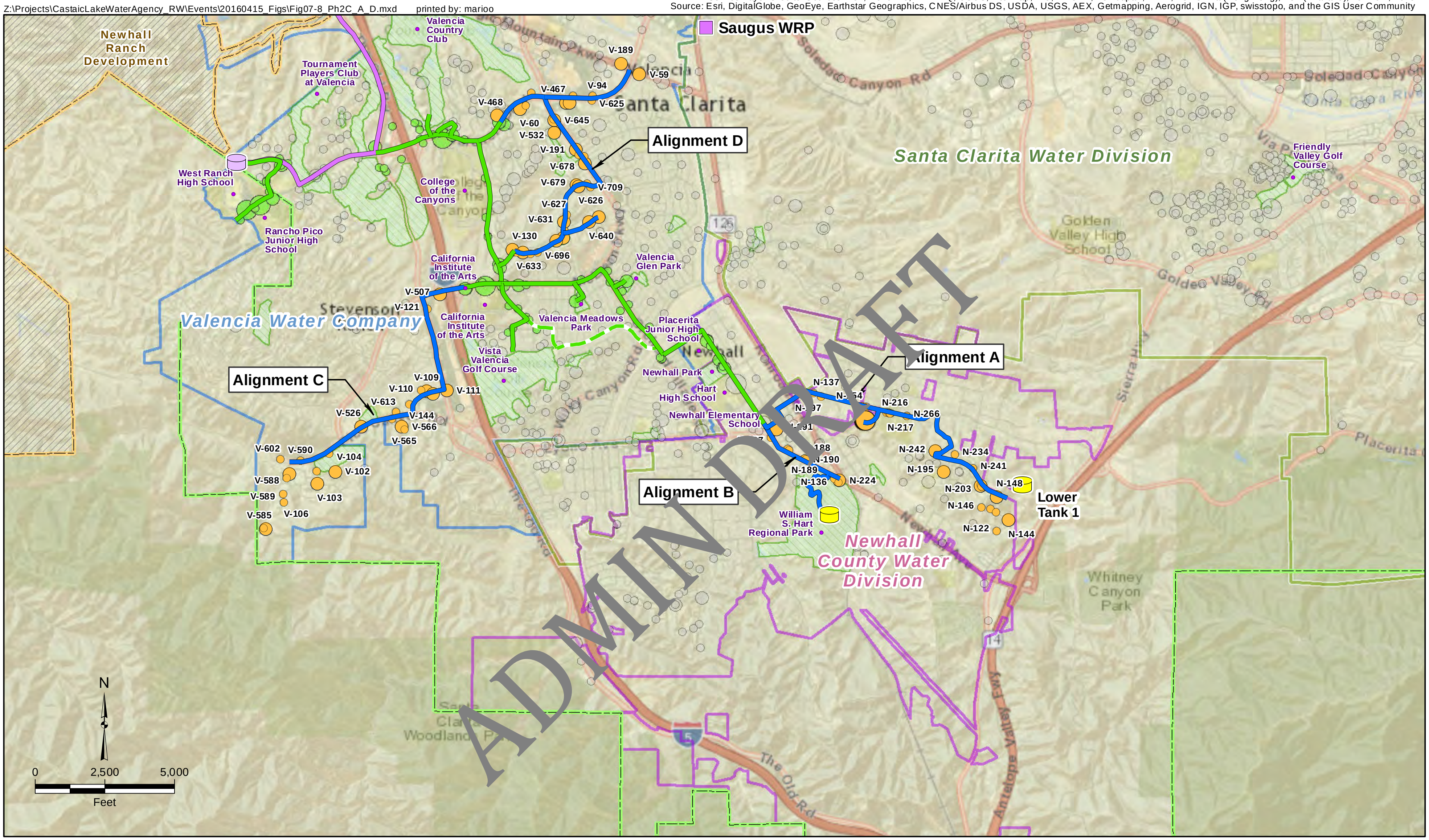
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Legend

- Existing Water Reclamation Plant
- Existing Recycled Water Tank
- Proposed Phase 3 Recycled Water Tank
- Existing Phase 1 Pipeline
- Planned Phase 2 Pipeline
- Future Phase 3 Pipeline
- Planned Developments
- Existing Parks and Golf Courses
- Castaic Lake Water Agency Service Area
- Valencia Water Company
- Newhall County Water District
- Santa Clarita Water Division

Irrigation Meters (AFY) within Phase 3A -D	Irrigation Meters (AFY) within Phase 2	Irrigation Meters (AFY) not within Phase 2 or Phase 3
0 - 10	0 - 10	0 - 10
11 - 50	11 - 50	11 - 50
51 - 145	51 - 145	51 - 145

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Alternative 2
Phase 2A + Alignments A-D

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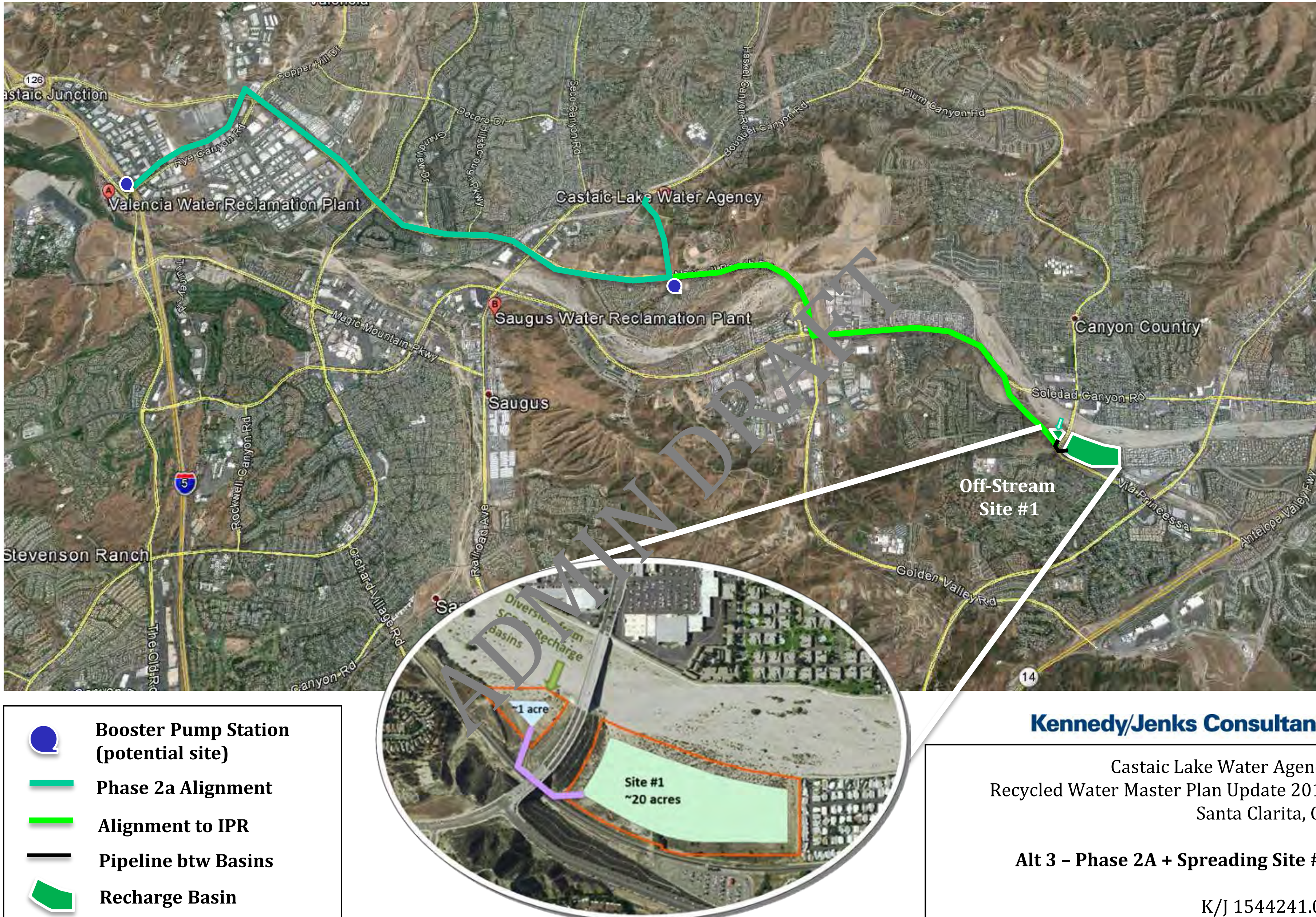
Figure 7-8



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Alt 3 – Phase 2A + Spreading Site #1

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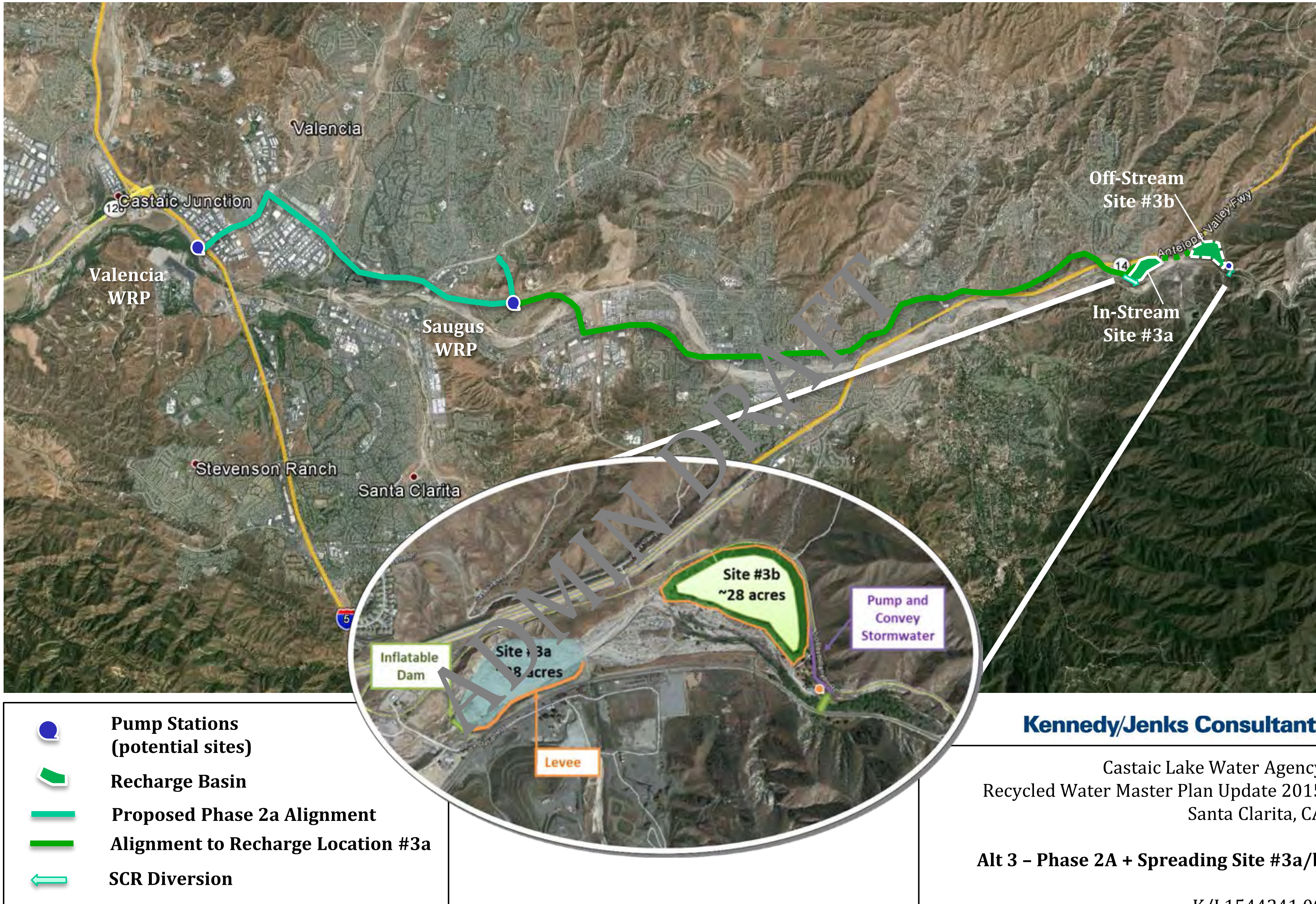
June 2016
Figure 7-10



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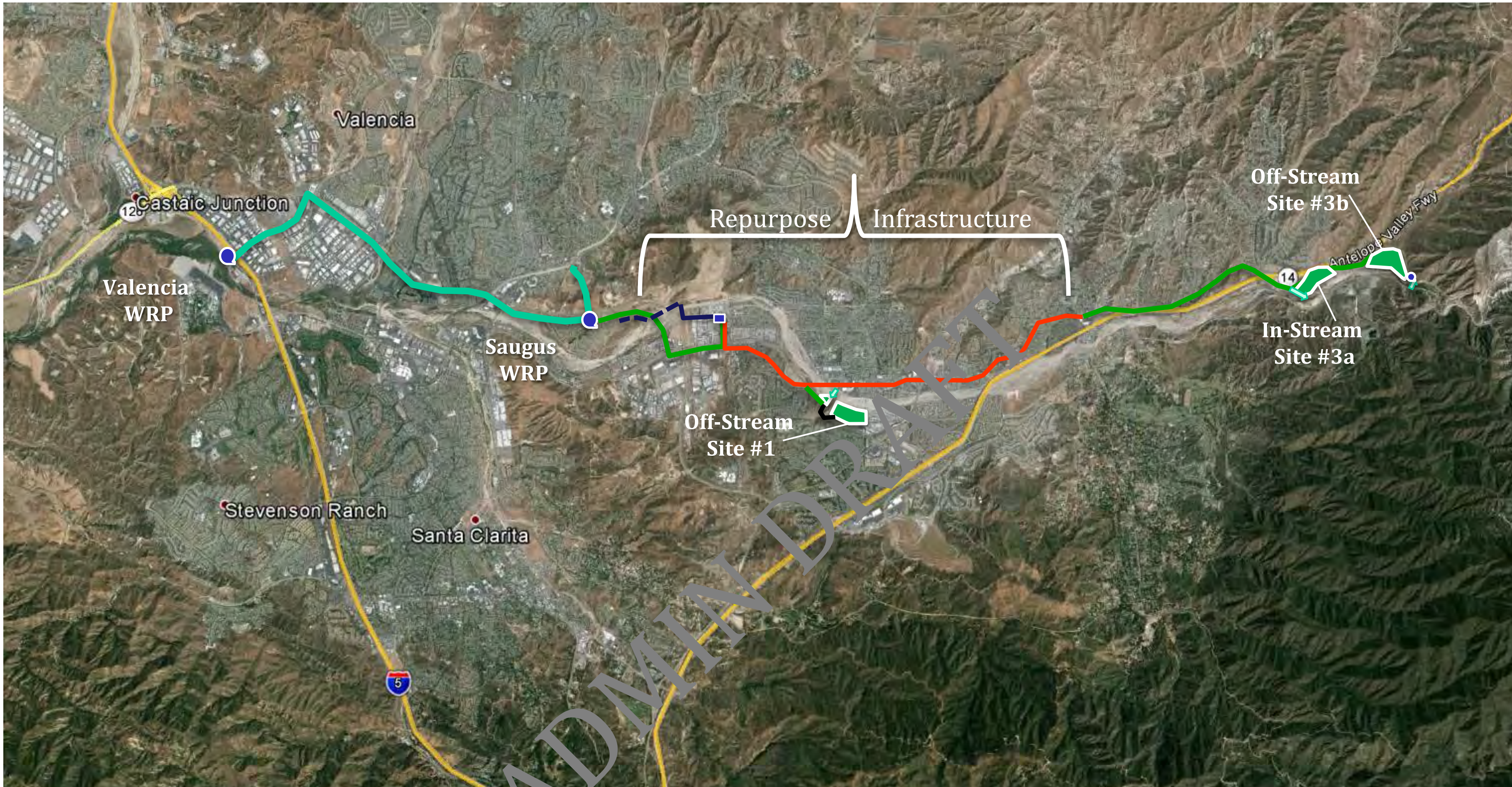
Alt 3 – Phase 2A + Spreading Site #3a/b

K/J 1544241.00
June 2016
Figure 7-11



(circle)	Pump Stations (potential sites)	(line)	Proposed Phase 2a Alignment
(square)	Existing Honby Pump Station	(line)	Alignment to Recharge Location #3
(basin)	Recharge Basin	(line)	Existing 14"-dia Honby Pipeline
(arrow)	SCR Diversion	(line)	Existing 30-33"-dia Honby Lateral alignment

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Alt 3 – Phase 2A + Spreading Site #1 + Spreading Site #3a/b

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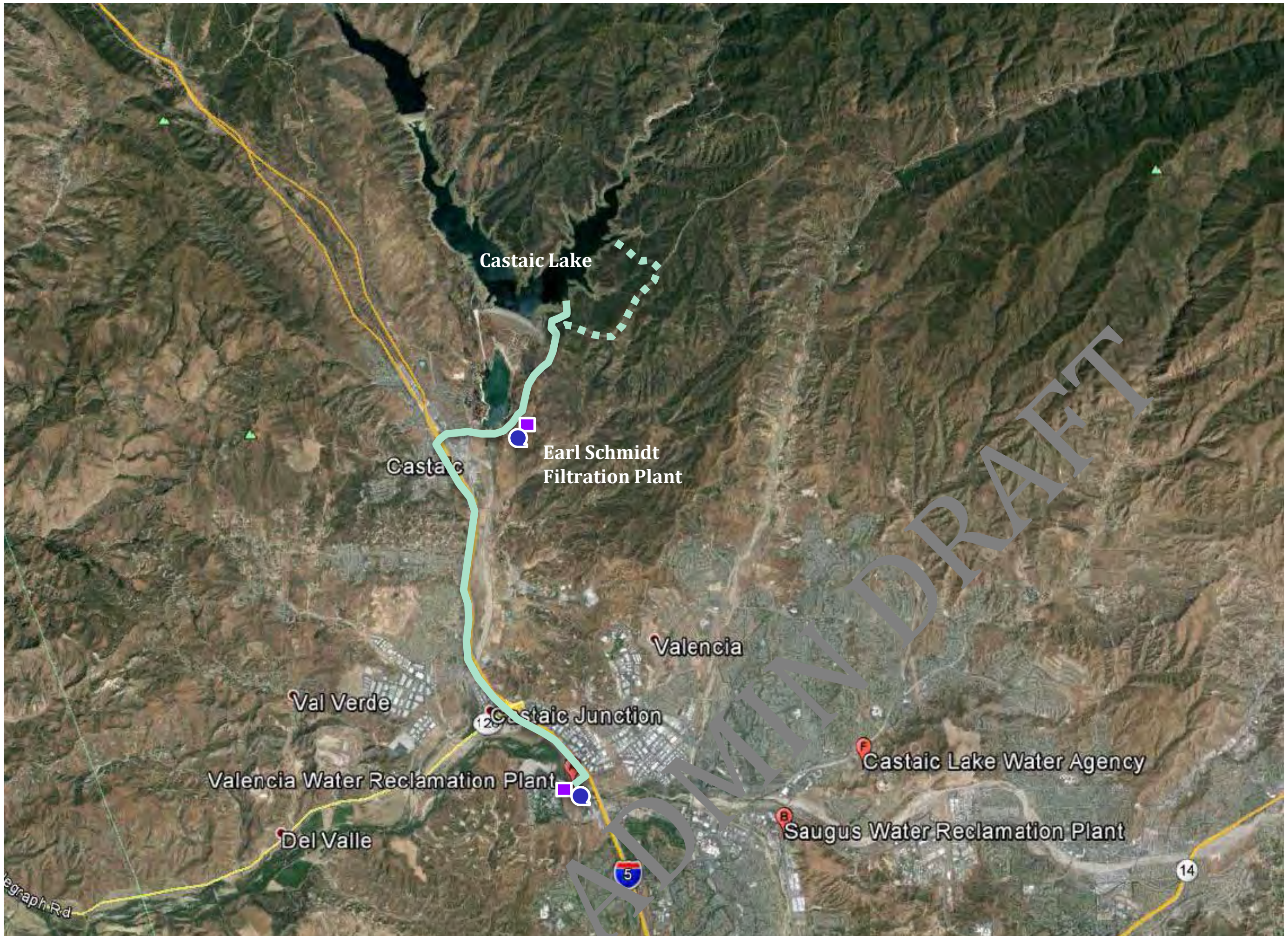
June 2016
Figure 7-12



- Advanced Water Treatment Facility (potential sites)
- Pump Stations (potential sites)
- Pipeline alignment (Valencia WRP to Lake)
- Pipeline extension (to increase retention time)

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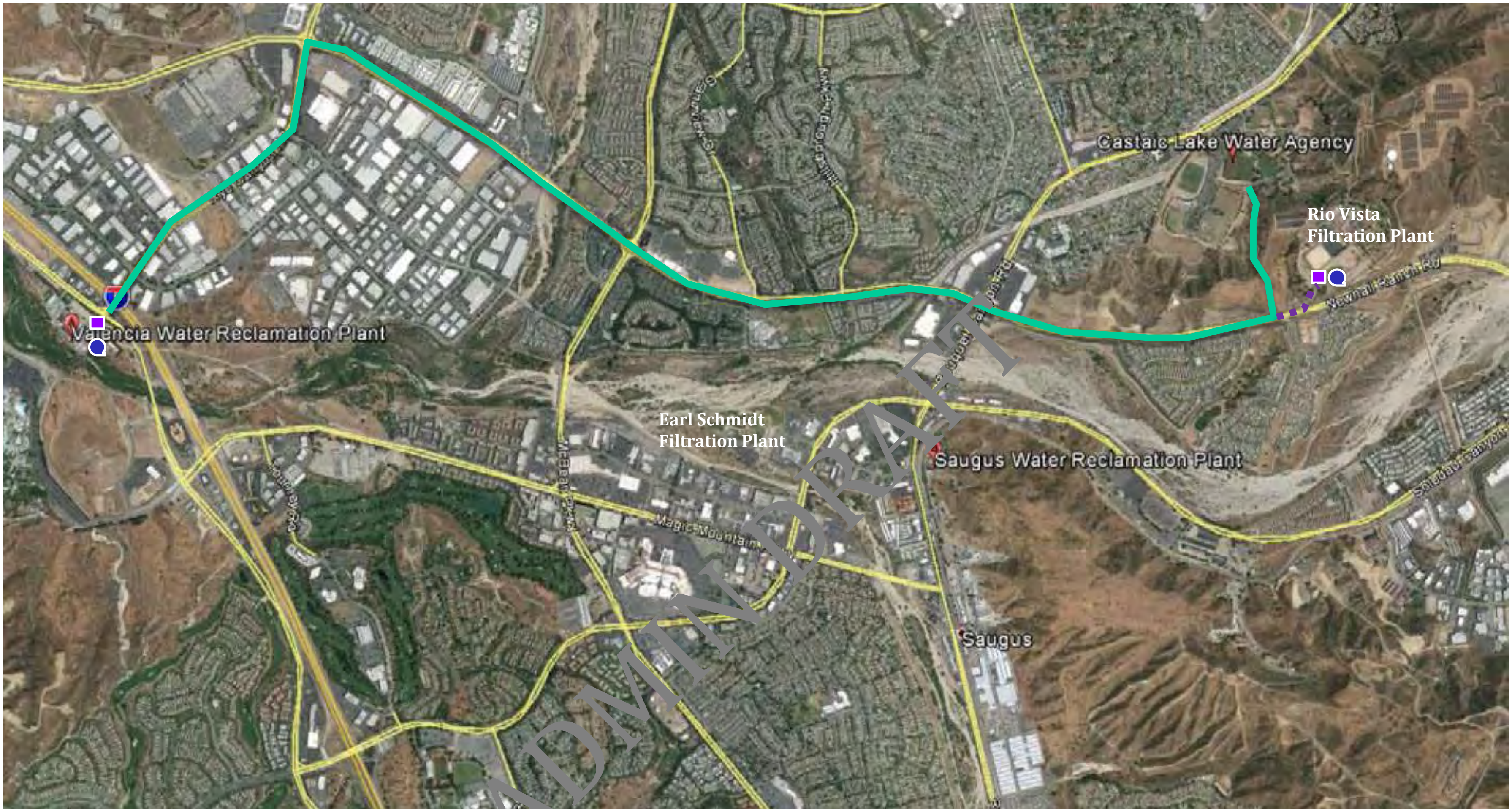
Santa Clarita, CA

Alt 4 – Surface Water Augmentation

K/J 1544241.00
June 2016
Figure 7-13



Advanced Water Treatment Facility (potential sites)

Pump Station (potential sites)

Proposed Phase 2a Alignment

Short extension to AWPC

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Alt 4 – Direct Potable Reuse

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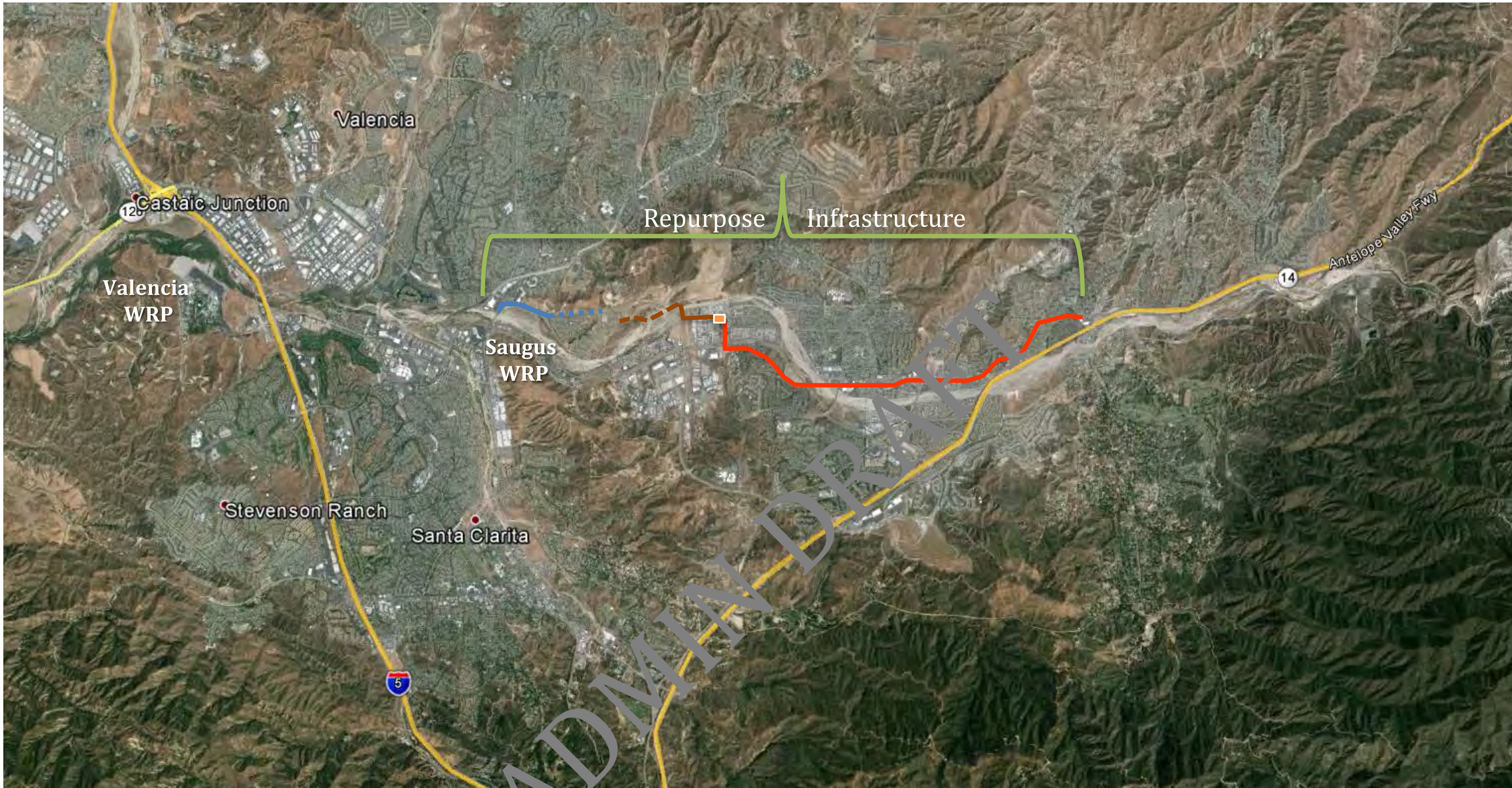
June 2016
Figure 7-14



■	Existing Honby/Sand Canyon Pump Station
━	Existing 16"-dia Groundwater Transmission Main
▪▪▪▪	Existing 20"-dia Groundwater Transmission Main
━	Existing 14"-dia Honby Pipeline
━	Existing 30"-dia Honby Lateral Alignment
‒ ‒ ‒	Existing 33"-dia Honby Lateral Alignment

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Castaic Lake Water Agency
Recycled Water Master Plan Update 2015
Santa Clarita, CA

Potential Reuse of Existing Infrastructure

K/J 1544241.00
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Figure 7-15

CASTAIC LAKE WATER AGENCY

Potable Reuse Alternative Technical Assessment

April 2016

Prepared by:

Trussell
TECHNOLOGIES INC

In association with:

Kennedy/Jenks Consultants
Engineers & Scientists

Prepared By:
Bryan Trussell, P.E., BCEE
Israel Monroy
Anya Kaufmann

Reviewed By:
R. Rhodes Trussell, Ph.D., P.E., BCEE
R. Shane Trussell, Ph.D., P.E., BCEE
David Hokanson, Ph.D., P.E., BCEE
Brian Pecson, Ph.D., P.E., BCEE
Sarah Triolo
Dawn Taffler, P.E., LEED® (Kennedy/Jenks)
Paul Tinhpheng, P.E., C.E.M. (Kennedy/Jenks)

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LIST OF ABBREVIATIONS

Description	Abbreviation
Advanced Oxidation Process	AOP
Advanced Water Treatment Facility	AWTF
Castaic Lake Water Agency	CLWA
Contaminants of Emerging Concern	CECs
Direct Potable Reuse	DPR
Division of Drinking Water	DDW
Enhanced Brine Concentration	EBC
Full Advanced Treatment	FAT
Groundwater Replenishment Reuse Regulations	GRR
Indirect Potable Reuse	IPR
Inland Empire Utilities Agency	IEUA
Ion Exchange	IX
Los Angeles County Department of Public Works	LACDPW
Los Angeles Regional Water Quality Control Board	LARWQCB
Maximum Contaminant Levels	MCLs
Membrane Filtration	MF
Modified Ludzack Ettinger	MLE
Nanofiltration	NF
National Pollutant Discharge Elimination System	NPDES
N-nitrosodimethylamine	NDMA
Notification Levels	NLs
Recycled Water	RW
Recycled Water Contribution	RWC
Reverse Osmosis	RO
Salt and Nutrient Management Plan	SNMP
Sanitation Districts of Los Angeles County	LACSD
Santa Clara River	SCR
Santa Clarita Valley Sanitation District	SCVSD
Santa Clarita Water District	SCWD
Soil Aquifer Treatment	SAT
Soil Aquifer Treatment Factor	STF
State Water Project	SWP
Surface Water Augmentation	SWA
Surface Water Treatment Rule	SWTR
Total Dissolved Solids	TDS
Total Maximum Daily Load	TMDL
Total Organic Carbon	TOC
Ultraviolet	UV
Valencia Water Company	VWC
Waste Discharge Requirement	WDR
Water Reclamation Plant	WRP

1. POTABLE REUSE OVERVIEW

The continuing drought in California has depleted surface water supplies to communities across the state. As a result, groundwater use has increased to compensate for this deficiency. The Santa Clara River Valley (Valley) experiences fluctuations in its supply of imported State Water Project (SWP) water annually, which has led to pumping more water from the Alluvial Aquifer and Saugus Formation. To offset future declines in SWP availability and reduce pumping in the two aquifers, potable reuse projects need to be considered as source alternatives.

The goal of this section is to present three types of potable reuse projects – Groundwater Replenishment (surface spreading and direct injection), Surface Water Augmentation, and Direct Potable Reuse – and evaluate them based on water quality and regulatory requirements. This technical assessment will provide CLWA and the purveyors a guideline in deciding on the implementation of a reuse project, which has the potential of enhancing local water supplies for residents of the Valley.

1.1 Potential Source Waters for Potable Reuse

The Santa Clarita Valley Sanitation District (SCVSD) owns and operates two treatment plants in the Valley, namely the Valencia Water Reclamation Plant (Valencia WRP) and the Saugus Water Reclamation Plant (Saugus WRP). The treatment processes for the Valencia and Saugus WRPs are the same and are shown in Figure 1. Both plants undergo biological treatment through a Modified Ludzack Ettinger (MLE) nitrification/denitrification process. The biological treatment is followed by a secondary settling tank, to remove suspended particles. The wastewater is then subject to filtration through the use of dual-media pressure filters. The filtered effluent is then chlorinated for disinfection. Both plants meet the Title 22 recycled water (RW) criteria.

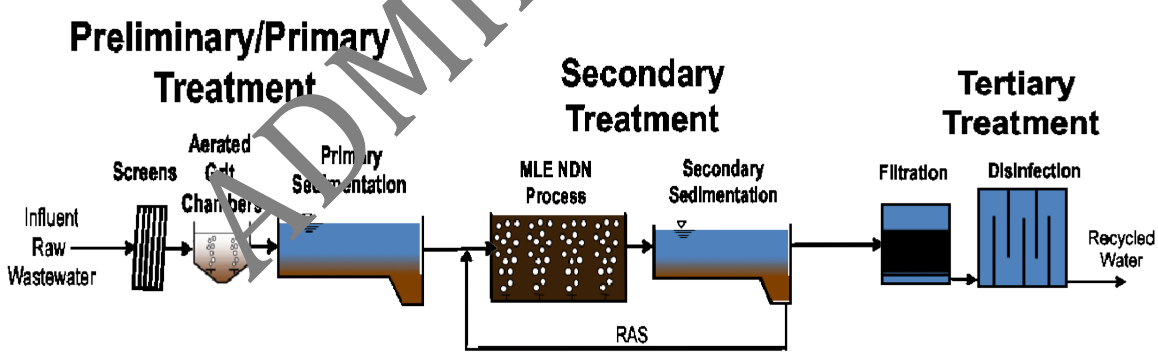

Figure 1 Treatment Process of the Valencia and Saugus WRP

1.1.1 Flow Availability

A flow analysis was performed using future RW flow data from Valencia WRP to determine the amount of water available for potable reuse. Table 1 summarizes the potential available supply of RW from the Valencia WRP in the year 2050. Due to additional conveyance costs, the Saugus WRP was not considered for this analysis. It was assumed that the available supply of RW must first fulfill the demands associated with RW customers in the Valley and the continuing environmental discharge into the Santa Clara River (SCR), a commitment made by SCVSD with the Los Angeles Regional Water Quality Control Board (LARWQCB) and assumed to be 8.5 MGD from the Valencia WRP for planning purposes.

Table 1 Projected RW Production and Discharge in 2050

SCVSD Treatment Plant	Projected Recycled Water Production (MGD)[a]	Anticipated Discharge Requirement (MGD)
Valencia WRP	**18.7**	**8.5**

[a]Based on a 65 gpcd wastewater generation rate multiplied by the projected population

The flows from Table 1 will first account for the 8.5 MGD of RW released into the SCR. Currently, the RW being released into the river is violating the chloride Total Maximum Daily Load (TMDL) of 100 mg/L set by the LARWQCB. This prompted the implementation of the Chloride Compliance Project that will include an Advanced Water Treatment Facility (AWTF) at the Valencia WRP. In addition, the existing chlorine disinfection will be replaced with an ultraviolet light (UV) disinfection system. As a planning tool, SCVSD provided guidance that 4.5 MGD of AWTF product water could be used as part of any potable reuse project, if needed.

The flows will then be utilized to meet the irrigation demands of customers under the existing Phase 1 and planned Phase 2 of the RW Master Plan, as well as the planned Newhall Ranch and Westside Communities developments (herein referred to as Newhall Ranch). Phase 1, Phase 2, and Newhall Ranch require 0.40 MGD, 1.89 MGD, and 3.05 MGD, respectively, or a total of 5.3 MGD. The remainder of the RW can then be used for a potable reuse project and is 4.9 MGD, as shown in Table 2.

Table 2 RW Available in 2050 from Valencia WRP

Projected Combined Flows for Valencia WRP (MGD)	Required River Discharge (MGD)	RW Demand (MGD)[1]	RW Available for Potable Reuse (MGD)
18.7	8.5	5.3	**4.9**

[1] RW demand for Valencia WRP only Phases 1, 2a, [illegible] 2d and that portion of planned Newhall Ranch development demands that are not met by the Newhall Ranch WRP.

1.1.2 Existing Water Quality

SCVSD provided water quality monitoring data from 2012-2014 for the tertiary effluent produced from the Valencia WRP. The water quality data is shown in Table 3, along with corresponding regulatory requirements.

Table 3 Water Quality Data from 2012 to 2014 for Final Effluent from Valencia WRP

Constituent	Units	Valencia WRP Effluent	Regulatory Requirement
pH	-	7.43	6.0 - 9.0[1]
Turbidity	NTU	0.50	2[1]
Total Coliform	org./100 mL	<1	2.2[1]
Temperature	°F	77.8	-
Total Suspended Solids	mg/L	<2.5	-
Settleable Solids	mL/L	<0.1	-
Total Dissolved Solids	mg/L	690	800[2]
Total BOD	mg/L	<0.6	-
Ammonia (as nitrogen)	mg/L	0.95	-

Organic Nitrogen	mg/L	1.07	-
Nitrate (as nitrogen)	mg/L	2.60	10[2]
Nitrite (as nitrogen)	mg/L	0.0029	1[3]
Total Nitrogen	mg/L	4.62	10[3]
Fluoride	mg/L	0.367	2[3]
Total Cyanide	mg/L	0.0013	0.15[3]
Chloride	mg/L	126	150[2]
Sulfate	mg/L	178	150[2]
Total Hardness	mg/L	259	-
Antimony	mg/L	4.70E-04	0.006[3]
Arsenic	mg/L	1.25E-04	0.01[3]
Barium	mg/L	0.00995	1[3]
Beryllium	mg/L	<5.00E-04	0.004[3]
Boron	mg/L	0.53	1[4]
Cadmium	mg/L	<2.50E-04	0.005[3]
Chromium VI	mg/L	<4.80E-06	0.01[3]
Total Chromium	mg/L	<7.00E-05	0.05[3]
Copper	mg/L	0.003	1[5]
Iron	mg/L	0.072	0.3[5]
Lead	mg/L	<3.00E-05	0.05[1]
Mercury	mg/L	4.57E-07	0.002[3]
Nickel	mg/L	0.0027	0.1[3]
Selenium	mg/L	1.70E-04	0.01[1]
Silver	mg/L	<3.00E-05	0.05[1]
Thallium	mg/L	<2.00E-05	0.002[3]
Zinc	mg/L	0.033	5[5]
Oil and Grease	mg/L	<0.8	-
Radioactivity (gross alpha + gross beta)	pCi/L	14.9	65[1]
Strontium-90	pCi/L	0.30	-
Diazinon	mg/L	2.54E-04	0.0012[4]
1,4-Dioxane	mg/L	8.60E-04	0.001[4]
Naphthalene	mg/L	<1.80E-04	0.017[4]
N-Nitrosodimethylamine (NDMA)	mg/L	1.21E-04	1.00E-05[4]
N-Nitrosodi-n-propylamine	mg/L	<1.20E-04	1.00E-05[4]
1,2,3,-Trichloropropane	mg/L	<1.20E-06	5.00E-06[4]
Perchlorate	mg/L	9.43E-04	0.006[3]
Total trihalomethanes (TTHM)	mg/L	0.050	**0.08**[6]
Bromodichloromethane	mg/L	0.020	
Bromoform	mg/L	0.0027	
Chloroform	mg/L	0.016	
Dibromochloromethane	mg/L	0.012	
Methyl-tert-butyl ether (MTBE)	mg/L	<1.60E-04	0.005[5]
Benzo(a)pyrene	mg/L	<7.00E-06	0.0002[7]

Chlordane	mg/L	<3.00E-05	0.0001[7]
2,4-D	mg/L	NM	0.07[7]
Endrin	mg/L	<2.00E-06	0.002[7]
Heptachlor	mg/L	<1.00E-06	0.00001[7]
Heptachlor Epoxide	mg/L	<1.00E-06	0.00001[7]
Hexachlorobenzene	mg/L	<1.80E-04	0.001[7]
Hexachlorocyclopentadiene	mg/L	<7.50E-04	0.05[7]
Lindane	mg/L	<1.00E-06	0.0002[7]
Methoxychlor	mg/L	NM	0.03[7]
Pentachlorophenol	mg/L	<3.80E-04	0.001[7]
2,3,7,8-TCDD (Dioxin)	mg/L	<4.80E-10	3.00E-08[7]
2,4,5-TP (Silvex)	mg/L	NM	0.05[7]
Benzene	mg/L	<1.00E-04	0.001[8]
Carbon Tetrachloride	mg/L	<7.00E-05	0.0005[8]
1,2-Dichlorobenzene	mg/L	<1.20E-04	0.6[8]
1,4-Dichlorobenzene	mg/L	<7.00E-05	0.005[8]
1,1-Dichloroethane	mg/L	<7.00E-05	0.005[8]
1,2-Dichloroethane	mg/L	<9.00E-05	0.0005[8]
1,2-Dichloropropane	mg/L	<[illegible].00E-05	0.005[8]
1,3-Dichloropropene	mg/L	*<[illegible].00E-04*[9]	0.0005[8]
Ethylbenzene	mg/L	<6.00E-05	0.3[8]
1,1,2,2-Tetrachloroethane	mg/L	<1.00E-04	0.001[8]
Toluene	mg/L	<6.00E-05	0.15[8]
1,2,4-Trichlorobenzene	mg/L	<1.70E-04	0.005[8]
1,1,1-Trichloroethane	mg/L	<7.00E-05	0.2[8]
1,1,2-Trichloroethane	mg/L	<1.00E-04	0.005[8]
Foaming Agents (MBAS)	mg/L	<0.03	0.5[5]
Toxaphene	mg/L	<4.00E-05	0.003[7]
Vinyl Chloride	mg/L	<1.20E-04	0.0005[8]

[1] RW as specified in RWQCB LA Order No. 89-129 (Valencia WRP). Trace constituent concentration limits obtained from California Department of Health Services, California Administrative Code, Title 22, Division 4, Chapter 15, "Domestic Water Quality and Monitoring" (1989).
[2] Groundwater quality objectives (GWQO) as stated in the Salt and Nutrient Management Plan (SNMP) of the Santa Clara River Valley East Subbasin.
[3] Table 64431-A (Inorganic Chemicals) of the Title 22 California Code of Regulations.
[4] California notification limits (NLs) set by the Department of Drinking Water (DDW).
[5] Table 64449-A of the Title 22 California Code of Regulations.
[6] Table 64533-A (Disinfection Byproducts) of the Title 22 California Code of Regulations.
[7] Table 64444-A(b) (Non-Volatile Organic Chemicals) of the Title 22 California Code of Regulations.
[8] Table 64444-A(a) (Volatile Organic Chemicals) of the Title 22 California Code of Regulations.
[9] No method of detection limit (MDL) provided in WQ data, so used the reporting detection limit (RDL) to specify the non-detected concentration range.
mg/L: milligrams per liter
NTU: Nephelometric Turbidity Units
pCi/L: Picocuries per liter

For all potable reuse alternatives, the RW must comply with existing Title 22 drinking water maximum contaminant levels (MCLs). The reclaimed water must meet primary and secondary MCLs for drinking water as defined in the Title 22 California Code of Regulations Tables 64444-A(a), 64444-A(b), 64449-A, 64449-B, 64533-A, and 64431-A.

For certain chemicals with no MCLs, the Division of Drinking Water (DDW) has established health-based advisory levels known as notification levels (NLs). Among this list of chemicals, there are two contaminants of emerging concern (CECs) that are of interest: N-nitrosodimethylamine (NDMA) and 1,4-Dioxane. While the levels of 1,4-Dioxane are within the acceptable range, the levels of NDMA for both plants are above the 0.000010 mg/L (10 ng/L) NL.

A Salt and Nutrient Management Plan (SNMP) was prepared for the Santa Clara River Valley East Subbasin, with the guidance of the LARWQCB, to establish water quality objectives that will help sustain and protect the local water supply. The RW will need to satisfy the SNMP water quality requirements for total dissolved solids (TDS), chloride, nitrate, and sulfate. From the data presented in Table 3, it is evident that all the groundwater quality objectives of the SNMP are met, with the exception of sulfate.

2. GROUNDWATER REPLENISHMENT ALTERNATIVES

2.1 Alternatives Overview

The following groundwater replenishment alternatives are utilized to augment groundwater supplies with RW: (1) surface spreading and (2) direct injection.

In surface spreading, reclaimed water is discharged into spreading basins, where it vertically percolates through the vadose (unsaturated) zone until it joins native groundwater and travels horizontally (saturated zone). The water naturally filters through the vadose and saturated zones achieving additional purification. This geopurification system is known as soil aquifer treatment (SAT). Per the Groundwater Replenishment Reuse Regulations (GRR), the wastewater needs to be treated to meet the criteria for Title-22 RW unrestricted use (eg. tertiary, disinfected with Total Coliform of <2.2 Most Probable Number /100 milliliters (mL)). A schematic of a common surface spreading project is shown in Figure 2.

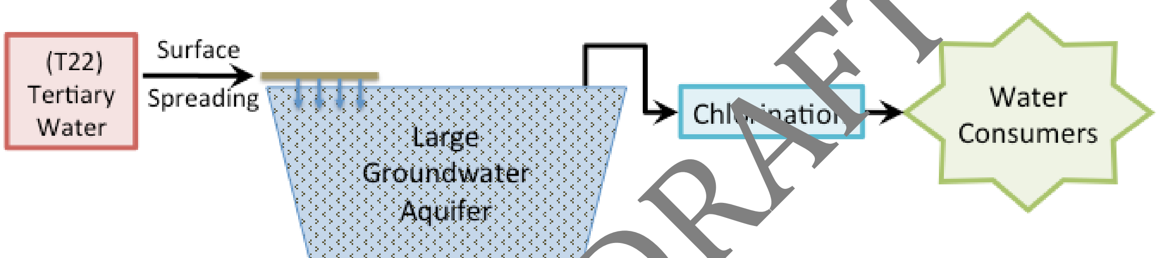

Figure 2 Schematic of a Typical Surface Spreading Project

In direct injection, RW that has gone through a full advanced treatment (FAT) process is directly injected into the saturated groundwater zone. While the implementation of FAT (i.e. membrane filtration (MF), reverse osmosis (RO), and an advanced oxidation process (AOP)) allows for the use of up to 100% RW (eg. no dilution requirement), the cost associated with the capital infrastructure, maintenance and operation of the technology, as well as the brine disposal, is significant. A schematic of a common direct injection project is shown in Figure 3.

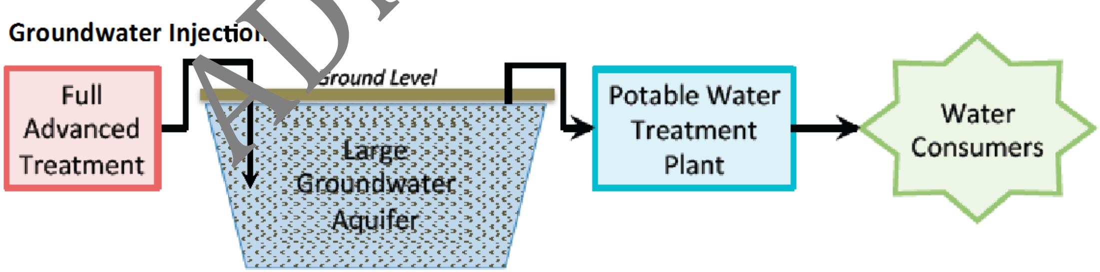

Figure 3 Schematic of a Typical Direct Injection Project

Both of these groundwater replenishment alternatives are governed by the GRR.

2.2 Groundwater Replenishment Reuse Regulations

The GRR of California's DDW, which were promulgated on June 18, 2014, govern surface spreading and direct injection recharge projects. The GRR define specific treatment requirements that both methods must meet:

- Title 22 Criteria
- Pathogenic Microorganism Control
- Total Organic Carbon (TOC) Requirement
- Total Nitrogen Requirement
- All Regulated Contaminant Limits

While most of the requirements are similar across both groundwater replenishment alternatives, there are some key differences. These will be discussed in further detail in the following sections.

2.3 SURFACE SPREADING

2.3.1 Treatment Requirements

For the surface spreading alternative, the GRR requires that the water meet Title 22 RW unrestricted use standards: the wastewater is subject to oxidation (biological treatment), filtration (dual-media pressure filters), and (chlorine) disinfection. As described previously, the Valencia WRP already has this level of treatment and no further treatment is explicitly required in the GRR.

2.3.2 Proposed Treatment Train

No additional treatment train is proposed for the surface spreading project alternatives. However, the inclusion of an ozonation step could provide significant destruction of CECs and help allay public perception concerns regarding trace pollutants. It would also improve the removal of organic matter through the SAT process, allowing more water to be spread as discussed further in Section 2.3.9 Total Organic Carbon and Ultimate Utilization.

2.3.3 RW Quality

According to the GRR, the total nitrogen concentration in RW must be less than 10 mg/L. Figure 4 shows the total nitrogen data from 2012-2014 for the Valencia WRP. The tertiary effluent from the Valencia WRP meets the total nitrogen requirement in the GRR.

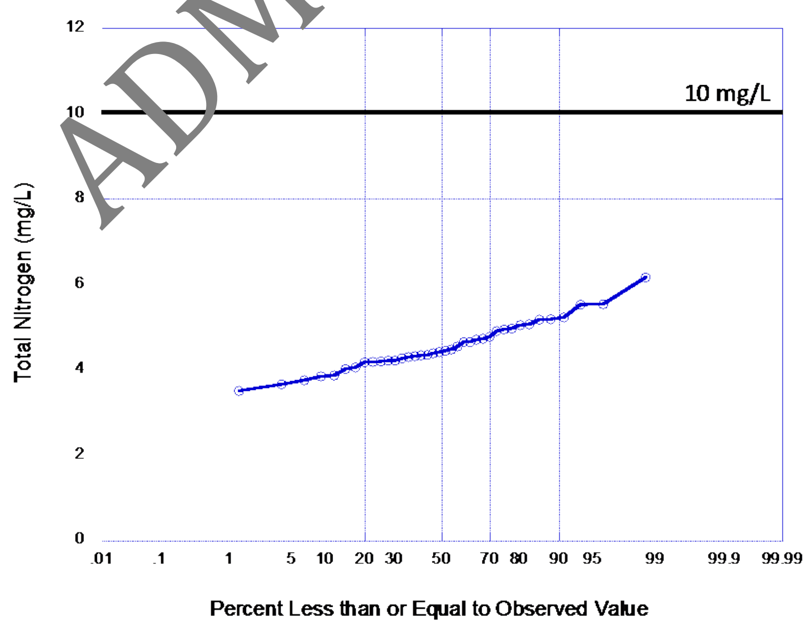

Figure 4 Total Nitrogen from 2012 to 2014 for Final Effluent from Valencia WRP

As previously discussed, the sulfate concentration in the effluent of the Valencia WRP is above the SNMP water quality objective in the Santa Clara River Valley East Subbasin. Any surface spreading project using the Valencia WRP effluent would require mitigation by blending with the planned Valencia AWTF or by providing additional treatment. Blending with the AWTF water was only considered in this analysis and a 70/30 blend of tertiary effluent to RO permeate was assumed based on input from SCVSD.

NDMA concentrations are above the NL established by the DDW and will require discussion on how SAT will aid the removal for a spreading project. The Montebello Forebay has been operating since the 1960's by spreading water that undergoes a similar level of treatment and contains NDMA levels above the NL. Research projects focused on NDMA at the Montebello Forebay, as well as other research, have indicated that NDMA is well removed by SAT (Trussell 2014, Drewes, 2006, Nalinakumari, 2010).

The RW from the Valencia WRP has no other constituents that are above their respective regulatory limits. One possible challenge could be the chloride TMDL in the SCR. While the RW would be spread and percolated into the ground (where the chloride limit is 150 mg/L), given the strict chloride limit in the SCR of 100 mg/L, special attention to prevent upwelling of the groundwater into the river will need to be addressed.

2.3.4 RW Availability

As discussed previously, any IPR scenario first must meet the minimum river discharge of 8.5 MGD and the RW demand of 5.3 MGD (see Table 2). After these demands, the Valencia WRP has 4.9 MGD of available RW.

2.3.5 Potential Recharge Locations

The document "Castaic Lake Water Agency – Water Resources Reconnaissance Study" (Recon Study) provided CLWA and the local water purveyors with water supply augmentation strategies to deal with future dry years and the resulting decrease in SWP water availability. In the groundwater replenishment analysis of the study, three recharge locations (shown in Figure 5) were considered as potential spreading basins based on the six-month retention time requirement used in the GRR to achieve 10-log removal of *Cryptosporidium* and *Giardia*. This will be discussed further in Section 2.3.6 Retention Time and Microorganism Control.

Figure 5 Potential Recharge Location (blue triangles) in Recon Study

In the Recon Study, Recharge Location #2 was eliminated as an option due to its proximity to existing drinking water wells, which would result in retention times below 6-months. For this analysis, the location of Recharge Location #1 was moved out of the river to the riverbank for further analysis. Having an in-river basin presents the challenge of managing the spreading facility operation during storm events to prevent discharge into the river itself. Moving the recharge location to the riverbank considerably simplifies this operation.

Consistent with the Recon Study, an infiltration rate of 3 feet per day was used for all spreading basins. The infiltration rate for any given spreading basin is site specific and can range from 0.5 feet per day to greater than 5 feet per day. An infiltration rate of 3 feet per day is consistent when compared with several active spreading basins owned and operated by the Los Angeles County Department of Public Works, Flood Control District (LACDPW) with similarly sandy soils (Table 4).

Table 4 Reference Infiltration Rates in Existing Spreading Basins

Existing Spreading Basin	Infiltration Rate (ft/d)	Reference
Montebello Forebay	2-3	Laws, et.al., 2010
Santa Fe Spreading Grounds[1]	4.7	via LACDPW website www.ladpw.org/wrd/spreadingground/information/facdept.cfm%3Ffacinit=1
Hansen Spreading Grounds[1]	2.5	via LACDPW website www.ladpw.org/wrd/spreadingground/information/facdept.cfm?facinit=20

[1] Currently only storm water is spread at these facilities, but no change in infiltration rate is anticipated with the implementation of RW for spreading.

2.3.5.1 Recharge Location #1

According to the LACDPW there are currently 53 acres of city-owned parcels available near Recharge Location #1 for use as a potential recharge basin (*SCR Watershed Study*, 2007). For this study, the 21 acres identified in Figure 6 were considered as Recharge Location #1. The 1 acre-basin is envisioned to be used as a settling basin for stormwater flows, which would be diverted to the pond via an inflatable dam across the SCR. A pipeline would connect the 1-acre area and the 20-acre area to maximize reuse. Additional study is required to optimize the location of the inflatable dam and to design the hydraulics and control to maximize recycled water and stormwater recharge. This project would likely require a partnership with LACDPW to operate the in-river and stormwater components of the system.

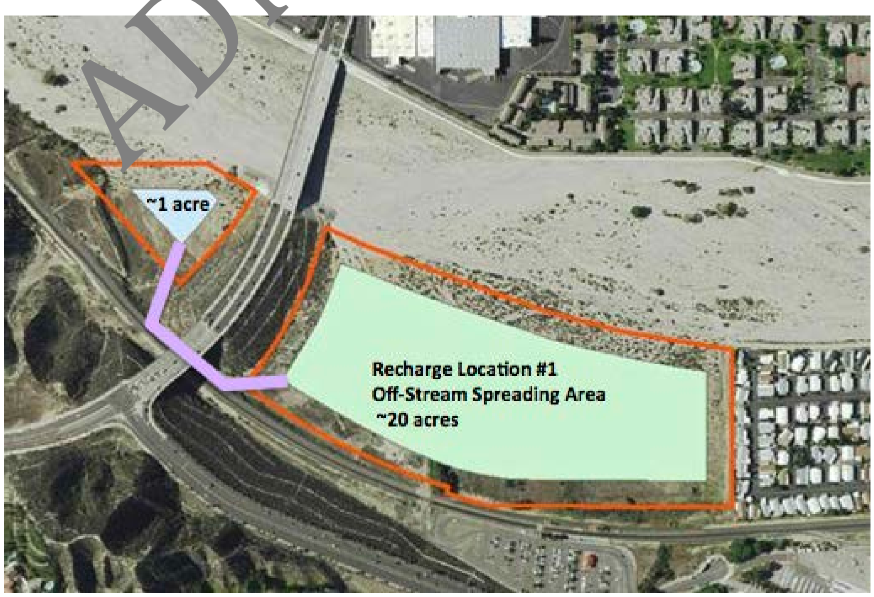

Figure 6 Proposed Location and Size of Recharge Location #1

2.3.5.2 Recharge Location #2

Recharge Location #2, as identified and discussed in the Recon Study, was eliminated from consideration due to insufficient travel time. No further analysis on this location was considered as part of the RW Master Planning effort.

2.3.5.3 Recharge Location #3

Recharge Location #3 was also considered as described in the Recon Study and the LACDPW's SCR Watershed Study (*SCR Watershed Study*, 2007). Recharge Location #3 is located in-river and would include a recharge area of approximately 28 acres, as shown in Figure 7.

Figure 7 Proposed Location and Size of Recharge Location #3

2.3.5.4 RW Spreading Restrictions

While the potential amount of RW available annually for spreading was developed and shown in Table 2, the actual RW contribution may be limited by seasonal water availability and the capacity of the respective recharge location. Stormwater capture was prioritized and it was assumed that during heavier months of rainfall, spreading RW would be limited. As shown in Table 5, if the average monthly rainfall (2007-2015) was greater than 2-inches, then a 50% usage was assumed. If the average monthly rainfall was greater than 1-inch, then a 75% usage was assumed. If the rainfall was less than 1-inch, the spreading basin was assumed to have full availability. These assumptions are based on an analysis of rain data and storm events. These assumptions are conservative and it’s possible that the recharge locations will be available for a higher percentage during winter months.

Table 5 Average Monthly Rainfall (2007-2015) and Assumed Spreading Basin Availability

Month	Average Precipitation (inches/month)	Recharge Availability (%)	Recharge Availability (days)
Jan	2.67	50%	16
Feb	2.40	50%	14
Mar	2.38	50%	16
Apr	1.18	75%	23
May	0.36	100%	31
Jun	0.03	100%	30
Jul	0.02	100%	31
Aug	0.11	100%	31
Sept	0.27	100%	30
Oct	0.27	100%	31
Nov	1.68	75%	23
Dec	1.78	75%	23

Monthly spreading flows of RW were determined for each recharge location based on the spreading area and the limitations caused by precipitation. The maximum RW spread was determined and is the same for both Recharge Location #1 and #3 and is summarized in Table 6 on an annual basis and Figure 8 on a monthly basis. Due to availability restrictions for basins during stormflow and peak summer irrigation demands on the RW supply, not all of the available RW can be spread.

Table 6 Annual RW Contributions for Recharge Locations #1 and #3

Recharge Location	RW Available (MGD)	RW Spread (MGD)
#1	4.9	3.3
#3	4.9	3.3

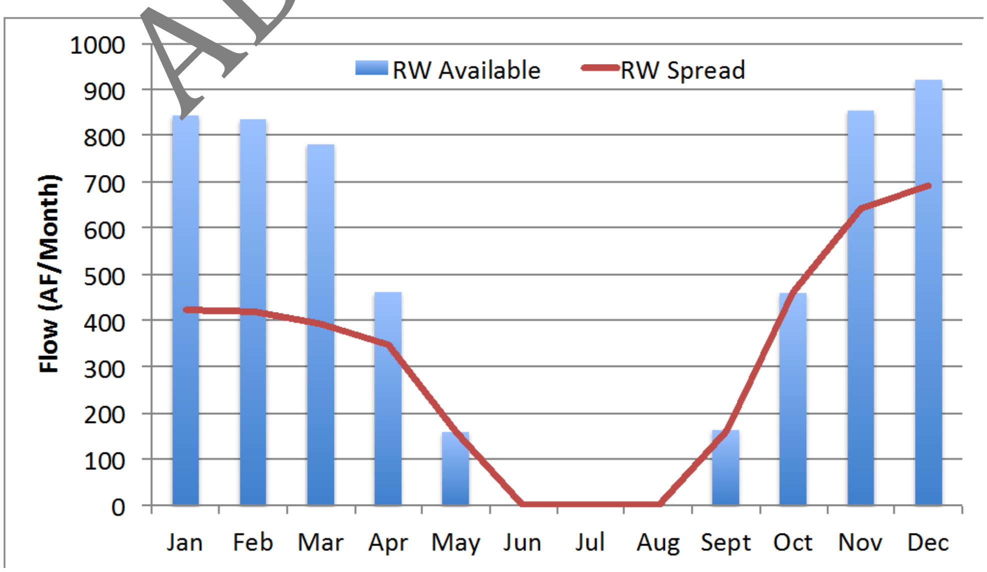

Figure 8 Monthly Comparison of Available RW and RW Spread for Recharge Location #1 and #3

2.3.6 Retention Time and Microorganism Control

The RW discharged will need to satisfy the GRR for pathogen control. Table 7 illustrates the required removal criteria for enteric virus, *Cryptosporidium*, and *Giardia* (V/G/C). For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least three processes must each achieve no less than 1-log reduction.

Table 7 GRR Pathogenic Microorganism Control

Pathogen	Removal Criteria
Enteric Virus	12-log
Giardia	10-log
Cryptosporidium	10-log

Removal credit can also be obtained through the amount of time the reclaimed water is maintained underground (e.g., retention time). For a surface spreading project, the following conditions apply:

- 1-log virus credit per month of retention time underground
- 10-log *Cryptosporidium* and *Giardia* credit for 6 months or greater retention time underground

To determine the retention times associated with Recharge Location #1 and Recharge Location #3, groundwater modeling was performed by GSI Water Solutions, Inc. (GSI). Calculated monthly discharge volumes were input into the model for varying groundwater conditions and retention times were calculated.

Figure 9 illustrates the results of the modeling effort for Recharge Location #1 and shows both the capture zones from nearby drinking water wells (indicated in thick yellow and white lines) and the flow path from the spreading basin (indicated with thin red lines). The results show that Valencia Water Company's (VWC) well VWC-U4 captures water in the range of 8-10 months. For planning stages, hydraulic modeling only receives half of the potential log credit. Therefore, a 10-month travel time would result in a 5/0/0 for V/G/C.

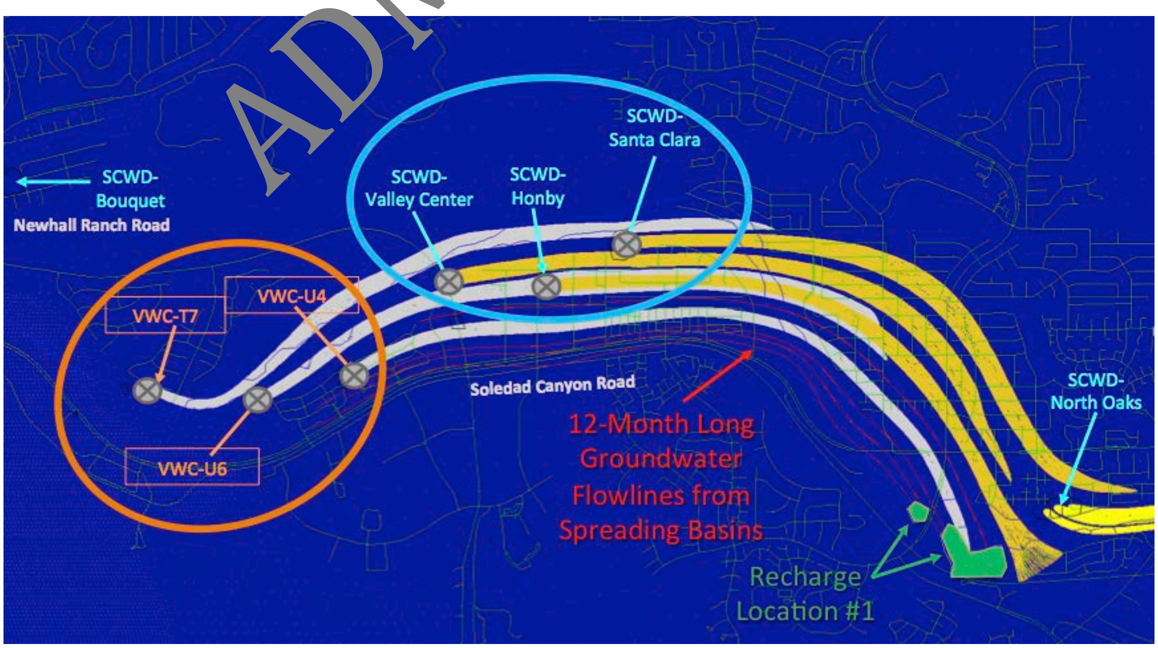

Figure 9 Groundwater Modeling for Recharge Location #1

To validate the retention time of the groundwater and thus increase the associated log credit, an added or intrinsic tracer test is required. An added tracer gets a 1-log reduction credit per month, while an intrinsic tracer gets 0.67-log credits per month. Implementation of an alternative using Recharge Location #1 would require one of two options: 1) Spread potable water spiked with a tracer to verify the travel time or 2) shut down well VWC-U4 for a time period on the order of 6-12 months while the tracer test is performed. If an intrinsic tracer is used, the travel time would need to be confirmed as 9 months or greater to receive 6/10/10 for V/G/C. If an added tracer is used, verification of greater than a 6-month travel time would translate to 6/10/10 for V/G/C.

The remaining 6-log virus credit can be achieved through conventional wastewater treatment processes that exist at the Valencia WRP; 1.9-logs from primary/secondary/tertiary treatment (*Rose et. al., 2004*) and 4-logs from chlorination or 5-logs from the future UV disinfection system.

Table 8 Anticipated Pathogenic Microorganism Control for Recharge Location #1

Pathogenic Microorganism	Goal	Primary, Secondary, Tertiary	Disinfection[1]	Subsurface Travel Time	Total
log virus	12	1.9	5	8	14.9
log Giardia	10	0.8	0	10	10.8
log Crypto	10	1.2	0	10	11.2

[1] Includes entire 5-log filtration disinfection requirement for Title 22 with UV

Additionally, Santa Clarita Water Division's (SCWD) SCWD-Honby well's capture zone is very close to the recharge location. This well would likely be monitored during the in situ tracer test and also has a travel time of near 8-10 months.

Other observations made by GSI include the possibility of groundwater upwelling into the river when the groundwater basin is relatively full and increased pumping by downstream production wells to prevent localized daylighting of groundwater at those wells. These issues will need to be considered and controlled when implementing a surface spreading project.

Figure 10 illustrates the results of the modeling effort for Recharge Location #3. The results show there is an 18-month travel time to the nearest drinking water well in the Pinetree Wellfield. A hydraulic modeling result receives 50% travel time credit, so a 9-month travel time will be credited, resulting in 9/10/10 for V/G/C. In combination with the above ground existing disinfection, this is sufficient to meet the required pathogenic microorganism control log removals as shown in Table 9.

Figure 10 Groundwater Modeling for Recharge Location #3

Table 9 Anticipated Pathogenic Microorganism Control for Recharge Location #3

Pathogenic Microorganism	Goal	Primary, Secondary, Tertiary	Disinfection	Subsurface Travel Time	Total
log virus	12	1.9	5[1]	9	15.9
log Giardia	10	0.8	0	10	10.8
log Crypto	10	1.2	0	10	11.2

[1] Includes entire 5-log filtration disinfection requirement for Title 22 with UV

2.3.7 Diluent Volume

An important parameter in any surface spreading project is the municipal recycled wastewater contribution (RWC) and its closely related TOC requirement in the GRR. The RWC is defined as:

$$RWC = \frac{Recycled\ Water\ Applied}{Recycled\ Water\ Applied + Dilution\ Water} \quad (1)$$

The dilution water is the pre-existing surface or subsurface flow available to blend with the RW. Sources of surface water include rainfall, stormwater, and irrigation runoff, while the category of subsurface water is comprised solely of native groundwater. In the case where surface flow data is absent, such as in Recharge Location #1 and Recharge Location #3, groundwater underflow is relied upon as the dilution water. These values were modeled by GSI as part of the Recon Study and are based on Darcy's Law, which consists of the hydraulic conductivity, cross sectional area, and hydraulic gradient of the desired recharge basin.

In the Recon Study, two cross sectional areas were utilized to obtain the diluent flows; Method 1 used the width of the entire aquifer and Method 2 used the cross sectional area of the recharge basin. For this report, the diluent water calculated via Method 2 was used for both Recharge Location #1 and Recharge Location #3 and was 16.1 MGD and 4.5 MGD, respectively. A higher diluent volume is desirable, since it allows more RW to be spread. While the diluent water calculated in Method 1 was significantly higher and therefore more desirable, DDW may not consider all of the calculated diluent water to be available for mixing with the RW applied.

Table 10 Modeled Diluent Waters

Site	Method #1-Groundwater Basin cross-sectional area (MGD)	Method #2-Recharge Location cross-sectional area (MGD)
Recharge Location #1	51.8	16.1
Recharge Location #3	32.1	4.5

Another method (Method 3), used by the Inland Empire Utilities Agency (IEUA) to calculate the underflow of the Chino Basin aquifer and already approved by the DDW, could be applied to both recharge locations to obtain higher diluent volumes. This technique involves a 45 degree, outward extension from the cross sectional area of the recharge basin, which inherently results in a larger area. Through Darcy's equation, a larger diluent volume could be attained, resulting in a larger allowable RW application.

2.3.8 RW Contribution

Per the GRR, at the beginning of the project, the initial maximum RWC cannot exceed 20% unless specifically pre-approved. A 20% initial RWC would result in a RW application of 4.0 MGD and 1.1 MGD for Recharge Locations #1 and #3, respectively. The diluent volume limitation of Recharge Location #3 is noticeable in the low amount of reclaimed water that can be spread in the initial startup of the groundwater replenishment project.

Table 11 Initial RW Applied[1]

Site	Diluent Volume (MGD)	Initial RW Applied (MGD)
Recharge Location #1	16.1	4.0
Recharge Location #3	4.5	1.1

[1]Assumes 20% recycled water contribution at startup

For the initial RWC of 20%, a maximum TOC concentration of 2.5 mg/L must be achieved in the percolated water from a surface spreading project. This value was found with equation 2:

$$TOC_{max} = \frac{0.5\ mg/L}{RWC} = \frac{0.5\,{}^{mg}/_{L}}{20\%} = 2.5\,{}^{mg}/_{L} \qquad (2)$$

Once an IPR spreading project is underway and has shown itself to be protective of public health and the environment, the sponsor (CLWA) can petition DDW to increase the RWC.

2.3.9 TOC and Ultimate Utilization

TOC is not routinely reported at the Valencia WRP. However, as part of SCVSD's chloride compliance AWTF planning, TOC concentrations in the Valencia WRP effluent were monitored. For planning purposes, SCVSD provided an average TOC value of 4.7 mg/L for the Valencia WRP. This is above the 2.5 mg/L for an initial 20% RWC and as such two mitigation efforts will be utilized: 1) blending of tertiary wastewater with AWTF water to lower the TOC above ground and 2) receiving credit for the TOC removal that naturally occurs via SAT. Typically, an SAT factor (STF) of 60-70% has been observed through other applications and research (Trussell, 2014, Laws, 2011, Ly, 2011, Chino, 2014). Table 12 shows the breakdown of RW sources for surface spreading at Recharge Location #1 and #3.

Table 12 TOC at Recharge Locations #1 and #3

Recharge Location	Possible RW Contribution [1] (MGD)	RW Source	RW Flow from Source (MGD)	TOC (mg/L)	SAT Credited TOC[2] (mg/L)	Ultimate RWC (%)
#1	**3.3**	Valencia Blend	1.8	3.4	**1.20**	**17%**
		Valencia Tertiary	1.5	4.7		
		RW Applied Total	**3.3**	**4.0**		
#3	**3.3**	Valencia Blend	2.0	3.4	**1.18**	**43%**
		Valencia Tertiary	1.3	4.7		
		RW Applied Total	**3.3**	**4.0**		

[1]As developed in Table 6
[2]An assumed SAT factor of 70% was used for this analysis.

The resulting analysis from Table 12 shows that at both Recharge Location #1 and Recharge Location #3, the TOC will be below the required 2.5 mg/L to meet the initial RWC of 20%. The ultimate RWC for Recharge Location #1 is 17% and the ultimate RWC for Recharge Location #3 is 43%. Recharge Location #3 is initially limited by the amount of diluent water (Table 11), but ultimately, both locations are limited by the available RW. Neither location is limited by the TOC requirement.

Table 13 compares the volume spread for the two recharge locations and shows how much RW could be applied at each location while still meeting the TOC and diluent volume requirements. It is clear from Table 13 that the limitation for both recharge locations is the amount of available RW. If more RW were available, these recharge locations could effectively spread up to the hypothetical ultimate RW shown in Table 13 based on the GRR's RWC and TOC requirements.

Table 13 Flow Comparison at Recharge Locations #1 and #3

Recharge Location	Available RW (MGD)	Initial RW (MGD)	Ultimate RW (MGD)	Hypothetical Ultimate RW[2] (MGD)
#1	3.3	3.3	3.3	10.7
#3	3.3	1.1[1]	3.3	4.2

[1]Based on an initial 20% RW Contribution
[2]RW that could be spread if more RW were available

2.3.10 Alternative Conveyance Concepts

Surface spreading at Recharge Locations #1 and #3 require conveyance to the proposed recharge location, the construction of the recharge basin, diversion facility and maintenance of the conveyance pipe and the recharge basin. The conveyance concept for Recharge Location #1 is shown in Figure 11. Surface spreading at Recharge Location #1 requires the extension of the proposed Phase 2A pipeline for approximately 3.5 miles, and the construction of the spreading basin and a diversion structure (eg. Recharge Location #1). A similar conveyance concept was developed for Recharge Location #3 by extending the pipeline as shown in Figure 12. Facility capital and operations costs for each alternative are presented in the Recycled Water Master Plan.

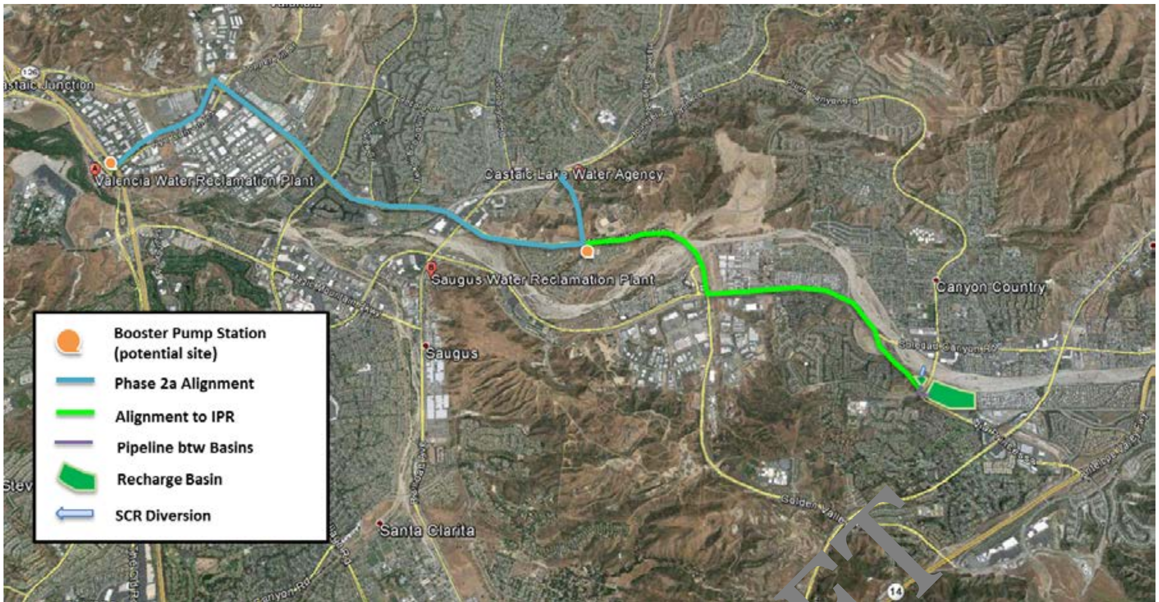

Figure 11 Conveyance Concept for Surface Spreading at Recharge Location #1

Figure 12 Conveyance Concept for Surface Spreading at Recharge Location #3

2.4 DIRECT INJECTION

The direct injection alternative is also regulated under the GRR and has very similar guidelines to the surface spreading alternative with some very important differences. Notable differences include:

- Full Advanced Treatment requirement
- 100% RWC contribution upon commencement
- 2-month minimum retention time with additional treatment above ground

2.4.1 Treatment Requirements

The direct injection alternative does not benefit from SAT and therefore needs to provide a higher degree of treatment above ground at a treatment facility itself. The GRR requires direct injection projects to have FAT (e.g., MF/RO/AOP). The GRR has specific requirements for the RO and AOP technologies in the FAT train. The RO membranes must achieve a minimum and average sodium chloride rejection of 99.0% and 99.2%, respectively. The initial RO permeate TOC must be less than 0.25 mg/L and not exceed 0.5 mg/L over the long term, based on a 20-week running average of all TOC results and the average of the last four TOC results.

There are two options for demonstrating the performance of the AOP. The first option is to conduct an occurrence study to look at one constituent from each of nine classes of chemicals and demonstrate between 0.3- and 0.5-log reductions of the various classes. The second, simpler option is to demonstrate 0.5-log removal of 1,4-dioxane. 1,4-dioxane was selected as an indicator because it represents the class of low molecular weight, uncharged chemicals that are difficult to remove through RO, and it is one of the more difficult chemicals to remove by advanced oxidation. Processes that can control 1,4-dioxane are assumed to remove numerous additional CECs, and thereby protect public health.

UV/hydrogen peroxide is the most common AOP in place for groundwater replenishment reuse projects. UV/free chlorine offers some unique advantages, and is being implemented as an alternative AOP at the City of Los Angeles, Bureau of Sanitation Terminal Island WRP. There are also situations where ozone/hydrogen peroxide may be an effective AOP for a GRRP though its inability to remove NDMA is often a limiting factor.

2.4.1.1 Brine Disposal

The implementation of an RO process creates brine that will need to be disposed of, a considerable challenge with the chloride TMDL for discharges to the Santa Clara River. A typical recovery for RO is 85% product water with 15% of the feed water being disposed of as brine. This brine is high in salts including chloride, which is well rejected by the RO membrane and builds up to high levels in the brine. Typical disposal methods for brine include truck hauling, ocean disposal, deep well injection, drying beds, and/or maximizing RO recovery.

2.4.1.2 SCVSD Chloride Compliance Project

SCVSD, as part of their chloride compliance project, spent considerable time and energy determining how best to design the optimal AWTF and dispose of the brine in the most economical way. SCVSD is currently in design using a treatment train that includes RO at an anticipated recovery of 99%, thereby minimizing the brine produced. The reduction in brine generation allows SCVSD to truck the brine at an economical rate when compared to other disposal methods. Specifically, SCVSD also studied conveyance to an ocean outfall and deep well injection as alternatives for brine disposal, but found that trucking the brine, along with minimizing its formation, was the most economical decision.

The SCVSD treatment train includes MF, enhanced brine concentration (EBC), RO, and UV for disinfection. The EBC process is designed to pretreat the water prior to RO to reduce certain target constituents that commonly foul RO membranes including calcium, magnesium, and other salts while allowing chloride to pass through to be removed by the RO. Figure 13 shows a schematic of the treatment train. The EBC process consists of nanofiltration (NF), ion exchange (IX) and pH control. The brine from the RO process will be trucked to the Sanitation Districts of Los Angeles County (LACSD) Joint Water Pollution Control Plant in Carson for disposal.

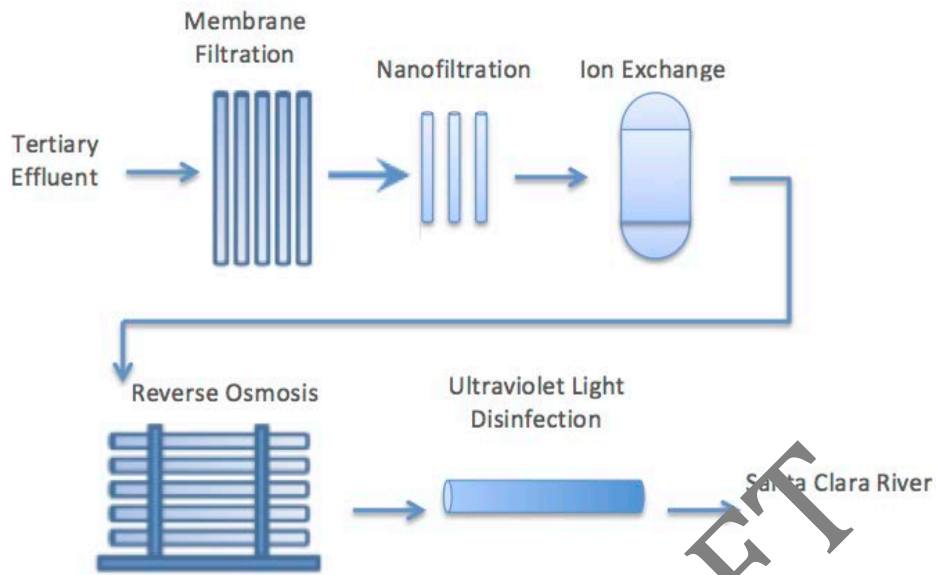

Figure 13 Valencia WRP's AWTF for Chloride Compliance

2.4.2 Proposed Treatment Train

Any advanced treatment train constructed as part of a direct injection IPR project will undergo the same set of challenges regarding brine disposal as those faced by SCVSD. As a result, a modified version of the treatment train selected by SCVSD was used for analysis and consideration for any CLWA AWTF requiring RO to minimize brine generation and disposal. As discussed, this treatment train consists of MF, EBC (NF, IX, pH control), RO, and UV. In the case of a direct injection project, the UV system must be designed for high doses capable of advanced oxidation, not simply for disinfection. This is the one modification from the SCVSD treatment train for the proposed AWTF for CLWA as shown in Figure 14.

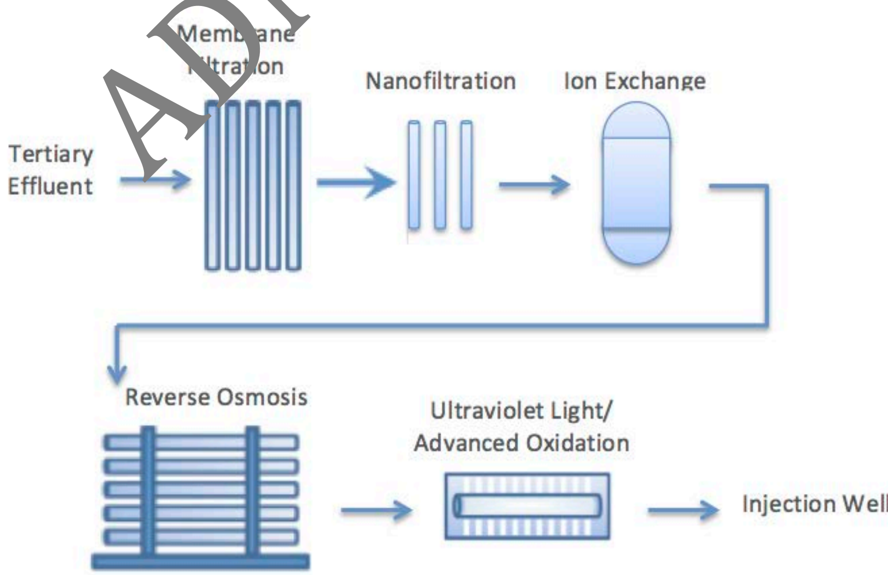

Figure 14 Proposed AWTF for Direct Injection Alternative

The recommended UV AOP could use either hydrogen peroxide or hypochlorous acid as the oxidant to drive the AOP reaction. A conservative estimate of the potential footprint of the AWTF is shown in Figure 15.

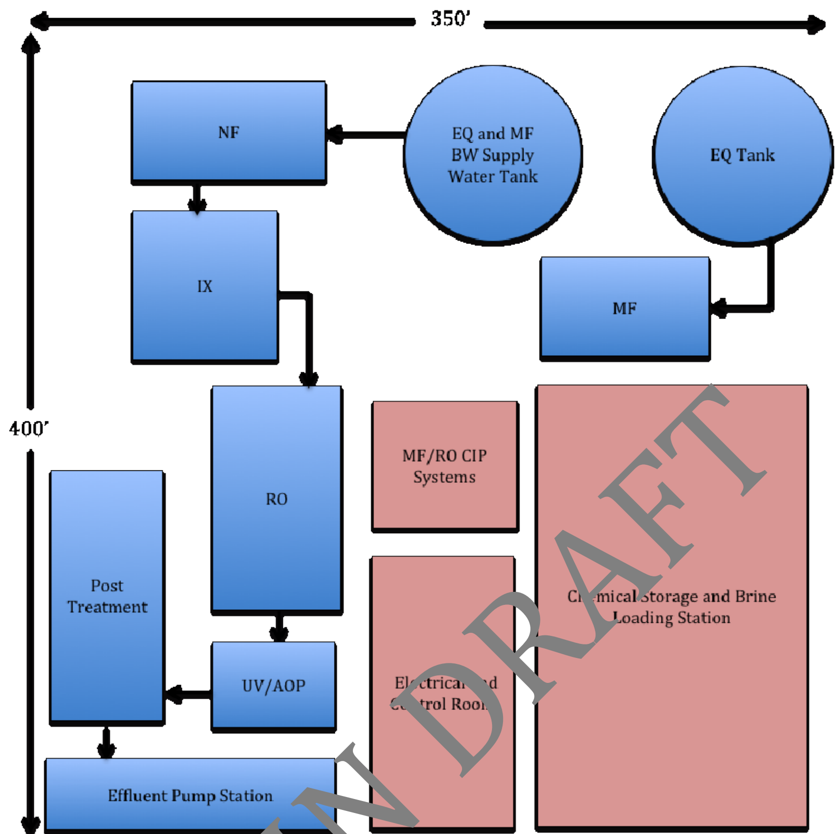

Figure 15 Preliminary AWTF Layout for Direct Injection Alternative

2.4.3 RW Quality

Since the water will be advanced treated through an RO system, it is anticipated that the water quality will be well below any regulated limits. Table 14 shows the anticipated water quality of several key constituents from the AWTF.

Table 14 Key Water Quality Parameters Projected Through AWTF for Direct Injection Alternative

Constituent	Units	VWRP Effluent	AWTF Effluent	Regulatory Requirement
Total Dissolved Solids	mg/L	690	<50	800[2]
Total Organic Carbon	mg/L	4.7	<0.1	0.5[1]
Nitrate (as nitrogen)	mg/L	2.60	<0.1	10[2]
Total Nitrogen	mg/L	4.6	2-4	10[1]
Chloride	mg/L	126	<10	150[2]
Sulfate	mg/L	178	<10	150[2]
1,4-Dioxane	µg/L	0.86	<0.15	1[3]
N-Nitrosodimethylamine (NDMA)	ng/L	121	<2	10[3]

[1] Groundwater quality objectives (GWQO) as stated in the Salt and Nutrient Management Plan (SNMP) of the Santa Clara River Valley East Subbasin.
[2] GRR requirement. Refer to Section 2.3.6.
[3] Table 64431-A (Inorganic Chemicals) of the Title 22 California Code of Regulations
[4] California notification limits (NLs) set by the Department of Drinking Water (DDW).

2.4.4 RW Availability

The Direct Injection alternative is not restricted by the RWC, as the GRR allows for 100% RWC upon commencement of the project (rather than the 20% initial RWC for surface spreading). Therefore, a direct injection project is not restricted by the amount of diluent water. An injection project is also not hindered by inclement weather as water can be injected into the ground regardless of the weather conditions. As such, all of the available RW can be utilized in a Direct Injection project. Furthermore, given the capital investment required for the AWTF, maximizing the usage of all available RW will be critical for creating the most economical alternative possible. Therefore, the AWTF is designed to treat all available RW for potable reuse. The capacity of the AWTF meets the maximum monthly available RW flow as shown in Table 15, or 9.7 MGD.

Table 15 Monthly RW Availability

Month	Monthly RW Availability (MGD)
Jan	8.9
Feb	9.6
Mar	8.2
Apr	5.0
May	1.7
Jun	0.0
Jul	0.0
Aug	0.[illegible]
Sept	[illegible].8
Oct	4.8
Nov	9.3
Dec	**9.7**
Annual Average	**4.9**

2.4.5 Potential Injection Well Locations

The injection wells can inject the RW into either the Saugus Formation or the Alluvial Aquifer in the Valley's groundwater basin. The Recon Study identified two potential locations, but considered the use of SWP for injection and as such, did not track the travel time between the injection wells and nearby potable water wells. If this alternative is selected for further consideration, additional modeling of the Saugus Formation and travel times will need to be performed to accurately site the injection well location. Figure 16 shows the recommended location of the wells as discussed in the Recon Study respective to the Valencia and Saugus WRPs. To minimize additional costs, it is assumed that the injection wells could be located onsite at the Valencia WRP, along with the AWTF. SCVSD indicated that they were not sure if there would be available footprint, so additional conveyance costs are possible if the AWTF and injection well needs to be located away from the existing Valencia WRP.

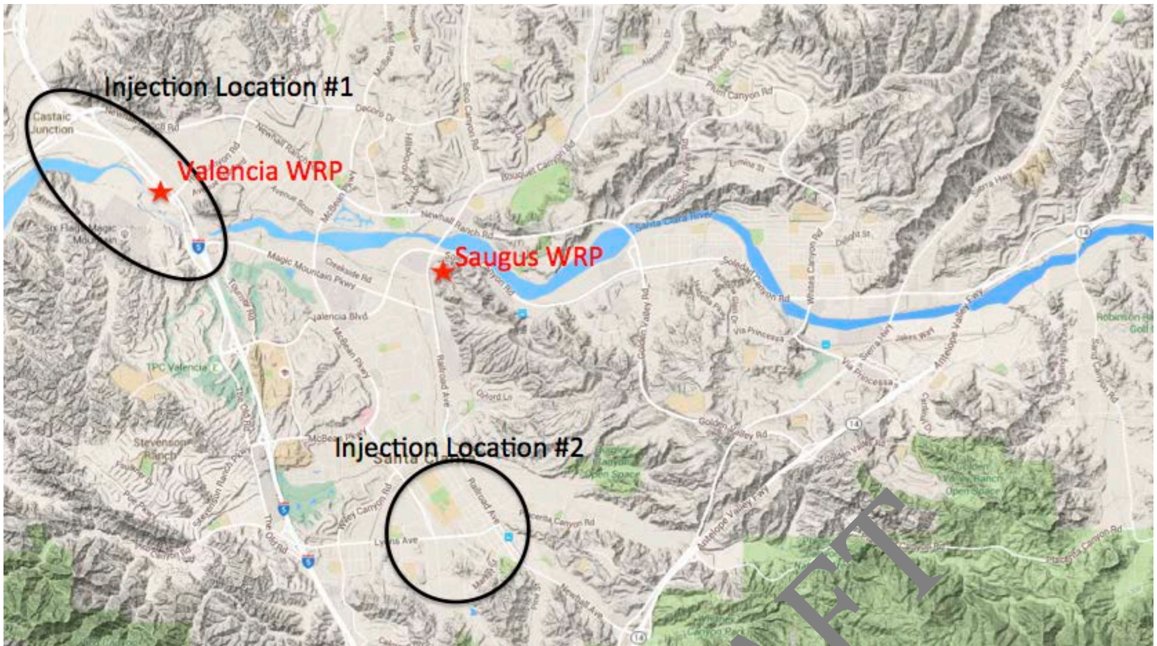

Figure 16 Injection Location Identified in Recon Study for Aquifer Storage and Recovery

2.4.6 Retention Time and Microorganism Control

The GRR mandates a minimum retention time in the groundwater basin of 2 months. No existing facilities currently operate with a retention time under 6 months, although at least four projects in planning stages are proposing such alternatives (Padre Dam, OCWD, WRD and Cambria). Minimizing the travel time underground will likely require that other aspects of the project are enhanced to compensate for the shorter retention times, including the use of enhanced treatment above ground and enhanced monitoring. Enhanced treatment indicates the need for moving beyond the 12/10/10 microorganism removal requirement stipulated in the GRR and would require additional treatment beyond what is stipulated in the currently recommended treatment train. Enhanced monitoring would require identification of additional surrogates or indicators capable of defining the treatment performance in a near time manner, allowing plant operators to notify water purveyors and DDW in a timely manner if a problem with the treatment system is identified.

For this study, it was assumed that a travel time of 6-months could be identified within the aquifer nearby the Valencia WRP. Additional consideration of this alternative should include a detailed analysis of groundwater travel times.

Table 16 Anticipated Pathogenic Microorganism Control for Direct Injection

Pathogenic Microorganism	Goal	Primary, Secondary, Tertiary	MF	NF	RO	UV/AOP	Subsurface Travel Time (6 months)	Total
log virus	12	1.9	0	1	1.5	6	6	16.4
log Giardia	10	0.8	4	1	1.5	6	0	13.3
log Crypto	10	1.2	4	1	1.5	6	0	13.7

2.4.7 Diluent Volume

The GRR stipulates that a direct injection project can have a RWC of 100% upon commencement. This makes the reliance of native groundwater a non-factor and as such is considered no further.

2.4.8 RW Contribution

The GRR stipulates that a direct injection project can have a RWC of 100% upon commencement. This makes the reliance on native groundwater a non-factor and as such is considered no further.

2.4.9 TOC and Ultimate Utilization

As previously indicated, the GRR requires that the RO process meet certain guidelines, including achieving an effluent TOC below 0.5 mg/L, based on a 20-week running average of all TOC results and the average of the last four TOC results. This allows the TOC requirement of 0.5 mg/L of wastewater origins to be met at all times and thus, no background diluent water is required. As such, all available product water from the AWTF can be injected into the groundwater basin and will be able to meet the TOC requirement.

Table 17 Direct Injection Alternative Flow Overview

Potable Reuse Scenario	Available RW (MGD)	Initial RW (MGD)	Ultimate RW (MGD)
Direct Injection	4.9	4.9	4.9

3. Surface Water Augmentation

Senate Bill 918 requires DDW to develop and promulgate regulations for surface water augmentation (SWA) by the end of 2016. SWA projects are similar to groundwater recharge in that they also use an environmental buffer--in this case, a reservoir--in between treatment and distribution. A schematic of a typical SWA project is shown in Figure 17. Key elements of SWA project requirements include pathogen and chemical control at the AWTF and retention time and dilution requirements in the reservoir.

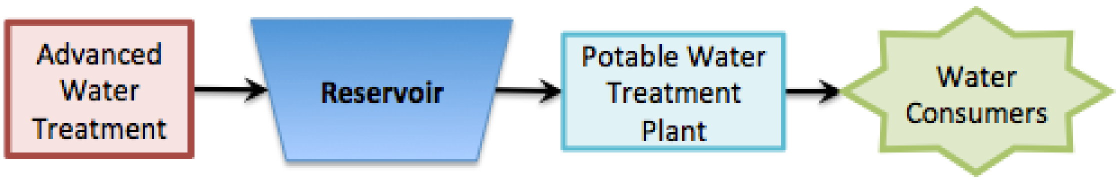

Figure 17 Schematic of a Typical SWA Project

3.1 Treatment Requirements

In the most recent draft SWA regulations, the treatment requirements look very similar to the GRR, particularly with regard to pathogenic microorganism control. Two main treatment pathways are available: (1) 12/10/10 for V/G/C with at least 100:1 dilution achieved in the reservoir, or (2) 12/10/10 for V/G/C with at least 10:1 dilution achieved in the reservoir and an additional 1-log of treatment provided by an additional process[1] - i.e., 13/11/11 for V/G/C. The size of the Castaic Lake reservoir and the anticipated project flow is such that at least 10:1 dilution can likely be achieved in the reservoir; thus, the pathogenic microorganism control requirement for CLWA's SWA project is likely to be 13/11/11 for V/G/C (for further information, see Section 3.7 Diluent Volume).

Where treatment credits are concerned, the principal difference between groundwater recharge and reservoir augmentation is the availability of treatment credit in the conventional drinking water treatment plant. The original surface water treatment rule, promulgated by EPA (EPA 1989), required the water treatment plant to provide treatment to remove 4-log virus and 3-log *Giardia*. This rule has since been updated to include 2-log *Cryptosporidium* removal as well. SWA projects can combine the treatment credit achieved prior to the reservoir and at the conventional drinking water treatment plant to achieve the required pathogen reductions. Assuming a requirement of 13/11/11 for V/G/C in the project overall, taking into account the 4/3/2 removal achieved at the drinking water treatment plant brings the minimum treatment requirements prior to the reservoir to 9/8/9.

3.2 Proposed Treatment Train

The primary purpose of designing the treatment processes will be to design a treatment system that has enough credit to achieve the required 12/10/10 log removal requirement for V/G/C by the draft SWA regulations and considers the drinking water treatment that is received on the downstream side of the reservoir storage. For this application, a similar treatment train is suggested as for the direct injection approach, as was shown in Figure 14. The capacity of the treatment system is the same, treating all available RW and sized at 9.7 MGD. The layout of the facility is the same as for direct injection as was shown in Figure 15.

[1] The process used to provide the additional 1-log of treatment does not need to be a unique type of process, but does need to be independent of and not reliant on the other treatment processes

3.3 RW Quality

The inclusion of an AWTF with an RO system will keep the product water quality well below any current regulatory limits. However, it is possible that the LARWQCB may require strict nutrient limits for environmental reasons, lowering the total nitrogen discharged as low as 1 mg/L.

3.4 RW Availability

Similar to Direct Injection, the SWA alternative is not restricted by the RWC. Therefore, the AWTF is being designed to treat all available RW and will have a capacity of 9.7 MGD to treat the maximum month RW flow (See Section 2.4.4 RW Availability).

3.5 Reservoir Specifications

CLWA receives their imported SWP water through the Castaic Lake Reservoir. The Castaic Lake Reservoir is a 320,000 acre-foot lake located on the northern edge of the CLWA service area. CLWA owns and operates the Earl Schmidt Filtration Plant, located on the southern border of the Castaic Lake Reservoir, which receives and treats water from the Castaic Lake Reservoir. The Metropolitan Water District of Southern California also uses the Castaic Lake Reservoir as part of its conveyance system for routing SWP water to customers in the Southern California area. As a result, there is a relatively low retention time in the reservoir considering its size.

Figure 18 Aerial of Castaic Lake

Due to the ongoing drought, the Castaic Lake Reservoir has seen an unprecedented drop in water storage. This can be seen most clearly in Figure 19, which shows the water level in the reservoir over the past eight years. For dilution and retention time calculations, the ultimate low water height and its corresponding volume that occurred on March 2[illegible], 2015 was used.

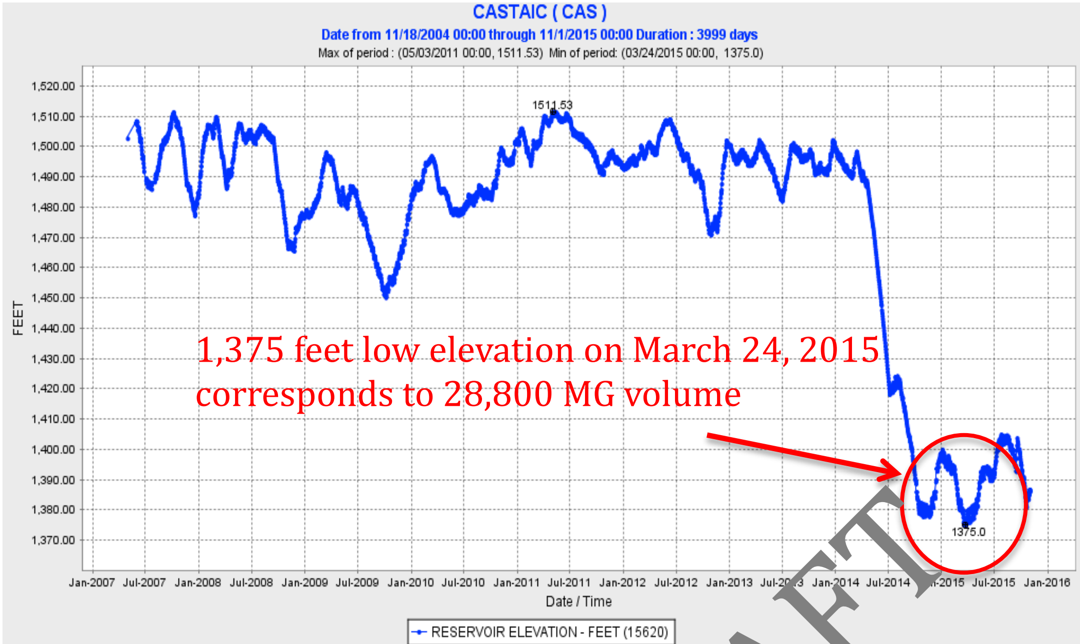

Figure 19 Castaic Lake Historical Elevation (2004–present)
(Source: California Department of Water Resources)

3.6 Retention Time

The draft SWA regulations continue to incorporate the concept of retention time, albeit taking into account the differences in hydrodynamics between an aquifer and a reservoir. The draft regulations stipulate that a reservoir used for SWA must have a minimum theoretical retention time of 6 months, to be measured on a monthly basis.

$$\tau = \frac{V_{total}}{Q_{out}} \geq 6\ months \qquad (3)$$

where V_{total} is the volume in the reservoir at the end of the month and Q_{out} is the total outflow from the reservoir during that month. The California Department of Water Resources tracks the flow out of the Castaic Lake Reservoir and over the past 10-years an average of 475 MGD leaves the reservoir per year (California Department of Water Resources, 2015). Using the low water level previously discussed, the theoretical retention time can be calculated.

$$\tau = \frac{28{,}800\ MG}{475\ MGD} = 2.0\ months\ \ngeq\ 6\ months \qquad (4)$$

As shown, the theoretical retention time is less than 6 months and thus this SWA project does not qualify under the current draft regulations. Because of the large outflows from the reservoir for other purposes, reduction of project flow would not enable this project to qualify. Unlike the groundwater regulations, there is no stipulation in the draft SWA regulations that allows for a project sponsor to petition the DDW for an alternative permitting process *for the reservoir criteria*[2]. Currently, discussions regarding this alternative permitting process are ongoing as many potential project sponsors are finding

[2] An alternative permitting pathway is available for other project components, including treatment, source control, and monitoring.

themselves in a similar situation with a lower retention time than stipulated in the draft regulations. A decision will be made in later 2016 whether to allow some flexibility in this requirement.

3.7 Dilution Requirement and Microorganism Control

The draft regulations stipulate dilution requirements for AWTF water discharged into the reservoir. The basis of these requirements is that any 24-hour input of RW to the reservoir must be mixed such that water withdrawn for use as drinking water will never contain more than 1% (or 10% with an additional log of treatment) of this input. The intent of this requirement is to provide a buffer against off-specification water that enters the reservoir; pathogen concentrations will be reduced by 2 logs, either through 100:1 dilution or 10:1 dilution with 1-log treatment.

Table 18 Draft SWA Regulation Microorganism Control Requirements

Dilution	Enteric Virus Removal	*Cryptosporidium* Removal	*Giardia* Removal
≥100:1	12-log	10-log	10-log
≥10:1	13-log	11-log	11-log
<10:1	Not classified as surface water augmentation		

To demonstrate compliance with this requirement, the draft regulations require hydrodynamic modeling that verifies the ability of the reservoir to meet this requirement under all conditions, as well as completion of a tracer study with added tracer prior to the end of the first six months of operation. The achievable dilution of a 24-hour input to Castaic Lake Reservoir can be estimated using a simplifying assumption of complete mixing; under this assumption, dilution is related to the theoretical retention time and the length of the input (Δt):

$$dilution\ factor = \frac{\tau}{\Delta t} = \frac{60\ days}{1\ day} = 60:1 \qquad (5)$$

This dilution factor means a SWA project using the Castaic Lake Reservoir would be required to achieve 13/11/11 removal for V/G/C, a slightly more stringent requirement than for groundwater recharge. Although no removal credit is given for retention time in the reservoir, the credit received at the Earl Schmidt Filtration Plant can reduce the treatment requirements at the AWTF. Table 19 shows the anticipated microorganism removals based on the developed treatment train. The draft regulation requires that no less than 9/8/9 logs of removal be achieved prior to discharge to the reservoir.

Table 19 Anticipated Pathogenic Microorganism Control for SWA

Pathogenic Microorganism	Goal	Primary, Secondary, Tertiary	MF	NF	RO	UV/AOP	Filtration Plant[1]	Total
log virus	13	1.9	0	1	1.5	6	4	14.4
log Giardia	11	0.8	4	1	1.5	6	3	16.3
log Crypto	11	1.2	4	1	1.5	6	2	15.7

[1] SWTR mandated log removal values are assumed.

3.8 Conveyance Concept

A 9-mile pipeline following Interstate-5 is proposed to convey the advanced treated water from the Valencia WRP to the Castaic Lake Reservoir as shown in Figure 20. Facility capital and operations costs are presented in the Recycled Water Master Plan.

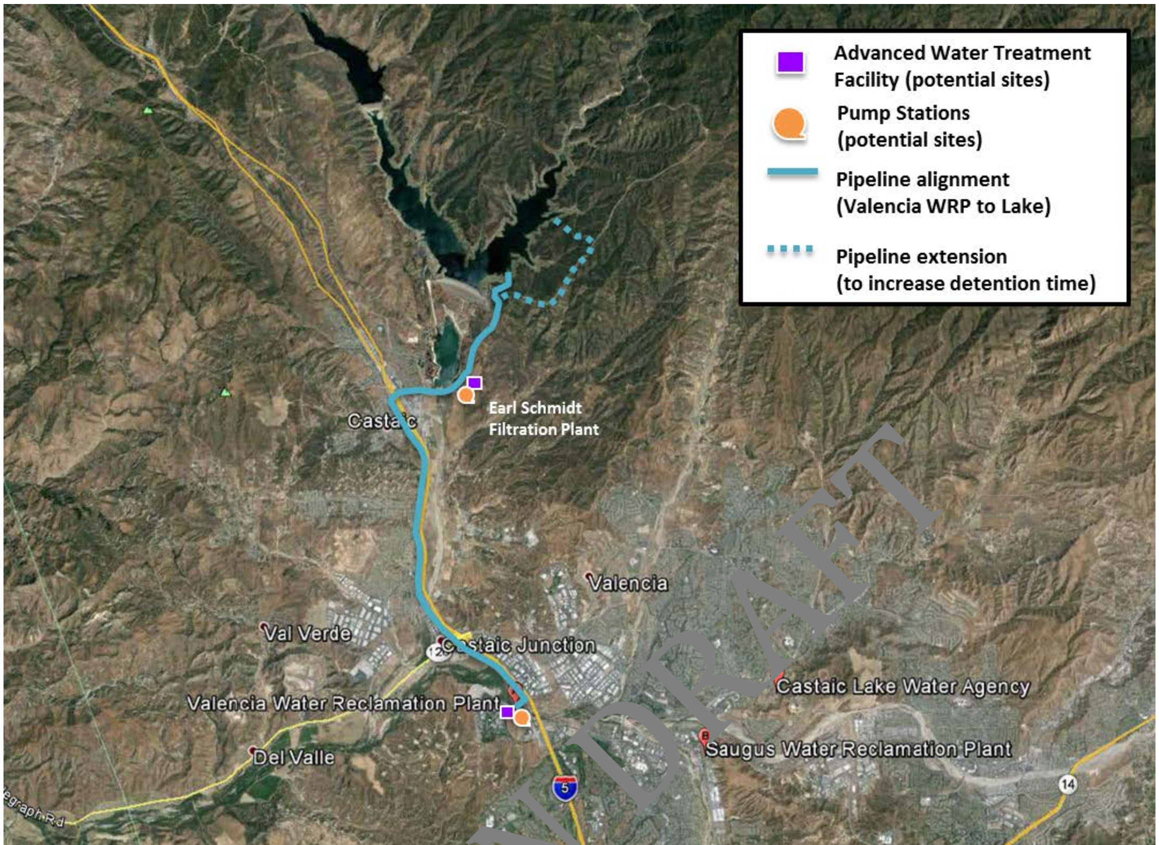

Figure 20 Conveyance Concept for SWA Project

Table 20 SWA Alternative Overview

Potable Reuse Scenario	Available RW (MGD)	Initial RW (MGD)	Ultimate RW (MGD)
SWA	4.9	4.9	4.9

4.0 Direct Potable Reuse

Direct potable reuse (DPR) has a spectrum of alternatives with significant differences in the 'directness' they seek. At one extreme, the finished water production scenario envisions an AWTF piped directly to a distribution system with no intervening barriers, storage, or retention time provided. This is the most direct form of DPR. On the other hand, AWTF water could be piped to a reservoir that is too small to comply with the surface water augmentation criteria. This water could be blended with existing source water, treated through a drinking water treatment plant, and then sent on to distribution. As such, a project classification between DPR and SWA may rely simply on the size and flow through a drinking water reservoir. Figure 21 illustrates the differing degrees of DPR project alternatives.

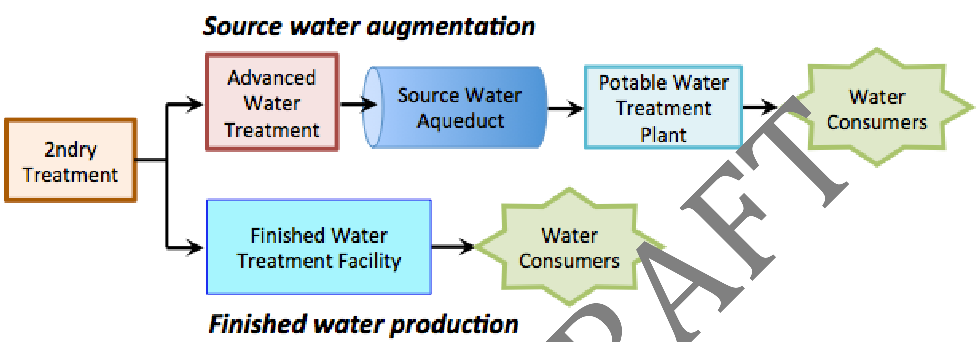

Figure 21 Potential Configurations of DPR Options and Comparison with SWA

SB918 has as its final requirement that DDW assess the feasibility of developing regulations for DPR. It is important to note that SB 918 does not require the development of regulations, but only an assessment of whether or not it is feasible to do so. ***There is no mandated timeline for the state to develop a formal DPR regulatory framework.***

The concept of DPR is fairly new and relatively untested. As a result, there is very little data on DPR design, performance, and safety. Such information is critical to assess DPR feasibility and as a result significant research efforts have recently commenced. Figure 22 provides an overview of the various research themes being pursued primarily by the WateReuse Research Foundation (WRRF), WateReuse California, and Water Research Foundation (WRF), in addition to other international partners.

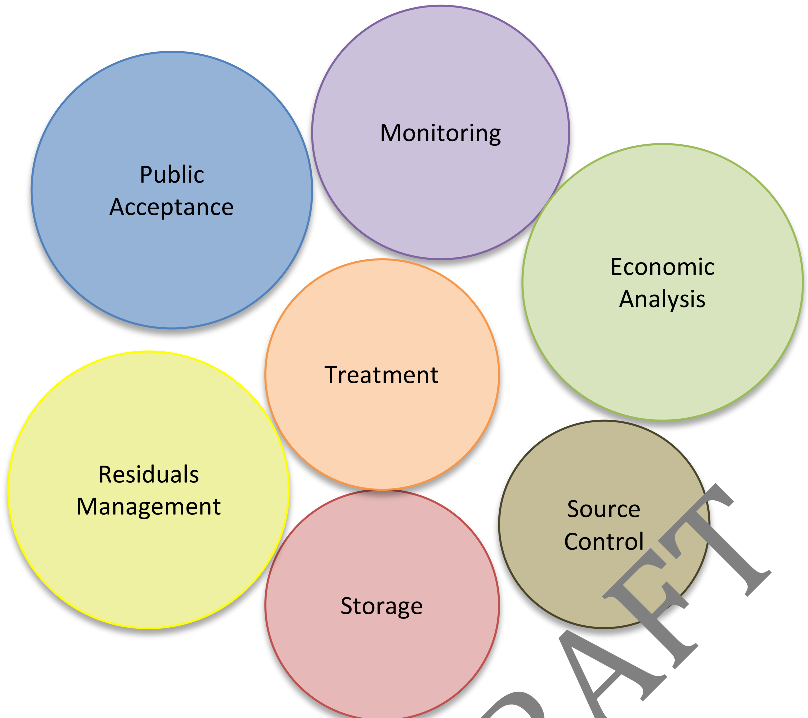

Figure 22 Ongoing Areas of DPR Research

4.1 Treatment Requirements

WRRF has created a keystone project that seeks to tie together many of the findings from the last few years of potable reuse research. This project is WRRF 14-12, entitled "Demonstrating Redundancy and Monitoring to Achieve Reliable Potable Reuse," a 1.6-MGD demonstration project at the City of San Diego's North City Water Reclamation Plant. This project ties together multiple aspects of DPR research on treatment, monitoring, and storage to address the fundamental issue of reliability in public health protection.

One result from recent potable reuse research is that the elements of public health protection--- treatment, monitoring, and storage-- can be balanced in different ways to still provide equal public health protection. For example, as retention time is reduced, increases in treatment and monitoring can compensate for equal protection. This most clearly can be seen with existing GRR, which require a minimum of 6-month retention time for less-treated Title 22 water (see Surface Spreading GWR alternative), yet a 2-month minimum retention times is allowed for full advanced treated water. A similar framework can be seen in the draft surface water augmentation regulations, which require 13/11/11 (V/G/C) logs of pathogen removal (instead of 12/10/10) if the reservoir provides less dilution.

4.2 Proposed Treatment Train

Project 14-12 has developed a DPR concept train that further augments both the treatment protection and the monitoring to provide continuous and demonstrable performance of a DPR train. The treatment train provides redundancy in both treatment and monitoring to reduce the probability that the system will fail to treat the water to the required levels. It also provides new and different barriers in the form of ozone and BAC pre-treatment, offering two new and different mechanisms to control the wide diversity of potential chemical and microbiological threats. Finally, the system has a high degree of monitoring to detect system compromises and failures, and respond accordingly. The treatment train from Project 14-12 is shown in Figure 23.

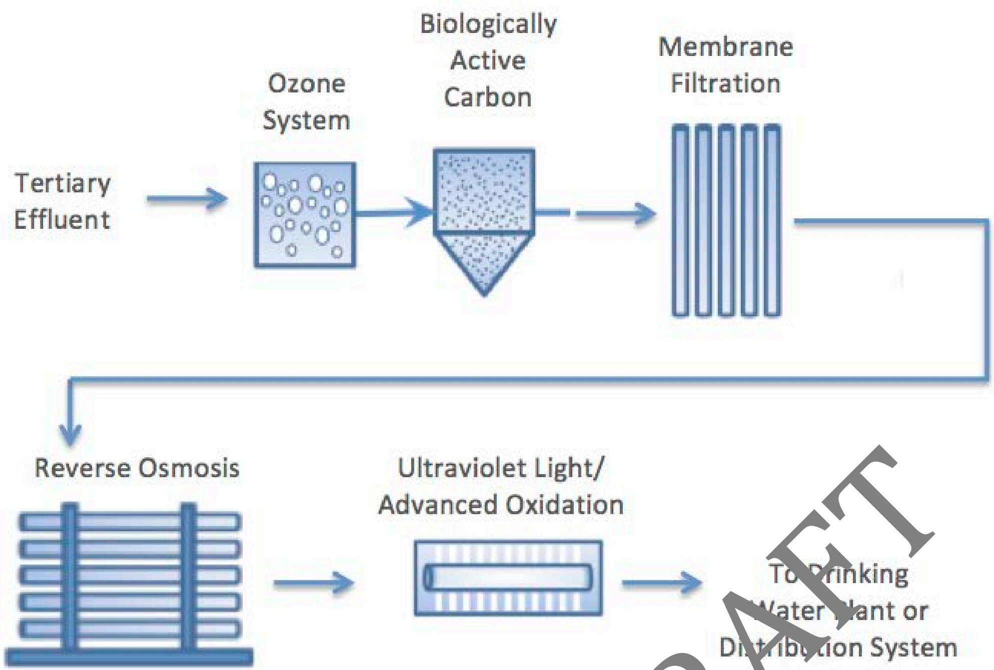

Figure 23 WRRF 14-12 Demonstration Treatment Facility

To maintain the desire to minimize brine, the treatment train used in WRRF 14-12 was modified to mirror the SCVSD chloride compliance project with the addition of ozone and BAC as pretreatment. Figure 24 shows the proposed treatment train. A conservative estimate of the preliminary layout for the proposed AWTF is shown in Figure 25.

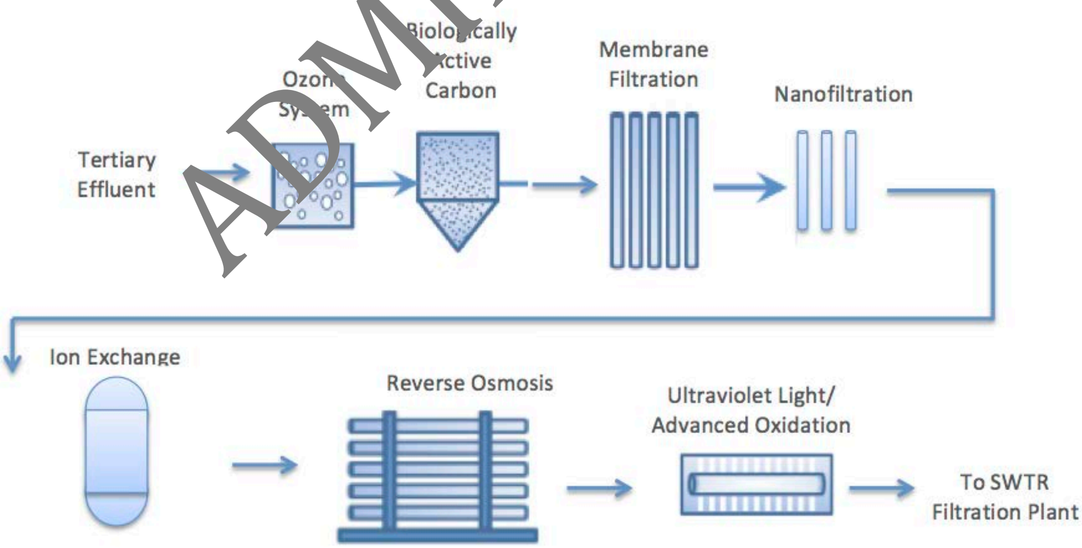

Figure 24 Proposed AWTF for DPR Treatment Alternative

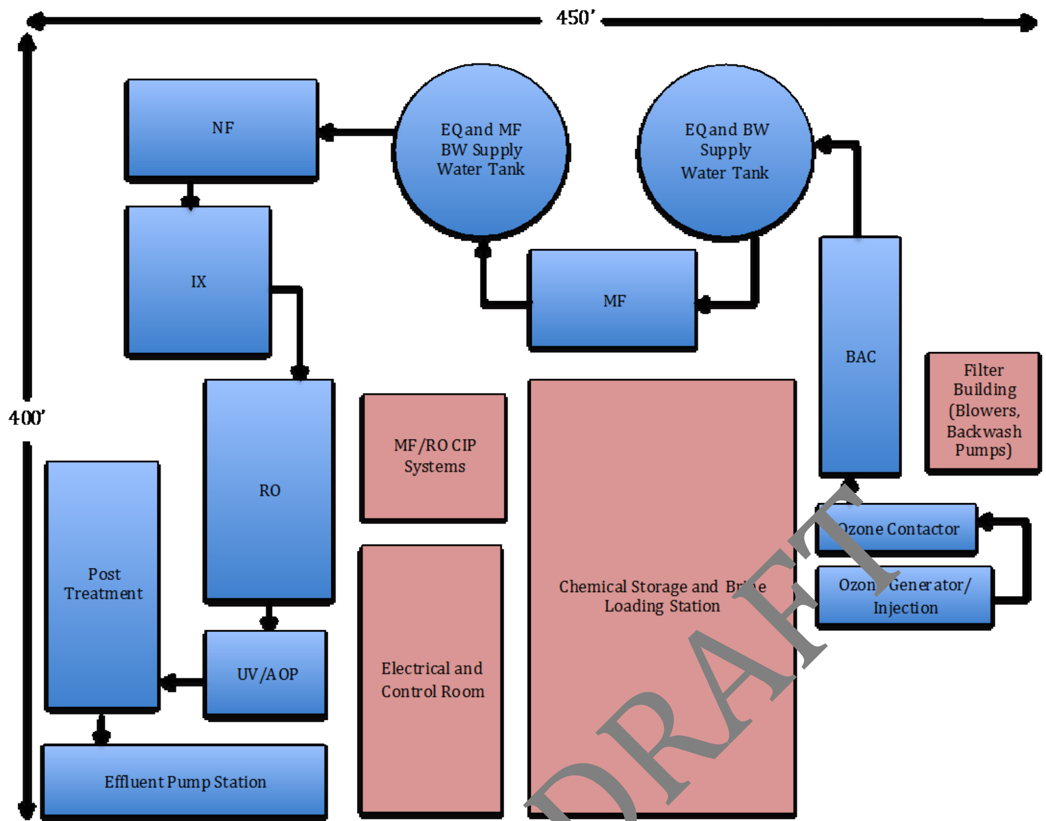

Figure 25 Preliminary AWTF Layout for DPR Treatment Alternative

4.3 Diluent Volume and Microorganism Control

While there is no framework yet for DPR, the effective microorganism control of the proposed treatment train was determined and is shown in Table 21. It is anticipated that a minimum of 13/11/11 will be required, as indicated by the SWA draft regulation where dilution is at a minimum.

Table 21 Anticipated Pathogenic Microorganism Control for DPR

Pathogenic Microorganism	Goal[1]	Primary, Secondary, Tertiary	O3	BAC	MF	NF	RO	UV AOP	Filtration Plant[2]	Total
log virus	≥13	1.9	6	0	0	1	1.5	6	4	20.4
log Giardia	≥11	0.8	6	0	4	1	1.5	6	3	22.3
log Crypto	≥11	1.2	2	0	4	1	1.5	6	0	15.7

[1] The DPR requirements are not developed and it is presumed that they will be no less than 13/11/11 to meet the most stringent requirements of the draft SWA regulations.
[2] SWTR mandated log removal values are assumed.

4.4 Conveyance Concept

The proposed DPR concept alternative involves sending the advanced treated water from Valencia WRP to the Rio Vista Filtration Plant for further treatment prior to distribution. Figure 26 shows the conveyance concept. ***It is important to note that this alternative is speculative as there is neither a developed framework for regulations nor any established timeframe for promulgating DPR regulations.***

Figure 26 Conveyance Concept for DPR

Table 22 DPR Alternative Overview

Potable Reuse Scenario	Available RW (MGD)	Initial RW (MGD)	Ultimate RW (MGD)
Direct Potable Reuse	4.9	4.9	4.9

5. SUMMARY OF POTABLE REUSE ALTERNATIVES

Table 23 summarizes the flows for all considered potable reuse alternatives. For all of the potable reuse scenarios, the available RW is dependent on population growth and water conservation because the projected flows are derived on a per capita basis. Additionally, the available RW is dependent on other non-potable RW demands such as the planned Newhall Ranch development. If additional RW were made available to potable reuse (eg. if purple pipe is not constructed as planned) more RW would be available for spreading (see Table 13 for ultimate spreading capacities). Finally, the addition of ozone as a pretreatment step to spreading would allow additional volume to be spread (even beyond what is stipulated in Table 13) and would assist in alleviating public perception by providing an additional treatment barrier that is effective at the destruction of CECs.

Table 23 Alternative Comparison

Potable Reuse Scenario	INITIAL		ULTIMATE		DESIGN
	Ave Annual Flow (MGD)	Annual Recharge Volume (AFY)	Ave Annual Flow (MGD)	Annual Recharge Volume (AFY)	Peak Flow for Conveyance (MGD)
Recharge Location #1	3.3	3,700	3.3	3,700	9.7
Recharge Location #3	1.1	1,200	3.3	3,700	9.7
Direct Injection	4.9	5,500	4.9	5,500	9.7
Surface Water Augmentation	4.9	5,500	4.9	5,500	9.7
Direct Potable Reuse	4.9	5,500	4.9	5,500	9.7

AFY = acre-feet per year

Note: Average and annual recharge volumes are based on 2050 available recycled water flows from the Valencia WRP.

6. REFERENCES

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Engineers Opinion of Probable Cost
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30 years
Alternative:	Phase 2a Boquent Canyon Alignment	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	0.4 mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	482 Annual Irrigation Demand (AFY)
				Design Capacity:	681 Max Day Demand (gpm)
					2,044 Peak Hourly Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	8 inch-dia pipeline segments	16,439	lf	112	1,841,185	8 in-diameter $14 per inch-dia-lf
2.2	12 inch-dia pipeline segments	3,106	lf	180	559,060	12 in-diameter $15 per inch-dia-lf
2.3	16 inch-dia pipeline segments	11,943	lf	240	2,866,203	16 in-diameter $15 per inch-dia-lf
2.4	Special Crossings (estimated)					
	Bore and Jack Pipe Laying	700	lf	2,640	1,848,000	16 in-diameter $165 per inch-dia-lf
	Bore and Jack Pit Constuction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major Intersections	950	lf	475	451,412	12 in-diameter $40 per inch-dia-lf
3.0	**Pump Stations**					
	Booster PS	1	LS	960,000	960,000	750 gpm 450 ft (TDH)
4.0	**Storage**					
	Hydropneumatic Tank	1	LS	200,000	200,000	Recent project experience
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	42	sites	26,000	1,092,000	Unit cost based o[illegible] retrofit cost curve deve[illegible] from VWC study by Dexter Willia[illegible]
	Subtotal Facility Costs				**$9,887,860**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		58,00[illegible]	% of Subto[illegible] treatment, pump station, storage and discharge costs (Includes g[illegible]ding, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		[illegible]00	% o[illegible]total treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		290,[illegible]	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$[illegible]06,000**	
					$10,293,860	
	Taxes	@	9%		355,963	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		514,693	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		1,544,079	% of Facility Direct Costs
	Estimate Contingency	@	[illegible]0%		3,088,158	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$15,796,753**	
	Escalation to Midpoint of Construction	@	16%		2,527,480	assume 2% percent over 8; contrustion start = 2023 end = 2025
	[illegible] Capital Cost [illegible]				**$18,324,233**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 2191 hours operated per year
Energy (conveyance to beneficial use)	348,200	KWh	0.12	41,784	Pump Station Hp = 213 Total Motor HP Required
Energy (other)	17,000	KWh	0.12	2,040	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	0.5	staff	100,000	50,000	full time staff at $100,000 salary per year
Maintenance: Other	482	AF	24	11,697	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		10,552	% of above O&M costs
Recycled Water Purchase (tertiary)	482	AF	200	96,400	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$212,473**	
Annual Unit O&M Costs ($/AFY)				**$441**	

Engineers Opinion of Probable Cost
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30	years
Alternative:	Phase 2a Central Park Alignment without Tank	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%	
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	0.5	mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	560	Annual Irrigation Demand (AFY)
				Design Capacity:	792	Max Day Demand (gpm)
					2,376	Peak Hourly Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	8 inch-dia pipeline segments	17,845	lf	112	1,998,613	8 in-diameter; $14 per inch-dia-lf
2.2	12 inch-dia pipeline segments	7,099	lf	180	1,277,755	12 in-diameter; $15 per inch-dia-lf
2.3	16 inch-dia pipeline segments	11,943	lf	240	2,866,203	16 in-diameter; $15 per inch-dia-lf
2.4	Special Crossings (estimate)					
	Bore and Jack Pipe Laying	700	lf	2,640	1,848,000	16 in-diameter; $165 per inch-dia-lf
	Bore and Jack Pit Constuction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major Intersections	950	lf	475	451,412	12 in-diameter; $40 per inch-dia-lf
3.0	**Pump Stations**					
	Booster PS	1	LS	1,540,000	1,540,000	1,250 gpm; 490 ft (TDH)
4.0	**Storage**					
	Hydropneumatic Tank	1	LS	200,000	200,000	Recent project experience
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	51	sites	26,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Williams
	Subtotal Facility Costs				**$11,577,983**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		87,000	% of Subtotal treatment, pump station, storage and discharge costs (includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		87,000	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		435,000	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$609,000**	
					$12,186,983	
	Taxes	@	[illegible]		416,807	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		609,349	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		1,828,048	% of Facility Direct Costs
	Estimate Contingency	@	[illegible]		3,656,095	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$18,697,283**	
	Escalation to Midpoint of Construction	@	16%		2,991,565	assume 2% percent over 8; contrustion start = 2023, end = 2025
	Project Capital Cost Total				**$21,688,848**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 2191 hours operated per year
Energy (conveyance to beneficial use)	631,918	KWh	0.12	75,830	Pump Station Hp = 387 Total Motor HP Required
Energy (other)	32,000	KWh	0.12	3,840	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	0.5	staff	100,000	50,000	full time staff at $100,000 salary per year
Maintenance: Other	560	AF	24	13,595	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		14,327	% of above O&M costs
Recycled Water Purchase (tertiary)	560	AF	200	112,038	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$269,630**	
Annual Unit O&M Costs ($/AFY)				**$481**	

Engineers Opinion of Probable Cost
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30 years
Alternative:	Phase 2a Central Park Alignment with Tank	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	0.5 mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	560 Annual Irrigation Demand (AFY)
				Design Capacity:	792 Max Day Demand (gpm)
					2,376 Peak Hourly Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	8 inch-dia pipeline segments	7,343	lf	112	822,423	8 in-diameter $14 per inch-dia-lf
2.2	12 inch-dia pipeline segments	17,600	lf	180	3,168,061	12 in-diameter $15 per inch-dia-lf
2.3	16 inch-dia pipeline segments	11,943	lf	240	2,866,203	16 in-diameter $15 per inch-dia-lf
2.4	Special Crossings (estimate)					
	Bore and Jack Pipe Laying	700	lf	2,640	1,848,000	16 in-diameter $165 per inch-dia-lf
	Bore and Jack Pit Constuction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major Intersections	950	lf	475	451,412	12 in-diameter $40 per inch-dia-lf
3.0	**Pump Stations**					
	Booster PS	1	LS	1,540,000	1,540,000	1,250 gpm 490 ft (TDH)
4.0	**Storage**					
	Storage Tank at Central Park	1	MG	725,500	725,500	RS Means 2015 Water St[illegible]age[illegible]k Construction Cost
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	51	sites	26,000	1,326,000	Unit cost bas[illegible] on retro[illegible]t cost curve deve[illegible]ped from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$12,817,599**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		113,2[illegible]	% of Subt[illegible]al treatment, pump station, storage and discharge costs
						([illegible]s grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		11[illegible]75	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		566,3[illegible]	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$[illegible]92,925**	
					[illegible]13,610,524	
	Taxes	@	[illegible]		461,434	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		680,526	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		2,041,579	% of Facility Direct Costs
	Estimate Contingency	@	[illegible]		4,083,157	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$20,877,220**	
	Escalation to Midpoint of Construction	@	16%		3,340,355	assume 2% percent over 8
						contrustion start = 2023 end = 2025
	Proj[illegible]ct Cap[illegible] Cost Total				**$24,217,575**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3286 hours operated per year
Energy (conveyance to beneficial use)	947,877	KWh	0.12	113,745	Pump Station Hp = 387 Total Motor HP Required
Energy (other)	47,000	KWh	0.12	5,640	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	0.5	staff	100,000	50,000	full time staff at $100,000 salary per year
Maintenance: Other	560	AF	24	13,595	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		18,298	% of above O&M costs
Recycled Water Purchase (tertiary)	560	AF	200	112,038	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$313,316**	
Annual Unit O&M Costs ($/AFY)				**$559**	

Engineers Opinion of Probable Cost
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30	years
Alternative:	Phase 2B Vista Canyon Development + SCWD	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%	
Area:	Served by Vista Canyon Water Factory	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	0.3	mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	300	Annual Irrigation Demand (AFY)
				Design Capacity:	424	Max Day Demand (gpm)
					1,272	Peak Hourly Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	8 inch-dia Pipelines South of Railroad Tracks	6,088	lf	112	681,871	8 in-diameter; $14 per inch-dia-lf
2.2	12 inch-dia Pipelines South of Railroad Tracks	4,862	lf	180	875,221	12 in-diameter; $15 per inch-dia-lf
2.3	8 inch-dia Pipelines North of Railroad Tracks	11,257	lf		*not incl*	Vista Canyon to pay for all onsite distribution pipeline serving the development
2.4	12 inch-dia Pipelines North of Railroad Tracks	1,777	lf		*not incl*	with an extension to the railroad tracks
3.0	**Pump Stations**					
	Booster PS	1	LS	310,000	310,000	272 gpm; 248 ft (TDH)
4.0	**Storage**					
4.1	Storage Tank	1	MG	1,150,000	1,150,000	Recent project experience
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	17	sites	27,000	459,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Williams.
	Subtotal Facility Costs				**$3,476,091**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		73,0[illegible]	% of Subtotal treatment, pump station, storage and discharge costs (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		[illegible]3,000	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		36[illegible]00	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**[illegible]11,000**	
					$[illegible],987,091	
	Taxes	@	9%		125,139	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		199,355	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		598,064	% of Facility Direct Costs
	Estimate Contingency	@	30%		1,196,127	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$6,105,776**	
	Escalation to Midpoint of Construction	@	6%		366,347	assume 2% percent over 3; contrustion start = 2018; end = 2020
	Project Capital Cost Total				**$6,472,123**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3286 hours operated per year
Energy (conveyance to beneficial use)	91,343	KWh	0.12	10,961	Pump Station Hp = 37 Total Motor HP Required
Energy (other)	5,000	KWh	0.12	600	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	0.5	staff	100,000	50,000	full time staff at $100,000 salary per year
Maintenance: Other	163	AF	24	3,959	Based on historical costs for parts, materials, outside service/contracting and other needs for SCWD deliveries only
Contingency	@	10.0%		6,552	% of above O&M costs
Recycled Water Purchase (tertiary)	163	AF	200	32,631	Assume Vista Canyon Water Factory RW rate would be comprable to the avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$104,703**	
Annual Unit O&M Costs ($/AFY)				**$247**	

Engineers Opinion of Probable Cost
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30 years
Alternative:	Phase 2C VWC-NCWD Extensions	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	1.2 mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	1,374 Annual Irrigation Demand (AFY)
				Design Capacity:	1,942 Max Day Demand (gpm)
					5,827 Peak Hourly Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	8 inch-dia pipeline segments	13,306	LF	112	1,490,298	8 in-diameter $14 per inch-dia-lf
2.2	12 inch-dia pipeline segments	2,046	LF	180	368,199	12 in-diameter $15 per inch-dia-lf
2.3	16 inch-dia pipeline segments	7,781	LF	240	1,867,483	16 in-diameter $15 per inch-dia-lf
2.4	20 inch-dia pipeline segments	5,200	LF	300	1,560,000	20 in-diameter $15 per inch-dia-lf
2.5	24 inch-dia pipeline segments	3,667	LF	384	1,408,143	24 in-diameter $16 per inch-dia-lf
2.6	Special Crossings					
	Bore & Jack Pipe Laying	550	LF	2,640	1,452,000	16 in-diameter $165 per inch-dia-lf
	Bore & Jack Pit Constuction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major intersections	500	LF	634	316,780	16 in-diameter $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	New PS at Valencia WRP	1	LS	3,610,000	3,610,000	4,400 [illegible] 380 ft (TDH)
3.2	New PS along Phase 2C	1	LS	2,120,000	2,120,000	5,20[illegible] gp[illegible] 173 ft (TDH)
4.0	**Storage**					
	Storage Tank	0	MG	1,500,000	0	Recent pr[illegible]ct experi[illegible]nce
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	66	sites	27,000	1,782,000	[illegible] cost based on r[illegible]fit cost curve developed from VWC study by [illegible]xte[illegible]lliams.
	Subtotal Facility Costs				[illegible]16,044,[illegible]04	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		286,[illegible]	% of Subtotal treatment, pump station, storage and discharge costs (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		286,500	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		1,432,500	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$2,005,500**	
					$18,050,404	
	Taxes	@	[illegible]9%		577,617	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	[illegible]		902,520	% of Facility Direct Costs
	Contractor Overhead & Profit	[illegible]	15%		2,707,561	% of Facility Direct Costs
	Estimate Contingency	@	30%		5,415,121	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$27,653,222**	
	Escalation to Midpoint of Construction	@	10%		2,765,322	assume 2% percent over 5
						contrustion start = 2020 end = 2022
	[illegible]oject Capital Cost Total				**$30,418,544**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 2191 hours operated per year
Energy (conveyance to beneficial use)	1,725,007	KWh	0.12	207,001	Pump Station Hp = 1056 Total Motor HP Required
Energy (other)	86,000	KWh	0.12	10,320	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	1.5	staff	100,000	150,000	full time staff at $100,000 salary per year
Maintenance: Other	1,374	AF	24	33,343	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		40,066	% of above O&M costs
Recycled Water Purchase (tertiary)	1,374	AF	200	274,791	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$715,522**	
Annual Unit O&M Costs ($/AFY)				**$368**	

Engineers Opinion of Probable Cost
Alternative 1 - Non-Potable Reuse Expansion (Phase 2)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30 years
Alternative:	Phase 2D VWC Extension	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	1.2 mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	1,374 Annual Irrigation Demand (AFY)
				Design Capacity:	1942 Max Day Demand (gpm)
					5,827 Peak Hourly Demand (gpm)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
	12 inch-dia pipeline segments	5,125	LF	180	922,500	12 in-diameter $15 per inch-dia-lf
3.0	**Pump Stations**					
	Booster PS	1	LS	990,000	990,000	1,000 gpm 351 ft (TDH)
4.0	**Storage**					
	Storage Tank	0	MG	1,500,000	0	Recent project experience
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	14	sites	25,000	350,000	Unit cost based on retrofit cost c[illegible] developed from VWC study by Dexter Williams.
	Subtotal Facility Costs				**$2,262,500**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		49,500	% [illegible]btotal treatmen[illegible] pump station, storage and discharge costs (In[illegible]udes [illegible]ing, erosion [illegible]ntrol, cut/fill, etc.)
7.0	Yard Piping	@	5%		49,500	% of [illegible]btot[illegible] tre[illegible], pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		[illegible]500	% of S[illegible]otal treat[illegible]ent, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**[illegible]346,5[illegible]**	
					$2,609,[illegible]0	
	Taxes	@	9%		[illegible]81,450	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		[illegible]30,450	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		391,350	% of Facility Direct Costs
	Estimate Contingency	@	30%		782,700	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$3,994,950**	
	Escalation to Midpoint of Construction	@	4%		159,798	assume 2% percent over 2; contrustion start = 2017 end = 2019
	Project C[illegible]pital Cos[illegible]otal				**$4,154,748**	

Annual Operations and Maintenance	Qty	[illegible]nits	Total Annual Costs $/Unit	Total	Notes
Energy Costs					Pump Operation = 2191 hours operated per year
Energy (conveyance to beneficial use)	[illegible]62,12[illegible]	KWh	0.12	43,455	Pump Station Hp = 222 Total Motor HP Required
Energy (other)	[illegible],000	KWh	0.12	2,160	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	1.5	staff	100,000	150,000	full time staff at $100,000 salary per year
Maintenance: Other	1,374	AF	24	33,343	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		22,896	% of above O&M costs
Recycled Water Purchase (tertiary)	1,374	AF	200	274,791	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$526,645**	
Annual Unit O&M Costs ($/AFY)				**$383**	

Engineers Opinion of Probable Cost
Alternative 2 - Non-Potable Reuse Expansion (Future Phases)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2A + Alignments E-H	**Prepared By:**	DTT	**Project Life:**	30 years
Description:	Includes Phase 2A and Future Expansion North of the Santa Clara River	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	0.5 mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560 AFY (Irrigation)
				Alignment E-H RW Delivered:	1,344 AFY (Irrigation)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
	Phase 2A Pipelines (Upsized)					
2.1	8 inch-dia pipeline segments	5,632	lf	112	630,830	8 in-diameter $14 per inch-dia-lf
2.2	12 inch-dia pipeline segments	870	lf	180	156,605	12 in-diameter $15 per inch-dia-lf
2.3	16 inch-dia pipeline segments	1,712	lf	240	410,786	16 in-diameter $15 per inch-dia-lf
2.4	24 inch-dia pipeline segments	13,974	lf	384	5,366,104	24 in-diameter $16 per inch-dia-lf
2.5	30 inch-dia pipeline segments	71	lf	510	36,220	30 in-diameter $17 per inch-dia-lf
2.6	Special Crossings (estimate)					
	Bore and Jack Pipe Laying	700	lf	3,960	2,772,000	24 in-diameter $165 per inch-dia-lf
	Bore and Jack Pit Constuction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major Intersections	950	lf	950	902,824	24 in-diameter $40 per inch-dia-lf
	Future Alignments E-H					
2.7	Alignment E - Rio Norte Jr High, Tesoro Del Valle Recreation Center	16,073	lf	112	1,800,203	8 in-diameter $14 per inch-dia-lf
		332	lf	180	59,807	12 in-diameter $15 per inch-dia-lf
		9,233	lf	240	2,216,021	16 in-diameter $15 per inch-dia-lf
2.8	Alignment F - Arroyo Secco Middle School	3,979	lf	112	445,636	8 in-diameter $14 per inch-dia-lf
		3,692	lf	240	[illegible]	16 in-diameter $15 per inch-dia-lf
2.9	Alignment G - Northpark Elementary School, Mountain View Park	6,564	lf	112	[illegible]	8 in-diameter $14 per inch-dia-lf
		11,616	lf	180	[illegible]	12 in-diameter $15 per inch-dia-lf
3.0	Alignment H - SCWD Office, La Mesa Middle School, Friendly Valley Golf Course	10,985	lf	112	[illegible]	8 in-diameter $14 per inch-dia-lf
		11,084	lf	180	[illegible]	12 in-diameter $15 per inch-dia-lf
		6,500	lf	[illegible]	[illegible]	16 in-diameter $15 per inch-dia-lf
3.0	**Pump Stations**					
3.1	New PS at Valencia WRP	1	LS	5,270,000	[illegible]	6,000 gpm 430 ft (TDH)
3.2	New PS along Alignment E	1	LS	[illegible]	650,000	1,100 gpm 180 ft (TDH)
3.3	New PS along Alignment G	1	LS	[illegible]	720,000	1,000 gpm 230 ft (TDH)
3.4	New PS along Alignment H	1	LS	[illegible]	1,340,000	1,800 gpm 285 ft (TDH)
4.0	**Storage**					
	Storage Tank at Central Park	1	MG	[illegible]	725,500	RS Means 2015 Water Storage Tank Construction Cost
5.0	**Site Retrofit Costs**					
	Phase 2A - Based on number and size of sites	51	sites	26,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by
	Alignments E-H - Based on number and size of sites	[illegible]	sites	25,400	4,089,400	Dexter Williams.
	Subtotal Facility Costs				**$37,485,623**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		435,275	% of Subtotal treatment, pump station, storage and discharge costs
						(Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		435,275	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		2,176,375	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$3,046,925**	
					$40,532,548	
	Taxes	@	9%		1,349,482	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		2,026,627	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		6,079,882	% of Facility Direct Costs
	Estimate Contingency	@	30%		12,159,765	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$62,148,305**	
	Escalation to Midpoint of Construction	@	16%		9,943,729	assume 2% percent over 8
						contrustion start = 2023 end = 2025
	Project Capital Cost Total				**$72,092,034**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3286 hours operated per year
Energy: New PS at Valencia WRP	3,992,691	KWh	0.12	479,123	Pump Station Hp = 1629 Total Motor HP Required
Energy: New PS along Alignment E	1,850,875	KWh	0.12	222,105	Pump Station Hp = 755 Total Motor HP Required
Energy: New PS along Alignment H	0	KWh	0.12	0	Pump Station Hp = 0 Total Motor HP Required
Energy (other)	292,000	KWh	0.12	35,040	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	1.5	staff	100,000	150,000	full time staff at $100,000 salary per year
Maintenance: Other	1,904	AF	24	46,209	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		93,248	% of above O&M costs
Recycled Water Purchase (tertiary)	1,904	AF	200	380,818	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$1,406,542**	
Annual Unit O&M Costs ($/AFY)				**$739**	

Engineers Opinion of Probable Cost
Alternative 2 - Non-Potable Reuse Expansion (Future Phases)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2C + Alignments A-D	**Prepared By:**	DTT	**Project Life:**	30	years
Description:	Includes Phase 2C and Future Expansion South of the Santa Clara River	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%	
Area:	Served by Valencia WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	1.2	mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2C RW Delivered:**	1,374	AFY (Irrigation)
				Alignment A-D RW Delivered:	1,017	AFY (Irrigation)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
	Existing Pipelines (no change)					The increased demand may require more capacity in the existing Phase 1 pipelines then presently available, but additional costs are not added at this time
	Phase 2C Pipelines (upsized)					
2.1	8 inch-dia pipeline segments	13,306	LF	112	1,490,298	8 in-diameter; $14 per inch-dia-lf
2.2	16 inch-dia pipeline segments	9,607	LF	240	2,305,697	16 in-diameter; $15 per inch-dia-lf
2.3	20 inch-dia pipeline segments	700	LF	300	210,000	20 in-diameter; $15 per inch-dia-lf
2.4	24 inch-dia pipeline segments	4,720	LF	384	1,812,349	24 in-diameter; $16 per inch-dia-lf
2.5	30 inch-dia pipeline segments	3,667	LF	510	1,870,190	30 in-diameter; $17 per inch-dia-lf
2.6	Special Crossings					
	Bore & Jack Pipe Laying	550	LF	3,960	2,178,000	24 in-diameter; $165 per inch-dia-lf
	Bore & Jack Pit Constuction	2	EA	35,000	70,000	based on [illegible] receiving pit costs
	Major intersections	500	LF	950	475,171	24 in-diameter; $40 per inch-dia-lf
	Future Alignments A-D					
2.7	Alignment A - The Master's College	826	lf	112	92,460	8 in-diameter; $14 per inch-dia-lf
		18,364	lf	240	4,407,281	16 in-diameter; $15 per inch-dia-lf
2.8	Alignment B - William S Hart Park	6,194	lf	180	1,114,846	12 in-diameter; $15 per inch-dia-lf
2.9	Alignment C - Pico Canyon Park, Pico Canyon Elementary School, Valer	11,859	lf	112	[illegible]8,226	8 in-diameter; $14 per inch-dia-lf
3.0	Alignment D - Santa Clarita City Hall	8,707	lf	112	[illegible]75,[illegible]	8 in-diameter; $14 per inch-dia-lf
		7,713	lf	180	1,3[illegible]8,25[illegible]	12 in-diameter; $15 per inch-dia-lf
3.0	**Pump Stations**					
3.1	Phase 2C Booster PS with increased flow for A-D	1	LS	5,[illegible]000	5,270,0[illegible]	1,000 gpm; 450 ft (TDH)
3.2	New PS along Phase 2C	1	LS	2,710,[illegible]	[illegible],000	5,200 gpm; 230 ft (TDH)
4.0	**Storage**					
4.1	Lower Storage Tank 1 (1600 ft elevation)	1	MG	1,000,[illegible]0	1,000,000	RS Means 2015 Water Storage Tank Construction Cost
5.0	**Site Retrofit Costs**					
	Phase 2C - Based on number and size of sites	[illegible]	sites	27,000	1,782,000	Unit cost based on retrofit cost curve developed from VWC study by
	Alignments A-D - Based on number and size of sites	[illegible]3	[illegible]	27,500	2,557,500	Dexter Williams.
	Subtotal Facility Costs				**$33,037,479**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		449,000	% of Subtotal treatment, pump station, storage and discharge costs (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		449,000	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	25%		2,245,000	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$3,143,000**	
					$36,180,479	
	Taxes	@	9%		1,189,349	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		1,809,024	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		5,427,072	% of Facility Direct Costs
	Estimate Contingency	@	30%		10,854,144	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$55,460,068**	
	Escalation to Midpoint of Construction	@	16%		8,873,611	assume 2% percent over 8; contrustion start = 2023 end = 2025
	Project Capital Cost Total				**$64,333,679**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	Notes
Energy Costs					Pump Operation = 3286 hours operated per year
Energy: Phase 2C Booster PS with increased flow for A-D	2,451,326	KWh	0.12	294,159	Pump Station Hp = 1000 Total Motor HP Required
Energy: New PS along Phase 2C	1,850,875	KWh	0.12	222,105	Pump Station Hp = 755 Total Motor HP Required
Energy:	0	KWh	0.12	0	Pump Station Hp = 0 Total Motor HP Required
Energy (other)	215,000	KWh	0.12	25,800	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	1.5	staff	100,000	150,000	full time staff at $100,000 salary per year
Maintenance: Other	2,391	AF	24	58,036	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		75,010	% of above O&M costs
Recycled Water Purchase (tertiary)	2,391	AF	200	478,289	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$1,303,400**	
Annual Unit O&M Costs ($/AFY)				**$545**	

Engineers Opinion of Probable Cost
Alternative 2 - Non-Potable Reuse Expansion (Future Phases)

KENNEDY/JENKS CONSULTANTS

Project:	CLWA Recycled Water Master Plan	**Prepared By:**	DTT	**Project Life:**	30	years
Description:	Westside Communities	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%	
Area:	Served by Valencia WRP and Newhall WRP	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	6.4	mgd
Estimate:	Conceptual-Level	**ENR**		**RW Delivered:**	7,184	AFY (Irrigation)

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						**Source of Facility Sizing Info = Nov 2015 RWMP Revision for Westside Communities**
1.0	**Treatment Facility (not included)**					
	Approx 50% of demand met by Valencia WRP					Assume purchase of tertiary RW at same rate as other alts
	Approx 50% of demand met by Newhall Ranch WRP					Assume purchase of tertiary RW at same rate as other alts
2.0	**Pipelines**					**Source: Nov 2015 RWMP Revision for Westside Communities (App A Peak Demand Output)**
2.1	8 inch-dia pipeline segments	91	LF	510	46,466	30 in-diameter; $17 per inch-dia-lf
2.2	12 inch-dia pipeline segments	59,919	LF	384	23,008,858	24 in-diameter; $16 per inch-dia-lf
2.3	16 inch-dia pipeline segments	19,382	LF	270	5,233,216	18 in-diameter; $15 per inch-dia-lf
2.4	Total inch-dia pipeline segments	81,859	LF	180	14,734,687	12 in-diameter; $15 per inch-dia-lf
2.4	Special Crossings					
	assumed as a percent of pipeline cost	1	LS	4,302,323	4,302,323	10% of pipeline costs assumed to respresent special crossings
3.0	**Pump Stations**					**Source: Nov 2015 RW[illegible]P Re[illegible]ion for Westside Communities (App A Pump Report)**
3.1	Zone 1 Pump Station (PZ1)	1	LS	2,730,000	2,730,000	5,1[illegible] gpm; 239 ft (TDH)
3.2	Zone 1 Pump Station (PZ11)	1	LS	3,840,000	3,840,000	4,[illegible]00 gpm; 417 ft (TDH)
3.3	Zone 2 Pump Station (PZ2)	1	LS	2,870,000	2,870,000	3,0[illegible]0 gpm; 424 ft (TDH)
3.4	Zone 2 Pump Station (PZ22)	1	LS	3,990,000	3,990,000	7,7[illegible] gpm; 244 ft (TDH)
3.5	Zone 3 Pump Station (PZ3)	1	LS	1,190,000	1,190,000	[illegible]200 gpm; 199 ft (TDH)
3.6	Zone 4 Pump Station (PZ4)	1	LS	240,000	240,000	2,[illegible] gpm; 18 ft (TDH)
3.7	Zone 5 Pump Station (PZ5)	1	LS	300,000	300,000	300 gpm; 184 ft (TDH)
4.0	**Storage Tank**					**Sou[illegible] Nov 201[illegible] RWMP Revision for Westside Communities (Table 4-1)**
4.1	Zone 1	0.3	MG	1,500,000	450,[illegible]00	Unit c[illegible]t based on recent project experience
	Zone 2	3.8	MG	1,000,000	3,800,[illegible]00	
	Zone 3	2.5	MG	1,000,000	[illegible]	
	Zone 4	0.9	MG	1,250,[illegible]	1,[illegible]500	
	Zone 5	0.8	MG	1,[illegible]50,000	1,025,[illegible]	
5.0	**Site Retrofit Costs**					
	Based on number and size of sites	54	sites	27,0[illegible]	1,458,000	Unit cost based on retrofit cost curve developed from VWC study by
						Dexter Williams. Number of Sites based on App A Demand Table IDs.
	Subtotal Facility Costs				**$72,781,048**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	[illegible]		1,199,875	% of Subtotal treatment, pump station, storage and discharge costs
						(Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		1,199,875	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and Remote (low-tech) Control	@	[illegible]		5,999,375	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$8,399,125**	
					$81,180,173	
	Taxes	@	9%		2,620,118	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		4,059,009	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		12,177,026	% of Facility Direct Costs
	Estimate Contingency	@	30%		24,354,052	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$124,390,378**	
	Escalation to Midpoint of Construction	@	11%		13,682,942	assume 2% percent over 6
						contrustion start = 2019; end = 2024
	Project Capital Cost Total				**$138,073,320**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3286 hours operated per year
Energy: Zone 1 Pump Station (PZ1)	1,873,077	KWh	0.12	224,769	Pump Station Hp = 764 Total Motor HP Required
Energy: Zone 1 Pump Station (PZ11)	646,997	KWh	0.12	77,640	Pump Station Hp = 1135 Total Motor HP Required
Energy: Zone 2 Pump Station (PZ2)	684,699	KWh	0.12	82,164	Pump Station Hp = 809 Total Motor HP Required
Energy: Zone 2 Pump Station (PZ22)	713,702	KWh	0.12	85,644	Pump Station Hp = 1183 Total Motor HP Required
Energy: Zone 3 Pump Station (PZ3)	248,273	KWh	0.12	29,793	Pump Station Hp = 281 Total Motor HP Required
Energy: Zone 4 Pump Station (PZ4)	4,628	KWh	0.12	555	Pump Station Hp = 22 Total Motor HP Required
Energy: Zone 5 Pump Station (PZ5)	596	KWh	0.12	72	Pump Station Hp = 36 Total Motor HP Required
Energy (other)	209,000	KWh	0.12	25,080	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, customer service)	3.0	staff	100,000	300,000	full time staff at $100,000 salary per year
Maintenance: Other	7,184	AF	24	174,343	Based on historical costs for parts, materials, outside service/contracting and other needs
Contingency	@	10.0%		100,006	% of above O&M costs
Recycled Water Purchase (tertiary)	7,184	AF	200	1,436,800	Based on avereage LACSD RW purchase rate from 2013 to 2015
Annual O&M Costs ($/year)				**$2,536,866**	
Annual Unit O&M Costs ($/AFY)				**$353**	

Engineers Opinion of Probable Cost
Alternative 3 - Groundwater Recharge (Surface Spreading)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2A + Spreading Site #1	**Prepared By:**	DTT	**Project Life:**	30 years
Description:	Includes Phase 2A costs and maximizes deliveries to Off-Stream Spreading Site #1	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Valencia WRP Supply (Tertiary + Demineralized Blend)	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	3.3 mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560 AFY (Irrigation)
				RW Recharged:	3,700 AFY (Spreading)
				Design Capacity:	9.7 mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	Phase 2A Pipelines to meet irrigation and IPR flows					
	8 inch-dia pipeline segments	7,343	LF	112	822,423	8 in-diameter $14 per inch-dia-lf
	24 inch-dia pipeline segments	17,600	LF	384	6,758,531	24 in-diameter $16 per inch-dia-lf
	24 inch-dia pipeline segments	11,943	LF	384	4,585,925	24 in-diameter $16 per inch-dia-lf
2.2	Phase 2A to Spreading Basin #1	18,480	LF	384	7,096,320	24 in-diameter $16 per inch-dia-lf
2.3	Special Crossings					
	Bore and Jack Pipe Laying	1,250	LF	3,960	4,950,000	24 in-diameter $165 per inch-dia-lf
	Bore and Jack Pit Construction	2	EA	35,000	70,000	based on jacking and receiving pit costs
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Spreading Basin #1	1	LS	6,770,000	6,770,000	7,000 gpm 490 ft (TDH)
						[illegible]ume sufficient [illegible] meet Phase 2A irrigation Demands
4.0	**Storage and Spreading Basin**					
4.1	Storage Tank at Central Park	1	MG	725,500	725,[illegible]	RS M[illegible]s 2015 Water Storage Tank Construction Cost
	Spreading Basin #1					
4.2	Construct 20 acre basin	100	AF	30,000	3,000,000	Re[illegible]t storage pond construction bid
4.3	Construct 1 acre settling basin	5	AF	60,000	[illegible],000	
4.4	Diversion Structure	600	LF	6,000	600,[illegible]	Inflatable rubber dam for stormwater flow diversions, includes foundation
4.5	Hydraulic control structures	3	LS	50,000	[illegible]5[illegible],000	*[illegible]ossibility to have LACSD pay for rubber dam*
4.6	Pipelines btw basins	1,000	LF	24[illegible]	2[illegible]0,000	16 in-diameter $15 per inch-dia-lf
5.0	**Monitoring Wells**					
5.1	Monitroing Wells	3	LS	160,[illegible]	480,000	
	Extraction Wells					Assume use of existing wells
6.0	**Site Retrofit Costs (Phase 2A)**					
	Based on number and size of sites	51	sites	[illegible]6,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$40,874,699**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	[illegible]%		763,275	% of Subtotal treatment, pump station, storage and discharge costs
						(Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		763,275	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and SCADA Control	@	25%		2,750,000	% of Subtotal treatment, pump station, storage and discharge costs
						(not icnluding spreading basin or pipelines)
	Subtotal Additional Facility Costs				**$4,276,550**	
					$45,151,249	
	Taxes	@	9%		1,471,489	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		2,257,562	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		6,772,687	% of Facility Direct Costs
	Estimate Contingency	@	30%		13,545,375	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$69,198,362**	
	Escalation to Midpoint of Construction	@	18%		12,455,705	assume 2% percent over 9
						contrustion start = 2024 end = 2026
	Project Capital Cost Total				**$81,654,067**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3861 hours operated per year
Energy: PS from Valencia WRP to Spreading Basin #1	6,237,026	KWh	0.12	748,443	Pump Station Hp = 2165 Total Motor HP Required
Energy (other)	312,000	KWh	0.12	37,440	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, monitoring)	2.0	staff	100,000	200,000	full time staff at $100,000 salary per year
					** may require additional LACFCD staff time to operate diversion/ponds*
Maintenance: Recharge Ponds	@	0.5%		40,078	Includes seasonal weed and erosion control, cleaning hydraulic structures, sediment removal, etc (% of direct facility costs)
Maintenance: Pump Station, Monitoring Wells, Diversion	@	1.0%		72,500	% of above direct facility costs for these components
Contingency	@	10%		109,846	% of above O&M costs
Recycled Water Purchase (tertiary for irrigation in summer)	237	AF	200	47,400	Based on avereage LACSD RW purchase rate from 2013 to 2015
Recycled Water Purchase (tertiary-blend non-summer irrigation)	323	AF	385	124,267	Based on 50:50 mix of tertiary:Blend at costs below
Recycled Water Purchase (tertiary for spreading)	1,850	AF	200	370,000	Based on avereage LACSD RW purchase rate from 2013 to 2015
Recycled Water Purchase (Valencia Blend for spreading)	1,850	AF	569	1,052,650	Based on preliminary estimate from LACSD at 70:30 belnd of tertiary:RO
Annual O&M Costs ($/year)				**$2,802,623**	
Annual Unit O&M Costs ($/AFY)				**$658**	

Engineers Opinion of Probable Cost
Alternative 3 - Groundwater Recharge (Surface Spreading)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2A + Spreading Site #3a	**Prepared By:**	DTT	**Project Life:**	30 years
Description:	Includes Phase 2A costs and maximizes deliveries to In-Stream Spreading Site #3a	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Valencia WRP Supply (Demineralized Blend)	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	3.3 mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560 AFY (Irrigation)
				RW Recharged:	3,700 AFY (Spreading)
				Design Capacity:	9.7 mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	Phase 2A Pipelines to meet irrigation and IPR flows					
	8 inch-dia pipeline segments	7,343	LF	112	822,423	8 in-diameter; $14 per inch-dia-lf
	24 inch-dia pipeline segments	17,600	LF	384	6,758,531	24 in-diameter; $16 per inch-dia-lf
	24 inch-dia pipeline segments	11,943	LF	384	4,585,925	24 in-diameter; $16 per inch-dia-lf
2.2	Phase 2A to Spreading Basin #3a	49,000	LF	384	18,816,000	24 in-diameter; $16 per inch-dia-lf
2.3	Special Crossings					
	Bore and Jack Pipe Laying	1,250	LF	3,960	4,950,000	24 in-diameter; $165 per inch-dia-lf
	Bore and Jack Pit Construction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major Intersections	500	LF	960	480,000	24 in-diameter; $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Central Park	1	LS	6,770,000	6,7[illegible]00	7,000 gpm; 490 ft (TDH)
						assume sufficient to meet Phase 2A irrigation Demands
3.2	Booster PS from Central Park to Spreading Basin #3	1	LS	5,660,000	5,660,[illegible]00	7,000 gpm; 400 ft (TDH)
4.0	**Storage and Spreading Basin**					
4.1	Storage Tank at Central Park	1	MG	72[illegible]0	725,500	RS Means 2015 Water Storage Tank Construction Cost
	Spreading Basin #3a					
4.2	Construct Levees for In-River Basin	2,000	LF	0	0	assume levee along south side of SCR
4.3	Diversion Structure	400	LF	[illegible]00	[illegible],400,000	Inflatable rubber dam for recharge basin creation
4.4	Hydraulic control structure	1	LS	50,0[illegible]	50,000	
5.0	**Monitoring Wells**					
5.1	Monitroing Wells	3	[illegible]	[illegible],000	480,000	
	Extraction Wells					Assume use of existing wells
6.0	**Site Retrofit Costs (Phase 2A)**					
	Based on number and size of sites	51	sites	26,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$53,894,379**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		804,275	% of Subtotal treatment, pump station, storage and monitoring wells (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		804,275	% of Subtotal treatment, pump station, storage and monitoring wells
8.0	Electrical, I&C, and SCADA Control	@	25%		4,021,375	% of Subtotal treatment, pump station, storage and discharge costs (not icnluding levee or pipelines)
	Subtotal Additional Facility Costs				**$5,629,925**	
					$59,524,304	
	Taxes	@	9%		1,940,198	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		2,976,215	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		8,928,646	% of Facility Direct Costs
	Estimate Contingency	@	30%		17,857,291	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$91,226,653**	
	Escalation to Midpoint of Construction	@	18%		16,420,798	assume 2% percent over 9
						contrustion start = 2024; end = 2026
	Project Capital Cost Total				**$107,647,451**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	Notes
Energy Costs					Pump Operation = 3861 hours operated per year
Energy: PS from Valencia WRP to Central Park	6,237,026	KWh	0.12	748,443	Pump Station Hp = 2165 Total Motor HP Required
Energy: Booster PS from Central Park to Spreading Basin #3	2,855,490	KWh	0.12	342,659	Pump Station Hp = 1768 Total Motor HP Required
Energy (other)	455,000	KWh	0.12	54,600	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, monitoring)	2.0	staff	100,000	200,000	full time staff at $100,000 salary per year
					** may require additional LACFCD staff time to operate diversion/ponds*
Maintenance: Recharge Ponds	@	0.5%		15,878	Includes seasonal weed and erosion control, cleaning hydraulic structures, sediment removal, etc (% of direct facility costs)
Maintenance: Pump Station, Monitoring Wells, Diversion	@	1.0%		4,800	% of above direct facility costs for these components
Contingency	@	10%		136,638	% of above O&M costs
Recycled Water Purchase (tertiary for irrigation in summer)	237	AF	200	47,400	Based on avereage LACSD RW purchase rate from 2013 to 2015
Recycled Water Purchase (tertiary-blend non-summer irrigation)	323	AF	569	183,895	Shift to conveying Valencia Blend for spreading
Recycled Water Purchase (Valencia Blend for spreading)	3,700	AF	569	2,105,300	Based on preliminary estimate from LACSD at 70:30 belnd of tertiary:RO
Annual O&M Costs ($/year)				**$3,839,613**	
Annual Unit O&M Costs ($/AFY)				**$901.28**	

Engineers Opinion of Probable Cost
Alternative 3 - Groundwater Recharge (Surface Spreading)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2A + Spreading Site #3b	**Prepared By:**	DTT	**Project Life:**	30 years
Description:	Includes Phase 2A costs and maximizes deliveries to Off-Stream Spreading Site #3b	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Valencia WRP Supply (Demineralized Blend)	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	3.3 mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560 AFY (Irrigation)
				RW Recharged:	3,700 AFY (Spreading)
				Design Capacity:	9.7 mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**Pipelines**					
2.1	Phase 2A Pipelines to meet irrigation and IPR flows					
	8 inch-dia pipeline segments	7,343	LF	112	822,423	8 in-diameter $14 per inch-dia-lf
	24 inch-dia pipeline segments	17,600	LF	384	6,758,531	24 in-diameter $16 per inch-dia-lf
	24 inch-dia pipeline segments	11,943	LF	384	4,585,925	24 in-diameter $16 per inch-dia-lf
2.2	Phase 2A to Spreading Basin #3a	49,000	LF	384	18,816,000	24 in-diameter $16 per inch-dia-lf
2.3	Extension from #3a to #3b	4,400	LF	384	1,689,600	24 in-diameter $16 per inch-dia-lf
2.4	Pipeline from SCR diversion to Basin (for stormwater)	1,200	LF	240	288,000	16 in-diameter $15 per inch-dia-lf
2.4	Special Crossings					
	Bore and Jack Pipe Laying	1,250	LF	3,960	4,950,000	24 in-diameter $165 per inch-dia-lf
	Bore and Jack Pit Construction	2	EA	35,000	70,000	based on jacking and receiving pit costs
	Major Intersections	500	LF	960	480,000	24 in-diameter $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Central Park	1	LS	6,770,000	6,770,000	7,000 gpm 490 ft (TDH)
						assume sufficient to meet Phase 2A irrigation Demands
3.2	Booster PS from Central Park to Spreading Basin #3	1	LS	5,660,000	5,660,000	7,000 gpm 400 ft (TDH)
3.3	Stormwater pump station to Spreading Basin	1	LS	560,000	560,000	3,400 gpm 48 ft (TDH)
4.0	**Storage and Spreading Basin**					
4.1	Storage Tank at Central Park	1	MG	725,500	725,500	RS Means 2015 Water Storage Tank Construction Cost
	Spreading Basin #3b					
4.2	Construct 28 acre basin	140	AF	30,000	4,200,000	Recent storage pond construction bid
4.3	Diversion Structure	200	LF	6,000	1,200,000	Inflatable rubber dam for stormwater diversion
4.4	Hydraulic control structure	2	LS	50,000	100,000	One at RW inlet and one at stormwater inlet
5.0	**Monitoring Wells**					
5.1	Monitroing Wells	3	LS	160,000	480,000	
	Extraction Wells					Assume use of existing wells
6.0	**Site Retrofit Costs (Phase 2A)**					
	Based on number and size of sites	51	sites	26,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$59,481,979**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		984,775	% of Subtotal treatment, pump station, storage and monitoring wells (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		984,775	% of Subtotal treatment, pump station, storage and monitoring wells
8.0	Electrical, I&C, and SCADA Control	@	25%		4,923,875	% of Subtotal treatment, pump station, storage and discharge costs (not icnluding levee or pipelines)
	Subtotal Additional Facility Costs				**$6,893,425**	
					$66,375,404	
	Taxes	@	9%		2,141,351	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		3,318,770	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		9,956,311	% of Facility Direct Costs
	Estimate Contingency	@	30%		19,912,621	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$101,704,457**	
	Escalation to Midpoint of Construction	@	18%		18,306,802	assume 2% percent over 9
						contrustion start = 2024 end = 2026
	Project Capital Cost Total				**$120,011,259**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3861 hours operated per year
Energy: PS from Valencia WRP to Central Park	6,237,026	KWh	0.12	748,443	Pump Station Hp = 2165 Total Motor HP Required
Energy: Booster PS from Central Park to Spreading Basin #3	2,855,490	KWh	0.12	342,659	Pump Station Hp = 1768 Total Motor HP Required
Energy: Stormwater pump station to Spreading Basin	134,260	KWh	0.12	16,111	Pump Station Hp = 102 Total Motor HP Required
Energy (other)	461,000	KWh	0.12	55,320	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, monitoring)	2.0	staff	100,000	200,000	full time staff at $100,000 salary per year
					** may require additional LACFCD staff time to operate diversion/ponds*
Maintenance: Recharge Ponds	@	0.5%		31,128	Includes seasonal weed and erosion control, cleaning hydraulic structures, sediment removal, etc (% of direct facility costs)
Maintenance: Pump Station, Monitoring Wells, Diversion	@	1.0%		4,800	% of above direct facility costs for these components
Contingency	@	10%		139,846	% of above O&M costs
Recycled Water Purchase (tertiary for irrigation in summer)	237	AF	200	47,400	Based on avereage LACSD RW purchase rate from 2013 to 2015
Recycled Water Purchase (tertiary-blend non-summer irrigation)	323	AF	569	183,895	Shift to conveying Valencia Blend for spreading
Recycled Water Purchase (Valencia Blend for spreading)	3,700	AF	569	2,105,300	Based on preliminary estimate from LACSD at 70:30 belnd of tertiary:RO
Annual O&M Costs ($/year)				**$3,874,902**	
Annual Unit O&M Costs ($/AFY)				**$909.56**	

Engineers Opinion of Probable Cost
Alternative 3 - Groundwater Recharge (Surface Spreading)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2A + Spreading Site #3b	**Prepared By:**	DTT	**Project Life:**	30 years
Description:	Includes Phase 2A costs and reuses Honby lateral and Honby pipeline to deliver to In-Stream Spreading Site	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Valencia WRP Supply (Demineralized Blend)	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	1.0 mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560 AFY (Irrigation)
				RW Recharged:	1,100 AFY (Spreading)
				Design Capacity:	3.0 mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**New Pipelines (west of Honby)**					
2.1	Phase 2A Pipelines to meet irrigation and IPR flows (limited by Honby Capacity)					
	8 inch-dia pipeline segments	7,343	LF	112	822,423	8 in-diameter $14 per inch-dia-lf
	14 inch-dia pipeline segments	17,600	LF	210	3,696,072	14 in-diameter $15 per inch-dia-lf
	16 inch-dia pipeline segments	11,943	LF	240	2,866,203	16 in-diameter $15 per inch-dia-lf
2.2	Phase 2A to old Honby Lateral	2,000	LF	210	420,000	14 in-diameter $15 per inch-dia-lf
	Repurpose Existing Pipelines					*assumes cost to rehab pipeline for reuse*
2.3	Repurpose Honby Lateral to get to Honby PS Pad	1	LS	200,000	200,000	Reuse ~ 6,000 LF of Honby Lateral, assume 600 LF to connect from east side to site of Honby PS
2.4	Rehab Honby Pipeline from Honby PS Pad to near Sand Canyon Rd	25,000	LF	140	3,500,000	12 in-diameter $12 per inch-dia-lf
2.5	Jacking/Receiving Pits for sliplining	25	LS	18,000	450,000	assume a jacking and receiving pit every 1,000 LF for sliplilning
	New Pipelines (east of Honby)					
2.6	Extension from Honby Pipeline near Sand Canyon to Site #3b	20,000	LF	210	4,200,000	[illegible] in-diameter $15 per inch-dia-lf
2.7	Pipeline from SCR diversion to Basin (for stormwater)	1,200	LF	240	288,000	16 in-diameter $15 per inch-dia-lf
2.8	Special Crossings					
	Bore and Jack Pipe Laying	0	LF	2,310	0	[illegible] in-diameter $165 per inch-dia-lf
	Bore and Jack Pit Construction	0	EA	35,000	0	bas[illegible] jacking and rece[illegible] pit costs
	Major Intersections	150	LF	560	84,000	14 in-[illegible]meter $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Central Park	1	LS	2,360,000	[illegible]	2,100 gpm 490 ft (TDH)
						assume su[illegible]ent to meet Phase 2A irrigation Demands
3.2	Booster PS from Old Honby PS Pad to Spreading Basin #3	1	LS	1,990,000	[illegible]	2,100 gpm 400 ft (TDH)
3.3	Stormwater pump station to Spreading Basin	1	LS	560,000	[illegible]	3,400 gpm 48 ft (TDH)
4.0	**Storage and Spreading Basin**					
4.1	Storage Tank at Central Park	1	MG	[illegible]	[illegible]	RS Means 2015 Water Storage Tank Construction Cost
	Spreading Basin #3b					
4.2	Construct 28 acre basin	140	AF	[illegible]	4,200,000	Recent storage pond construction bid
4.3	Diversion Structure	200	LF	[illegible]	1,200,000	Inflatable rubber dam for stormwater diversion
4.4	Hydraulic control structure	2	LS	[illegible]	100,000	One at RW inlet and one at stormwater inlet
5.0	**Monitoring Wells**					
5.1	Monitroing Wells	3	LS	[illegible]	480,000	
	Extraction Wells					Assume use of existing wells
6.0	**Site Retrofit Costs (Phase 2A)**					
	Based on number and size of sites	51	sites	26,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$29,468,197**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		580,775	% of Subtotal treatment, pump station, storage and monitoring wells
						(Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		580,775	% of Subtotal treatment, pump station, storage and monitoring wells
8.0	Electrical, I&C, and SCADA Control	@	25%		2,903,875	% of Subtotal treatment, pump station, storage and discharge costs
						(not icnluding levee or pipelines)
	Subtotal Additional Facility Costs				**$4,065,425**	
					$33,533,622	
	Taxes	@	9%		1,060,855	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		1,676,681	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		5,030,043	% of Facility Direct Costs
	Estimate Contingency	@	30%		10,060,087	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$51,361,289**	
	Escalation to Midpoint of Construction	@	18%		9,245,032	assume 2% percent over 9
						contrustion start = 2024 end = 2026
	Project Capital Cost Total				**$60,606,321**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs					Pump Operation = 3861 hours operated per year
Energy: PS from Valencia WRP to Central Park	1,856,406	KWh	0.12	222,769	Pump Station Hp = 645 Total Motor HP Required
Energy: Booster PS from Old Honby PS Pad to Spreading Basin #3	252,971	KWh	0.12	30,357	Pump Station Hp = 526 Total Motor HP Required
Energy: Stormwater pump station to Spreading Basin	48,953	KWh	0.12	5,874	Pump Station Hp = 102 Total Motor HP Required
Energy (other)	108,000	KWh	0.12	12,960	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, monitoring)	2.0	staff	100,000	200,000	full time staff at $100,000 salary per year
					** may require additional LACFCD staff time to operate diversion/ponds*
Maintenance: Recharge Ponds	@	0.5%		31,128	Includes seasonal weed and erosion control, cleaning hydraulic structures, sediment removal, etc (% of direct facility costs)
Maintenance: Pump Station, Monitoring Wells, Diversion	@	1.0%		4,800	% of above direct facility costs for these components
Contingency	@	10%		50,789	% of above O&M costs
Recycled Water Purchase (tertiary for irrigation in summer)	237	AF	200	47,400	Based on avereage LACSD RW purchase rate from 2013 to 2015
Recycled Water Purchase (tertiary-blend non-summer irrigation)	323	AF	569	183,895	Shift to conveying Valencia Blend for spreading
Recycled Water Purchase (Valencia Blend for spreading)	1,100	AF	569	625,900	Based on preliminary estimate from LACSD at 70:30 belnd of tertiary:RO
Annual O&M Costs ($/year)				**$1,415,871**	
Annual Unit O&M Costs ($/AFY)				**$852.84**	

Engineers Opinion of Probable Cost
Alternative 3 - Groundwater Recharge (Surface Spreading)

KENNEDY/JENKS CONSULTANTS

Project:	Phase 2A + Spreading Site #3b	**Prepared By:**	DTT	**Project Life:**	30	years
Description:	pipeline	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%	
Area:	Valencia WRP Supply (Demineralized Blend)	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	3.3	mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560	AFY (Irrigation)
				RW Recharged:	3,700	AFY (Spreading)
				Design Capacity:	3.0	mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (no additional facilities)**					
2.0	**New Pipelines (west of Site #1)**					
2.1	Phase 2A Pipelines to meet irrigation and IPR flows (limited by Honby Capacity)					
	8 inch-dia pipeline segments	7,343	LF	112	822,423	8 in-diameter $14 per inch-dia-lf
	24 inch-dia pipeline segments	17,600	LF	384	6,758,531	24 in-diameter $16 per inch-dia-lf
	24 inch-dia pipeline segments	11,943	LF	384	4,585,925	24 in-diameter $16 per inch-dia-lf
2.2	Phase 2A to old Honby Lateral	2,000	LF	384	768,000	24 in-diameter $16 per inch-dia-lf
2.3	Honby PS to Spreadng Site #1	10,000	LF	384	3,840,000	24 in-diameter $16 per inch-dia-lf
	Repurpose Existing Pipelines					**assumes cost to rehab pipeline for reuse*
2.4	Repurpose Honby Lateral to get to Honby PS Pad	1	LS	200,000	200,000	Reuse ~ 6,000 LF of Honby Lateral, assume 600 LF to connect from east side to site of Honby PS
2.5	Rehab Honby Pipeline from Honby PS Pad to near Sand Canyon Rd	25,000	LF	140	3,500,000	12 in-diameter $12 per inch-dia-lf
2.6	Jacking/Receiving Pits for sliplining	25	LS	10,000	250,000	assume a jacking and receiving pit every 1,000 LF for sliplilning
	New Pipelines (east of Honby)					
2.7	Extension from Honby Pipeline near Sand Canyon to Site #3b	20,000	LF	210	4,200,000	14 in-diameter $15 per inch-dia-lf
2.8	Pipeline from SCR diversion to Basin (for stormwater)	1,200	LF	240	288,000	16 in-diameter $15 per inch-dia-lf
2.9	Special Crossings					
	Bore and Jack Pipe Laying	0	LF	2,310	0	14 in-dia[illegible]eter $165 per inch-dia-lf
	Bore and Jack Pit Construction	0	EA	35,000	0	based on jacking and receiving [illegible] costs
	Major Intersections	150	LF	560	84,000	1[illegible] [illegible]ameter $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Spreading Basin #1	1	LS	6,770,000	6,770,000	7,00[illegible] 490 ft (TDH)
						**assume sufficient to mee[illegible]se 2A irrigation Demands*
3.2	Booster PS from Old Honby PS Pad to Spreading Basin #3	1	LS	1,990,000	1,990,000	2,100 gpm 400 ft (TDH)
3.3	Stormwater pump station to Spreading Basin	1	LS	560,000	560,000	[illegible]400 gpm 48 ft (TDH)
4.0	**Storage and Spreading Basin**					
	Storage Tank at Central Park	1	MG	725,500	[illegible]25,50[illegible]	[illegible]S Means 20[illegible] Water Storage Tank Construction Cost
4.1	**Spreading Basin #3b**					
4.2	Construct 20 acre basin	100	AF	30,000	3,[illegible]000	[illegible]torag[illegible] pond construction bid
4.3	Construct 1 acre settling basin	5	AF	60,000	300,[illegible]	
4.4	Diversion Structure	600	LF	6,[illegible]	3,600,00[illegible]	[illegible]nflatable rubber dam for stormwater flow diversions, includes foundation
4.5	Hydraulic control structures	3	LS	[illegible],000	[illegible]50,000	*[illegible]ossibility to have LACSD pay for rubber dam*
4.6	Pipelines btw basins	1,000	LF	[illegible]40	[illegible],000	16 in-diameter $15 per inch-dia-lf
	Spreading Basin #3a					
4.7	Construct 28 acre basin	140	AF	30,000	4,[illegible]0,000	Recent storage pond construction bid
4.8	Diversion Structure	200	LF	6,000	[illegible],200,000	Inflatable rubber dam for stormwater diversion
4.9	Hydraulic control structure	2	LS	50,000	100,000	One at RW inlet and one at stormwater inlet
5.0	**Monitoring Wells**					
5.1	Monitroing Wells	3	LS	[illegible],000	480,000	
	Extraction Wells					Assume use of existing wells
6.0	**Site Retrofit Costs (Phase 2A)**					
	Based on number and size of sites	[illegible]	sites	26,000	1,326,000	Unit cost based on retrofit cost curve developed from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$49,938,379**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		1,165,775	% of Subtotal treatment, pump station, storage and monitoring wells
						(Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		1,165,775	% of Subtotal treatment, pump station, storage and monitoring wells
8.0	Electrical, I&C, and SCADA Control	@	25%		5,828,875	% of Subtotal treatment, pump station, storage and discharge costs
						(not icnluding levee or pipelines)
	Subtotal Additional Facility Costs				**$8,160,425**	
					$58,098,804	
	Taxes	@	9%		1,797,782	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		2,904,940	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		8,714,821	% of Facility Direct Costs
	Estimate Contingency	@	30%		17,429,641	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$88,945,987**	
	Escalation to Midpoint of Construction	@	18%		16,010,278	assume 2% percent over 9
						contrustion start = 2024 end = 2026
		Project Capital Cost Total			**$104,956,265**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	Notes
Energy Costs					Pump Operation = 3861 hours operated per year
Energy: PS from Valencia WRP to Spreading Basin #1	6,237,026	KWh	0.12	748,443	Pump Station Hp = 2165 Total Motor HP Required
Energy: Booster PS from Old Honby PS Pad to Spreading Basin #3	849,916	KWh	0.12	101,990	Pump Station Hp = 526 Total Motor HP Required
Energy: Stormwater pump station to Spreading Basin	164,468	KWh	0.12	19,736	Pump Station Hp = 102 Total Motor HP Required
Energy (other)	363,000	KWh	0.12	43,560	5% of sum of pumping energy requirements
Labor Costs					
Other Labor (pipeline, PS, monitoring)	2.0	staff	100,000	200,000	full time staff at $100,000 salary per year
					** may require additional LACFCD staff time to operate diversion/ponds*
Maintenance: Recharge Ponds	@	0.5%		67,578	Includes seasonal weed and erosion control, cleaning hydraulic structures, sediment removal, etc (% of direct facility costs)
Maintenance: Pump Station, Monitoring Wells, Diversion	@	1.0%		4,800	% of above direct facility costs for these components
Contingency	@	10%		118,611	% of above O&M costs
Recycled Water Purchase (tertiary for irrigation in summer)	237	AF	200	47,400	Based on avereage LACSD RW purchase rate from 2013 to 2015
Recycled Water Purchase (tertiary-blend non-summer irrigation)	323	AF	569	183,895	Shift to conveying Valencia Blend for spreading
Recycled Water Purchase (Valencia Blend for spreading)	3,700	AF	569	2,105,300	Based on preliminary estimate from LACSD at 70:30 belnd of tertiary:RO
Annual O&M Costs ($/year)				**$3,641,313**	
Annual Unit O&M Costs ($/AFY)				**$854.73**	

Engineers Opinion of Probable Cost
Alternative 4 - Advanced Treatment for Potable Reuse

KENNEDY/JENKS CONSULTANTS

Project:	CLWA RWMP	**Prepared By:**	DTT	**Project Life:**	30 years
Alternative:	Direct Injection Location #1 (Near Valencia WRP)	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Valencia WRP Supply (Tertiary + Demineralized)	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	4.9 mgd
Estimate:	Conceptual-Level	**ENR**		**RW Recharged:**	5,500 AFY
				Design Capacity:	9.7 mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility (AWTF for Peak Flow)**					Source: Trussell TM based on costs from LACSD Chrloride EIR
1.1	Microfiltration	1	LS	18,600,000	18,600,000	
1.2	Enhanced Brine Concentration (NF + IX)	1	LS	36,200,000	36,200,000	
1.3	Reverse Osmosis	1	LS	29,950,000	29,950,000	
1.4	UV AOP	1	LS	4,700,000	4,700,000	
1.5	Other Appurtenances	1	LS	17,550,000	17,550,000	
2.0	**Pipelines**					
2.1	Valencia to Direct Injection Location #1	6,000	lf	384	2,304,000	24 in-diameter; $16 per inch-dia-lf
2.2	Special Crossings (estimate)	100	lf	960	96,000	24 in-diameter; $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Direct Injection Site	1	LS	1,720,000	1,720,000	7,00[illegible] gpm; 100 ft (TDH)
3.1	Injection Well pump	1	LS	1,230,000	1,230,000	7,000 gpm; 80 ft (TDH)
4.0	**Storage**					
	None					
5.0	**Groundwater Wells**					
5.1	Injection wells	7	LS	1,070,00[illegible]	7,490,[illegible]0	1,000 gpm per well
5.2	Monitroing Wells	3	LS	160,[illegible]0	480,00[illegible]	
5.3	Extraction Wells					Assume use of existing wells
	Subtotal Facility Costs				**$120,320,000**	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		5,896,000	% of Subtotal treatment, pump station, storage and discharge costs (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	5%		5,896,000	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and SCADA Control	@	2[illegible]%		29,480,000	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$41,272,000**	
					$161,592,000	
	Taxes	@	9%		4,331,520	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		8,079,600	% of Facility Direct Costs
	Contractor Overhead & Profit	@	#####		24,238,800	% of Facility Direct Costs
	Estimate Contingency	@	#####		48,477,600	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$246,719,520**	
	Escalation to Midpoint of Construction	@	#####		44,409,514	assume 2% percent over 9
						contrustion start = 2024; end = 2026
	Project Capital Cost Total				**$291,129,034**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	Notes/Source
Energy Costs (non-treatment)					Pump Operation = 5150 hours operated per year
Energy (injection wells)	1,122,149	KWh	0.12	134,658	Pump Station Hp = 292 Total Motor HP Required
Energy (other)	56,000	KWh	0.12	6,720	5% of sum of pumping energy requirements
Labor Costs (non-treatment)					
Other Labor (pipeline, injection wells, monitoring)	1.0	staff	100,000	100,000	full time staff at $100,000 salary per year
Maintenance: Pipeline, Injection and Monitoring Wells	@	1.0%		133,200	% of above direct facility costs for pipelines, injection and monitoring wells
Contingency	@	10%		37,458	% of above O&M costs
Recycled Water Purchase (tertiary)	5,500	AF	200	1,100,000	Based on avereage LACSD RW purchase rate from 2013 to 2015
Advanced Treatment Costs					Source: Trussell Technologies, including energy, labor, chemicals, materials and replacement costs by process type
Microfiltration	4,900,000	gal	0.22	1,097,600	
Enhanced Brine Concentration (NF + IX)	4,900,000	gal	0.45	2,195,200	unit cost based on average operating flow over the year
Reverse Osmosis	4,900,000	gal	0.43	2,095,418	
UV AOP	4,900,000	gal	0.04	199,564	
Other Appurtenances	4,900,000	gal	0.12	598,691	
Annual O&M Costs ($/year)				**$7,698,508**	
Annual Unit O&M Costs ($/AFY)				**$1,400**	

Engineers Opinion of Probable Cost
Alternative 4 - Advanced Treatment for Potable Reuse

KENNEDY/JENKS CONSULTANTS

Project:	CLWA RWMP	**Prepared By:**	DTT	**Project Life:**	30 years
Alternative:	SW Augmentation at Castaic Lake	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%
Area:	Castaic Lake	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	4.9 mgd
Estimate:	Conceptual-Level	**ENR**		**RW Augmented to Castaic Lake:**	5,500 AFY
				Design Capacity:	9.7 mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility**					Source: Trussell TM based on costs from LACSD Chrloride EIR
1.1	Microfiltration	1	LS	18,600,000	18,600,000	
1.2	Enhanced Brine Concentration (NF + IX)	1	LS	36,200,000	36,200,000	
1.3	Reverse Osmosis	1	LS	29,950,000	29,950,000	
1.4	UV AOP	1	LS	4,700,000	4,700,000	
1.5	Other Appurtenances	1	LS	17,550,000	17,550,000	
2.0	**Pipelines**					
2.1	Valencia WRP to ARWT at Earl Schmidt	36,000	LF	384	13,824,000	24 in-diameter $16 per inch-dia-lf
2.2	ARWT to Castaic Lake (Boat Ramp Location)	9,000	LF	384	3,456,000	[illegible] in-diameter $16 per inch-dia-lf
2.3	Special Crossings					
	Major Intersections	400	LF	960	384,000	[illegible]4 in-diameter $40 per inch-dia-lf
3.0	**Pump Stations**					
3.1	Valencia WRP to ARWT at Earl Schmidt	1	LS	6,990,000	6,990,000	7,000 gpm 530 ft (TDH)
3.2	ARWT to Castaic Lake	1	LS	2,250,000	2,250,000	7,000 gpm 140 ft (TDH)
4.0	**Storage**					
	None					
5.0	**Discharge Facility**	4.9	mgd	350,000	[illegible]710,000	Standard bank outfall with erosion protection and energy dissipation.
	Subtotal Facility Costs				$[illegible]614,000	
Additional Facility Capital Costs						
6.0	Site Development Costs	@	5%		5,897,500	% of Subtotal treatment, pump station, storage and discharge costs (Includes grading, erosion control, cut/fill, etc.)
7.0	Yard Piping	@	[illegible]%		5,897,500	% of Subtotal treatment, pump station, storage and discharge costs
8.0	Electrical, I&C, and SCADA Control	@	2[illegible]%		29,487,500	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$41,282,500**	
					$176,896,500	
	Taxes	@	9%		4,882,104	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		8,844,825	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		26,534,475	% of Facility Direct Costs
	Estimate Contingency	@	30%		53,068,950	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$270,226,854**	
	Escalation to Midpoint of Constructio[illegible]	@	28%		75,663,519	assume 2% percent over 14
						contrustion start = 2028 end = 2032
	Project Capital Cost Total				**$345,890,373**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	
Energy Costs (non-treatment)					Pump Operation = 5150 hours operated per year
Energy - Valencia WRP to ARWT at Earl Schmidt	8,623,383	KWh	0.12	1,034,806	Pump Station Hp = 2245 Total Motor HP Required
Energy - ARWT to Castaic Lake	2,331,128	KWh	0.12	279,735	Pump Station Hp = 607 Total Motor HP Required
Energy (other)	548,000	KWh	0.12	65,760	5% of sum of pumping energy requirements
Labor Costs (non-treatment)					
Other Labor (pipeline, pump stations, discharge, monitoring)	1.0	staff	100,000	100,000	full time staff at $100,000 salary per year
Maintenance: Pipeline, Pump Station, discharge	@	1.0%		286,140	% of above direct facility costs for pipelines, injection and monitoring wells
Contingency	@	10%		176,644	% of above O&M costs
Recycled Water Purchase (tertiary)	5,500	AF	200	1,100,000	Based on avereage LACSD RW purchase rate from 2013 to 2015
Advanced Treatment Costs					Source: Trussell Technologies, including energy, labor, chemicals, materials and replacement costs by process type
Microfiltration	4,900,000	gal	0.22	1,097,600	
Enhanced Brine Concentration (NF + IX)	4,900,000	gal	0.45	2,195,200	unit cost based on average operating flow over the year
Reverse Osmosis	4,900,000	gal	0.43	2,095,418	
UV AOP	4,900,000	gal	0.04	199,564	
Other Appurtenances	4,900,000	gal	0.12	598,691	
Annual O&M Costs ($/year)				**$9,229,558**	
Annual Unit O&M Costs ($/AFY)				**$1,678**	

Engineers Opinion of Probable Cost
Alternative 4 - Advanced Treatment for Potable Reuse

KENNEDY/JENKS CONSULTANTS

Project:	CLWA RWMP	**Prepared By:**	DTT	**Project Life:**	30	years
Alternative:	Direct Potable Reuse + Phase 2A	**Date Prepared:**	Feb-2016	**Interest Rate:**	4%	
Area:	r	**K/J Proj. No.**	1544241.00	**Average Annual Product Flow:**	4.9	mgd
Estimate:	Conceptual-Level	**ENR**		**Phase 2A RW Delivered:**	560	AFY (Irrigation)
				RW delivered to Rio Vista:	5,500	AFY (DPR)
				Design Capacity:	9.7	mgd

Item No.	Description	Qty	Units	Total Costs $/Unit	Total Capital Cost	Notes/Source
Facility Capital Costs						
1.0	**Treatment Facility**					Source: Trussell TM based on costs from LACSD Chrloride EIR
1.1	Ozone System	1	LS	3,150,000	3,150,000	
1.2	Biologically Active Carbon Filter	1	LS	7,900,000	7,900,000	
1.3	Microfiltration	1	LS	18,600,000	18,600,000	
1.4	Enhanced Brine Concentration (NF + IX)	1	LS	36,200,000	36,200,000	
1.5	Reverse Osmosis	1	LS	29,950,000	29,950,000	
1.6	UV AOP	1	LS	4,700,000	4,700,000	
1.7	Other Appurtenances	1	LS	17,550,000	17,550,000	
2.0	**Pipelines**					
2.1	Phase 2A Pipelines to meet irrigation and IPR flows					
	8 inch-dia pipeline segments	7,400	LF	272	2,012,800	8 in-diameter $14 per inch-dia-lf
	24 inch-dia pipeline segments	17,600	LF	384	6,758,531	24 in-diameter $16 per inch-dia-lf
	24 inch-dia pipeline segments	11,943	LF	384	4,585,925	24 in-diameter [illegible]16 per inch-dia-lf
2.2	Phase 2A to Rio Vista	1,000	LF	384	384,000	24 in-diameter $16 per inch-dia-lf
2.3	Special Crossings					
	Major Intersections	950	LF	960	912,000	24 in-diameter [illegible] per inch-dia-lf
	Bore and Jack Pipe Laying	700	LF	3,960	2,772,000	24 in-diamet[illegible] $165 [illegible] inch-dia-lf
	Bore and Jack Pit Constuction	2	EA	35,000	70,000	based on jacking and receiving [illegible]osts
3.0	**Pump Stations**					
3.1	PS from Valencia WRP to Central Park	1	LS	6,770,000	6,770,000	7,000 [illegible]pm 490 ft (TDH)
3.1	Suction PS at Rio Vista	1	LS	410,000	410,000	3,000 g[illegible]m 20 ft (TDH)
4.0	**Storage Tank**					
4.1	Storage Tank at Central Park	1	MG	725,500	725,500	RS [illegible]ans 20[illegible] [illegible]ter Stora[illegible]e Tank Construction Cost
	Eng Buffer Storage (at ARWT or Rio Vista)					
4.2	Steel Ground Tank	5	mil gal	350,000	1,7[illegible]	[illegible]S Means 2[illegible] Water Storage Tank Construction Cost
6.0	**Site Retrofit Costs (Phase 2A)**					
	Based on number and size of sites	51	sites	26,000	1,326,[illegible]0	Unit [illegible]st based on retrofit cost curve developed from VWC study by Dexter Willliams
	Subtotal Facility Costs				**$146,526,756**	
Additional Facility Capital Costs						
5.0	Site Development Costs	@	5%		6,385,275	% of Subtotal treatment, pump station, storage and discharge costs
						(Includes grading, erosion control, cut/fill, etc.)
6.0	Yard Piping	@	5%		6,385,275	% of Subtotal treatment, pump station, storage and discharge costs
7.0	Electrical, I&C, and SCADA Control	@	25%		31,926,375	% of Subtotal treatment, pump station, storage and discharge costs
	Subtotal Additional Facility Costs				**$44,696,925**	
					$191,223,681	
	Taxes	@	9%		5,274,963	apply taxes to 40% of the Capital Costs for facilities
	Mobilization/Bonds/Permits	@	5%		9,561,184	% of Facility Direct Costs
	Contractor Overhead & Profit	@	15%		28,683,552	% of Facility Direct Costs
	Estimate Contingency	@	30%		57,367,104	% of Facility Direct Costs
Subtotal with Contractor Markups and Contingency					**$292,110,485**	
	Escalation to Midpoint of Construction	@	38%		111,001,984	assume 2% percent over 19
						contrustion start = 2033 end = 2037
	Project Capital Cost Total				**$403,112,469**	

Annual Operations and Maintenance	Qty	Units	Total Annual Costs $/Unit	Total	Notes
Energy Costs (non-treatment)					Pump Operation = 5150 hours operated per year
Energy - Suction PS at Rio Vista	240,906	KWh	0.12	28,909	Pump Station Hp = 63 Total Motor HP Required
Energy (other)	12,000	KWh	0.12	1,440	5% of sum of pumping energy requirements
Labor Costs (non-treatment)					
Other Labor (pipeline, pump station, storage tank, monitoring)	0.5	staff	100,000	50,000	full time staff at $100,000 salary per year
Maintenance: Pipeline, Pump Station, Tank	@	1.0%		284,768	% of above direct facility costs for pipelines, injection and monitoring wells
Contingency	@	10%		36,512	% of above O&M costs
Recycled Water Purchase (tertiary)	5,500	AF	200	1,100,000	Based on avereage LACSD RW purchase rate from 2013 to 2015
Advanced Treatment Costs					Source: Trussell Technologies, including energy, labor, chemicals, materials and
Ozone System	4,900,000	gal	0.04	199,564	replacement costs by process type
Biologically Active Carbon Filter	4,900,000	gal	0.01	39,913	unit cost based on average operating flow over the year
Microfiltration	4,900,000	gal	0.22	1,097,600	
Enhanced Brine Concentration (NF + IX)	4,900,000	gal	0.45	2,195,200	
Reverse Osmosis	4,900,000	gal	0.43	2,095,418	
UV AOP	4,900,000	gal	0.04	199,564	
Other Appurtenances	4,900,000	gal	0.12	598,691	
Annual O&M Costs ($/year)				**$7,927,577**	
Annual Unit O&M Costs ($/AFY)				**$1,441**	

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Appendix B: Summary of Recycled Water Regulations

B.1. Federal Requirements

Federal requirements relevant to the discharge of recycled water, or wastewater, and any other liquid wastes to "navigable waters" are contained in the 1972 amendments to the Federal Water Pollution Control Act of 1956, commonly known as the federal Clean Water Act (CWA) (Public Law 92-500). The CWA created the U.S. Environmental Protection Agency (USEPA) and established the National Pollutant Discharge Elimination System (NPDES), a permit system for discharge of contaminants to navigable waters. NPDES requires that all municipal and industrial dischargers of liquid wastes apply for and obtain a permit prior to initiating discharge.

There are no federal regulations governing water reuse in the United States, thus regulations (or guidelines) for recycled water are developed and implemented at the state government level. The lack of federal regulations has resulted in differing standards among states that have developed recycled water regulations (WateReuse 2009). This appendix focuses on recycled water regulations in the State of California.

Recognizing the need to provide national guidance on water reuse regulations and program planning, the U.S. Environmental Protection Agency (USEPA) has developed comprehensive, up-to-date water reuse guidelines in support of regulations and guidelines developed by states, tribes, and other authorities (USEPA 2012). The 2012 USEPA Guidelines for Water Reuse provides support for both project planners and state regulatory officials by providing a national overview of the status of reuse regulations and clarifying some of the variations in the regulatory frameworks that support reuse in different states and regions of the United States

B.2. State Requirements

In the State of California, recycled water requirements are administered by the State Water Resource Control Board (SWRCB) - Division of Drinking Water (DDW), formerly under California Department of Public Health (CDPH), and individual Regional Water Quality Control Boards (RWQCBs). The regulatory requirements for recycled water projects in California are contained in the following sources[1,2]:

- California Code of Regulations (CCR) -Title 22 and Title 17
- California Health and Safety Code
- California Water Code.

[1] State requirements for production, discharge, distribution, and use of recycled water are contained in the California Water Code, Division 7-Water Quality, Sections 1300 through 13999.16 (Water Code); the California Administrative Code, Title 22-Social Security, Division 4 Environmental Health, Chapter 3-Reclamation Criteria, Sections 60301 through 60475 (Title 22); and the California Administrative Code, Title 17-Public Health, Chapter 5, Subchapter 1, Group 4-Drinking Water Supplies, Sections 7583 through 7630 (Title 17).

[2] Applicable excerpts from Title 22, Title 17, and the Health and Safety Code are documented in "The Purple Book", which provides a single source of guidelines and requirements for recycled water use in California (CDPH 2001).

Title 22 State Clean Water Act (CWA)

In 1975, Title 22 was prepared by the California Department of Public Health (now DDW[3]) in accordance with the requirements of Division 7, Chapter 7 of the Water Code. In 1978, Title 22 was revised to conform with the 1977 amendment to the federal CWA. The requirements of Title 22, as revised in 1978, 1990, and 2001, regulate production and use of recycled water in California.

The DDW regulates the treatment, quality, and use of recycled water, as well as the proper separation of recycled water and drinking water systems. Title 22 stipulates the levels of treatment for different uses of recycled water, permissible types of reuse, and minimum recycled water quality requirements. Water meeting these standards is considered safe for non-drinking purposes. Routine monitoring is required to ensure that the intended quality is consistently being produced.

Figure A.1 illustrates the allowable uses of recycled water for each level of treatment. Most recycled water used in California meets the Title 22 standards for "disinfected tertiary recycled water", which has the most stringent requirements for non-potable reuse. "Disinfected tertiary recycled water" means a filtered and subsequently disinfected wastewater that meets certain total coliform concentration, turbidity, and disinfection requirements. A lower degree of treatment, "disinfected secondary recycled water", is allowed for specified irrigation, non-irrigation and environmental uses, and is less frequently used. In some cases, a higher degree of treatment beyond Title 22 requirements is performed to meet more stringent requirements for salt and nutrient-sensitive uses.

[3] The Drinking Water Program for CDPH moved to the SWRCB and was renamed the Division of Drinking Water (DDW) as of July 1, 2014.

Figure B.1 Non-Potable Recycled Water Uses Allowed[1] in California

This summary is prepared by WateRuse Association of California, from the December 2, 2000, Title 22 adopted Water Recycling Criteria, and supersedes all earlier versions.

Recycled Water Use	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 23 Recycled Water	Undisinfected Secondary Recycled Water
Irrigation for:				
Food crops where recycled water contacts the edible portion of the crop, including all root crops	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Parks and playgrounds	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
School grounds	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Residential landscaping	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Unrestricted-access golf courses	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Any other irrigation uses not specifically prohibited by other provisions of the *California Code of Regulations*	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Food crops, surface-irrigated, above-ground edible portion, not contacted by recycled water	ALLOWED	ALLOWED	NOT ALLOWED	NOT ALLOWED
Cemeteries	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Freeway landscaping	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Restricted-access golf courses	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Ornamental nursery stock and sod farms with unrestricted public access	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Pasture for milk animals for human consumption	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Nonedible vegetation with access control to prevent use as a park, playground or school grounds	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Orchards with no contact between edible portion and recycled water	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Vineyards with no contact between edible portion and recycled water	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Fodder and fiber crops and pasture for animals not producing milk for human consumption	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Seed crops not eaten by humans	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Food crops undergoing commercial pathogen-destroying processing before consumption by humans	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Ornamental nursery stock, sod farms not irrigated less than 14 days before harvest	ALLOWED	ALLOWED	ALLOWED	ALLOWED
Supply for impoundment:				
Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms	ALLOWED[2]	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Restricted recreational impoundments and publicly accessible fish hatcheries	ALLOWED	ALLOWED	NOT ALLOWED	NOT ALLOWED
Landscape impoundments without decorative fountains	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Supply for cooling or air conditioning:				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	ALLOWED[3]	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED

Recycled Water Use	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 23 Recycled Water	Undisinfected Secondary Recycled Water
Other Uses:				
Groundwater Recharge	ALLOWED under special case-by-case permits by RWQCB[4]			
Flushing toilets and urinals	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Priming drain traps	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that may contact workers	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Structural fire fighting	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Decorative fountains	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Commercial laundries	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Consolidation of backfill material around potable water pipelines	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Artificial snow making for commercial outdoor use	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Commercial car washes, not heating the water, excluding the general public from the washing process	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that will not come into contact with workers	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Industrial boiler feed	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Nonstructural fire fighting	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Backfill consolidation around nonpotable piping	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Soil compaction	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Mixing concrete	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Dust control on roads and streets	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Cleaning roads, sidewalks and outdoor work areas	ALLOWED	ALLOWED	ALLOWED	NOT ALLOWED
Flushing sanitary sewers	ALLOWED	ALLOWED	ALLOWED	ALLOWED

1 Refer to the full text of the version of California Department of Public Health's "Regulations Related to Recycled Water", published on January 1, 2009. This chart is only an informal summary of uses allowed in that publication. The most current Title 17 and Title 22 regulations can be downloaded from: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20150625.pdf

2 With "conventional tertiary treatment." Additional monitoring for two years or more is necessary with direct filtration.

3 Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

4 Refer to the June 18, 2014 final Groundwater Recharge Guidelines, available from the DDW website at: http://www.cdph.ca.gov/services/DPOPP/regs/Pages/DPH14-003EGroundwaterReplenishmentUsingRecycledWater.aspx

In addition to recycled water uses and treatment requirements, Title 22 addresses sampling and analysis requirements at the treatment plant, preparation of an engineering report prior to production or use of recycled water, general treatment design requirements, reliability requirements, and alternative methods of treatment.

Title 17 State Drinking Water Code

The focus of Title 17 is protection of drinking (potable) water supplies through control of cross-connections[4] with potential contaminants, including non-potable water supplies such as recycled water. Title 17, Group 4, Article 2 - Protection of Water System, Table 1, specifies the minimum backflow protection required on the potable water system for situations in which there is potential for contamination to the potable water supply. Recycled water is addressed in Title 17 as follows:

- An **air-gap separation** is required on "Premises where the public water system is used to supplement the recycled water supply."
- A **reduced pressure principle backflow prevention device** is required on "Premises where recycled water is used…and there is no interconnection with the potable water system."
- A **double-check valve assembly** may be used for "Residences using recycled water for landscape irrigation as part of an approved dual plumbed use area established pursuant to Sections 60313 through 60316 unless the recycled water supplier obtains approval for the local public water supplier, or (DDW) if the water supplier is also the supplier of the recycled water, to utilize an alternative backflow prevention plan that includes an annual inspection and annual shutdown test of the recycled water and potable water systems pursuant to subsection 60316(a)."

Title 17 specifies the minimum backflow protection on the potable water system for situations in which there is potential for contamination to the potable water supply. In conjunction with local health agencies, DDW reviews and approves final onsite (customer) system plans for cross-connection control in accordance with Title 17, and inspects each system prior to operation. Backflow prevention and cross-connection testing would be performed for each site in accordance with DDW requirements before the recycled water supply is connected to that site.

B.3. State Guidelines

To assist in compliance with Title 22, DDW has prepared a number of guidelines for production, distribution, and use of recycled water. Additionally, DDW recommends use of guidelines prepared by the California-Nevada Section of the American Water Works Association (AWWA). These guidelines are summarized below.

<u>Guideline for the Preparation of an Engineering Report on the Production, Distribution, and Use of Recycled Water</u>. According to Title 22, prior to implementation of a water reclamation project (production, distribution, or use) an engineering report must be prepared and submitted to DDW. This guideline, prepared by DDW and dated March 2001, specifies the contents of an engineering report. The report should describe the production process, including the treated (effluent) water quality, the raw water quality, the treatment process; the plant reliability features the supplemental water supply, the monitoring program, and a contingency plan to prevent

[4] A cross-connection is an unprotected actual or potential connection between a potable water system used to supply water for drinking purposes and any source or system containing unapproved water or a substance that is not or cannot be approved as safe, wholesome, and potable, which in this case will be recycled water. By-pass arrangements, jumper connections, removable sections, swivel or changeover devices, or other devices through which backflow could occur, shall be considered to be cross-connections

distribution of inadequately treated water. The report should include maps of the distribution system and describe how the system will comply with DDW and AWWA guidelines and Title 17. The report should include maps of proposed use areas and should describe the use areas, the types of uses proposed, the people responsible for supervising the uses, the design of the user systems, and the proposed user inspection and monitoring programs.

Manual of Cross Connection Control/Procedures and Practices. This manual, dated July 1981, focuses on establishing a cross-connection control program to protect the public against backflow and back-siphonage of contamination. Main elements of the manual include areas where protection is required; causes of backflow; approved backflow preventers; procedures, installation, and certification of backflow preventers; and water shutoff procedures (for conditions which pose a hazard to the potable water supply).

Guidelines for the Distribution of Nonpotable Water. These guidelines were prepared by the California-Nevada Section of AWWA in 1992. The purpose of these guidelines is to provide guidance for planning, designing, constructing, and operating non-potable water systems, including recycled water systems. Distribution lines, storage and supply, pumping, on-site (user) applications, and system management are discussed. DDW guidelines reference these guidelines.

Guidelines for the On-Site Retrofit of Facilities Using Disinfected Tertiary Recycled Water. The California-Nevada Section of AWWA prepared these guidelines in 1997 to provide guidance on modifying existing on-site facilities for conversion to use of recycled water, including recommendations for signage, backflow prevention, and separation standards, for landscape irrigation, agricultural irrigation, industrial uses, and impoundments.

B.4. State Recycled Water Policy

The SWRCB adopted a Recycled Water Policy (RW Policy) in 2009 to establish more uniform requirements for water recycling throughout the State and to streamline the permit application process in most instances. The RW Policy includes a mandate that the State increase the use of recycled water over 2002 levels by at least 200,000 AFY by 2030. Also included are goals for stormwater reuse, conservation, and potable water offsets by recycled water. The onus for achieving these mandates and goals is placed both on recycled water purveyors and potential users. Absent unusual circumstances, the RW Policy puts forth that recycled water irrigation projects that meet DDW requirements and other State or Local regulations be adopted by Regional Boards within 120 days. These streamlined projects will not be required to include a monitoring component.

The RW Policy requires that salt/nutrient management plans be developed for every basin in California and adopted as Basin Plan Amendments by 2015. These Management Plans are to be developed by local stakeholders and funded by the regulated community.

The RW Policy also required the formation of a Blue-Ribbon Advisory Panel (Panel) to guide future actions with respect to contaminants of emerging concern (CECs). CECs include chemicals and other substances that have no regulatory standard, have recently been “discovered” in natural streams, and potentially cause deleterious effects in aquatic life at environmentally relevant concentrations. The Panel was convened in May 2009 and completed in May 2010. A final report was issued in June 2010. The recommendations of the Panel resulted in the finalization of the Groundwater Recharge and Reuse Regulations in June 2014, which incorporated the Panel's recommendations.

B.5. Indirect Potable Reuse Regulations

The California Water Code addresses the use of recycled water for IPR via groundwater recharge and reservoir augmentation.

Groundwater Recharge Reuse Regulations

Regulations for groundwater replenishment using recycled water became effective on June 18, 2014. These regulations define full advanced treatment (FAT) as the treatment of an oxidized wastewater (wastewater in which the organic matter has been stabilized) using a RO and oxidation treatment process meeting certain minimum criteria. FAT (also referred as Advanced Water Purification (AWP)) is required in the case of groundwater replenishment via injection (subsurface application), but not necessarily for surface spreading. Key aspects of these regulations are summarized Appendix C: Potable Reuse Evaluation.

Reservoir Augmentation Regulations

A recycled water reservoir augmentation project is defined as a project that plans to use recycled municipal wastewater for the purpose of augmenting a reservoir that is designated as a source of domestic water supply. A significant degree of regulatory uncertainty exists with respect to the overall implementation of a reservoir augmentation project. Chief among these uncertainties is the fact that (1) DDW regulations for such a project have not yet been developed, and (2) DDW has not yet convened the required expert panel to assess reservoir augmentation public safety needs. Appendix C discusses probable DDW reservoir augmentation requirements.

B.6. Direct Potable Reuse Regulations

The California Water Code was modified by legislative statute to require DDW, in consultation with the SWRCB, to investigate and report on the feasibility of developing uniform water recycling criteria for DPR by December 31, 2016. Preliminary DPR regulations may not be available in California until 2020. In addition to FAT or AWP of the recycled water, an "engineered buffer" (storage tank) would need to be provided for a DPR project to ensure that water quality leaving the facility always met regulatory standards. Future DPR regulations, compared to IPR, are anticipated to include additional monitoring and/or treatment requirements to ensure the overall reliability of the treatment scheme, with a focus on acute risks (i.e., pathogens), critical control points, and continuous verification of treatment performance (NWRI 2014). The two major alternatives for the safe design of DPR are 1) focus on the engineered storage buffer that provides time for sample analysis, such as real-time pathogen log reduction monitoring, to ensure water meets quality requirements before distribution, or 2) emphasis on increased advanced treatment to meet the same goals (i.e., treatment redundancy). The required treatment technologies may be similar to the IPR regulations, i.e., RO and AOP. Appendix C provides additional information on potential DPR regulations.

DDW. 2001. California Health Laws Related to Recycled Water "The Purple Book" Excerpts from the Health and Safety Code, Water Code, and Titles 22 and 17 of the California Code of Regulations. California Department of Public Health [Available at: http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/Purplebookupdate6-01.PDF, accessed June 30, 2014].

DDW. 2014. California Department of Public Health Regulations Related to Recycled Water – June 18, 2014 (Revisions effective on 6/18/14) [Available at: http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20140618.pdf, accessed October 9, 2014].

Trussell RR, Salveson A, Snyder SA, Trussell RS, Gerrity D, Pecson BM. 2013. Potable Reuse: State of the Science Report and Equivalency Criteria for Treatment Trains. WateReuse Research Foundation, Alexandria, VA.

USEPA. 2012. Guidelines for Water Reuse. EPA/600/R-12/618. United States Environmental Protection Agency and National Risk Management Research Laboratory. http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf

WateReuse Association. 2009. Manual of Practice – How to Develop a Water Reuse Program. Principal authors: Thomas Holliman, Richard Atwater, Dr. James Crook and Lois Humphreys.