Main Body w/o Appendices

City of Santa Cruz

Final
Santa Cruz Regional Recycled Water Facilities Planning Study

June 2018

Kennedy/Jenks Consultants

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FINAL
City of Santa Cruz Regional Recycled Water Facilities Planning Study

6 June 2018

Prepared for

City of Santa Cruz
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Santa Cruz, CA 95060

K/J Project No. 1668007.00

Note to Reader:

The Draft RWFPS was submitted to the SWRCB in September 2017, representing the City of Santa Cruz's decisions based on the understanding of regional projects, regulatory requirements and water supply conditions at that time. There have been and continue to be developments that influence the City's pursuit of recycled water, such as the Soquel Creek Water District finalizing aspects of their recycled water program and other regulatory milestones related to indirect and direct potable reuse. The City recognizes that some of the information in this document is no longer current, and that as regional projects and regulations evolve, future opportunities for reuse may also evolve. The City is committed to tracking the state of regulations and regional reuse programs in the future.

Acknowledgments

Funding for this plan has been provided in full or in part through an agreement with the State Water Resources Control Board. The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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(TM #1a and #1b are included in Appendix A)
TM #2a Beltz Wellfield Area Injection Well Capacity and Siting Study
TM #2b Santa Margarita Basin Injection Well Capacity and Siting Study
(TM #2a and #2b are included in Appendix C)
TM #3 Surface Water Augmentation (Included in Appendix D)
TM #4 Streamflow Augmentation (Included in Appendix E)

** Meeting agendas and presentations from the kick-off, workshops and webinars are available through the City.

Acronyms and Abbreviations

Ac	Acre
AF	Acre-feet
AFD	Acre-feet per day
AFY	Acre-feet per year
AMBAG	Association of Monterey Bay Area Governments
AOP	Advanced oxidation process
ASR	Aquifer storage & recovery
AWPF	Advanced Water Purification Facility
AWTF	Advanced Water Treatment Facility
AWT	Advanced Water Treatment
BAC	Biologically Activated Carbon
Basin Plan	Water Quality Control Plan for the Central Coast Region
bg	billion gallons
bgy	billion gallons per year
COS	Cost of service
CCF	Hundred cubic feet
CCR	California Code of Regulations
CCRWQCB	Central Coast Regional Water Quality Control Board
CCT	Chlorine contact tank
CDPH	California Department of Public Health
CEC	Contaminant of Emerging Concern
CEQA	California Environmental Quality Act
City	City of Santa Cruz
CWA	Clean Water Act
DBP	disinfection byproduct
DDW	Division of Drinking Water
DPR	Direct potable reuse
DWR	Department of Water Resources
EHS	Santa Cruz County Environmental Health Services
EIR	Environmental Impact Report
FAT	Full Advanced Treatment
FPR	Facilities Planning Report
Ft	Feet
GAC	Granular activated carbon
General Order	Water Reclamation Requirements for Recycled Water Use
GHWTP	Graham Hill Water Treatment Plant

GMF	Granular media filtration
gpd	Gallons per day
gpm	Gallons per minute
GRRP	Groundwater Replenishment Reuse Project
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
GW	Groundwater
HOA	Home Owner Association
IPR	Indirect potable reuse
IRWM	Integrated Regional Water Management
IWP	Integrated Water Plan
JPA	Joint Powers Authority
LF	Lineal feet
LRV	Log reduction values
M	million
Max	Maximum
MBR	Membrane bioreactor
MCL	Maximum contaminant limit
MF	Microfiltration
MG	Million gallons
MGA	Mid-County Groundwater Agency
mgd	Million gallons per day
mg/L	Milligrams per liter
Min	Minimum
MND	Mitigated Negative Declaration
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPR	Non-Potable Reuse
NTU	Nephelometric Turbidity Units
O&M	Operations and maintenance
Ocean Plan	Water Quality Control Plan for the Waters of California
PAYGO	Pay-as-you-go
PTG	Pasteurization Technology Group
RL	Reporting limit
RO	Reverse osmosis
RW	Recycled water

RWFPS	Recycled Water Facilities Planning Study
RWQCB	Regional Water Quality Control Board
SCCSD	Santa Cruz County Sanitation District
SCPWD	Santa Cruz Public Works Department
SCWD	Santa Cruz Water Department
SGMA	Sustainable Groundwater Management Act
SLVWD	San Lorenzo Valley Water District
SMGB	Santa Margarita Groundwater Basin
SNMP	Salt and Nutrient Management Plan
SqCWD	Soquel Creek Water District
SRF	State Revolving Fund
SVWD	Scotts Valley Water District
SWA	Surface Water Augmentation
SWRCB	State Water Resources Control Board
TDH	Total dynamic head
TDS	Total dissolved solids
TOC	Total organic carbon
TM	Technical memorandum
TMDL	Total Maximum Daily Load
TSS	Total suspended solids
UCSC	University of California Santa Cruz
ug/L	Micrograms per liter
UF	Ultrafiltration
uS/cm	Microsiemens per centimeter
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
UWMP	Urban Water Management Plan
V/G/C	Virus, Giardia, and Cryptosporidium
WC	Water Code
WCMP	Water Conservation Master Plan
WDR	Waste Discharge Requirements
WQO	Water Quality Objective
WRF	Water Reclamation Facility
WRFP	Water Recycling Funding Program
WRRF	WateReuse Research Foundation
WSAC	Water Supply Advisory Committee
WWTF	Wastewater Treatment Facility

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Executive Summary

ES.1 Introduction and Background

The City of Santa Cruz (City) relies on a water supply that is primarily dependent on local surface water runoff, with groundwater contributing only 5 percent of the annual water supply and no connection to an imported water source from outside the region. The strong reliance on local surface water sources and over-drafted groundwater basins are the primary threat to water supply reliability. The ongoing drought and the future uncertainties of climate change are further jeopardizing the sustainability of the City's current water supply system and ability to meet existing and anticipated future demands.

The City is currently implementing a supply augmentation plan with the goal of reaching supply sufficiency by 2025. The City's Water Supply Advisory Committee (WSAC) recommended several strategies to address an agreed-upon water supply gap of 1.2 billion gallons per year[1] during times of extended drought. The WSAC recommendations include continued water conservation and the evaluation of additional water supply alternatives including the development of groundwater storage (via in lieu water transfers and aquifer storage and recovery), recycled water and desalination.

This Recycled Water Facilities Planning Study (RWFPS) was developed in part to accomplish the following tasks as described in the WSAC final report: (1) to identify recycled water alternatives and increase the understanding of recycled water, and (2) to complete a high-level feasibility study and conceptual level design of alternatives for recycled water. The overall objective of the RWFPS extends beyond those embodied in the WSAC Final Report[1]. While studying the potential for recycled water to provide water supply benefit to the City, the RWFPS also evaluates a much broader range of potential beneficial uses of the treated effluent from the Santa Cruz Wastewater Treatment Facility (WWTF).

This study is a joint project between the Santa Cruz Water Department (SCWD), which is responsible for potable water supply in the City's service area, the Santa Cruz Public Works Department (SCPWD), which is responsible for wastewater and operates the Regional Santa Cruz WWTF and the State of California, who is funding a portion of the project through the State Water Resources Control Board's (SWRCB) Water Recycling Funding Program (herein referred to as Study Partners). Study Contributors include Soquel Creek Water District (SqCWD), Scotts Valley Water District (SVWD), the University of California Santa Cruz (UCSC) and the County of Santa Cruz, and the Santa Cruz County Sanitation District (SCCSD). This study recognizes the potential to develop future partnerships with the aforementioned regional agencies, and possibly the San Lorenzo Valley Water District (SLVWD), to increase reuse in the region.

[1] Water Supply Advisory Committee Final Report on Agreements and Recommendations (WSAC 2015)

This document is intended to help guide the City to identify a preferred recycled water project(s) for the future.

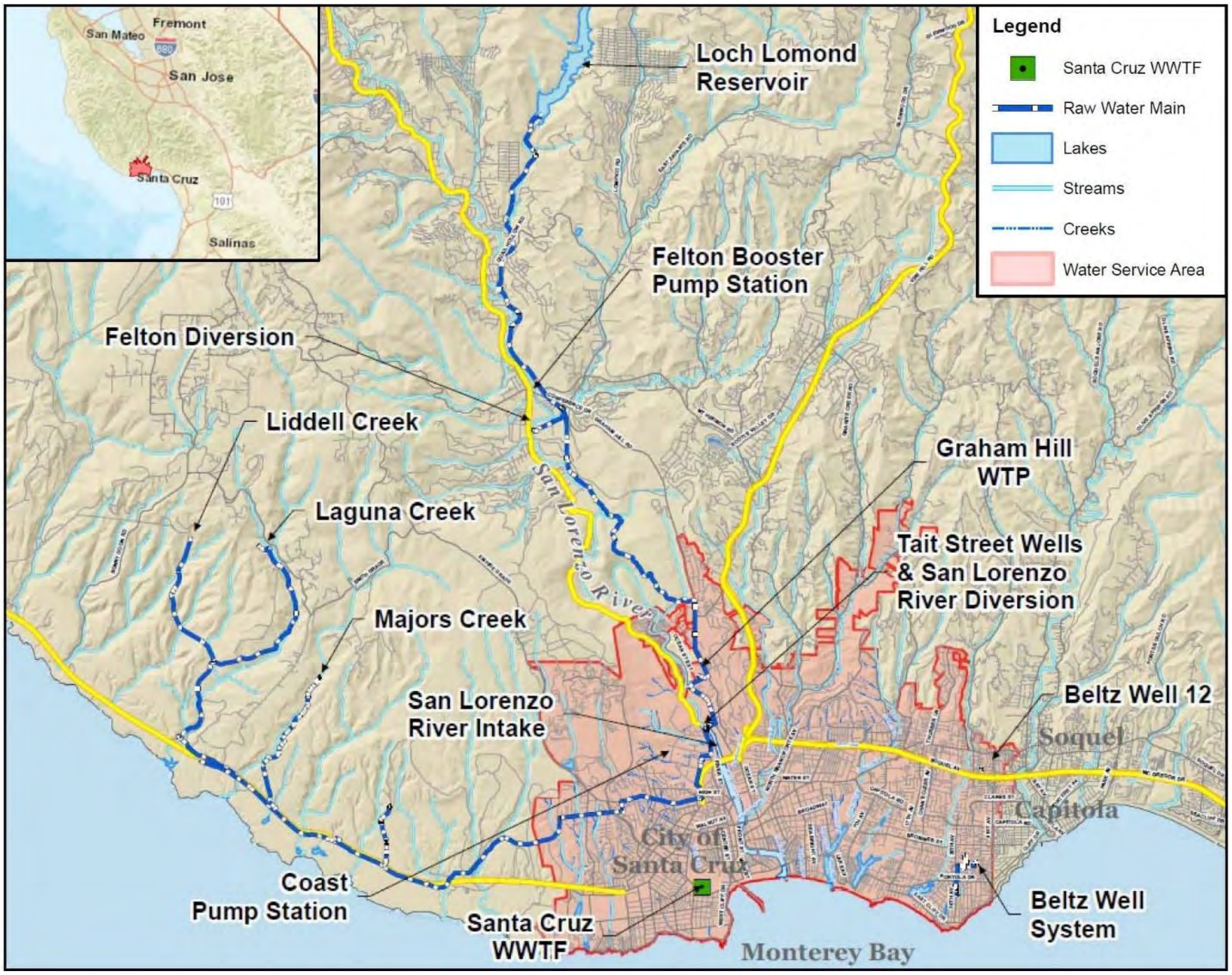
ES.2 City Water Supply and Wastewater Facilities

The City of Santa Cruz is a small-sized community located in Santa Cruz County, south of the San Francisco Bay Area at the north end of the Monterey Bay. The area has a Mediterranean climate with a cool, dry summer and a mild, wet winter. The total population in the Santa Cruz regional area includes over 132,000 people in the SCWD and SqCWD service areas and an estimated 40,000 people in the SLVWD and SVWD areas.

The City's major water supply and wastewater facilities are shown in Figure ES-1 and summarized herein. SCWD major water supply facilities include; (1) the Graham Hill Water Treatment Plant (GHWTP), which is the City's only surface water treatment plant for potable distribution, (2) treated water storage reservoirs throughout the city service area, (3) surface diversions on the San Lorenzo River and other smaller creeks from North Coast Sources, (4) Loch Lomond Reservoir, (5) the Beltz Well System in the Santa Cruz Mid-County Groundwater Basin, which includes the Beltz Wellfield and the Beltz Treatment Plants, and (6) pipelines and pump stations to distribute water throughout the city service area. The City complies with all drinking water standards set by the USEPA and SWRCB Division of Drinking Water (DDW).

The City owns and the SCPWD operates the regional Santa Cruz Wastewater Treatment Facility (Santa Cruz WWTF), which treats municipal wastewaters to secondary standards for discharge through an outfall to the Pacific Ocean. Municipal wastewater generated within the City limits is delivered to the Santa Cruz WWTF by a collection system that is operated by the SCPWD. SCCSD collects wastewater outside of the City limits via a central pumping facility in Live Oak where the wastewater is then pumped to the Santa Cruz WWTF. The plant also treats dry weather flows from Neary Lagoon, septage from unsewered areas and grease trap pumping. SVWD also adds its treated wastewater to the treated effluent for combined disposal through the outfall.

Figure ES-1: Major Water Supply and Wastewater Treatment Facilities



ES.3 Regional Facilities and Plans for Reuse

Regional facilities of interest for this study include water and wastewater facilities owned and operated by the City's neighbors, SqCWD, the SVWD, the City of Scotts Valley (which produces recycled water for the SVWD) and the SCCSD (a special district that provides wastewater collection service). These regional agencies are also committed to exploring opportunities to develop and expand recycled water use within their service areas and for the region as a whole.

Similar to the City, the SqCWD does not have access to imported supplies from federal, state or other sources outside the Santa Cruz area. SqCWD obtains 100 percent of its water supply from two groundwater aquifers within the Santa Cruz Mid-County Groundwater Basin via production wells. The basin currently is in a state of critical overdraft, and the cumulative impact of pumping in excess of sustainable yields will eventually lead to seawater intrusion and to potential contamination of the groundwater basin and drinking water (Carollo 2016). In addition to potential desalination, water transfers, and stormwater projects, the SqCWD is evaluating the Pure Water

Soquel project to replenish groundwater with advanced treated recycled water to prevent seawater intrusion and develop an alternative water source to supplement a supply shortfall of between 1.25 mgd (1,410 AFY) and 1.52 mgd (1,700 AFY). Wastewater from the SqCWD service area is currently sent to the Santa Cruz WWTF for treatment. Treated effluent would be used as the source water for their Groundwater Replenishment Reuse Project (GRRP). The City's RWFPS builds upon the alternatives in the SqCWD GRRP to identify opportunities for sharing facilities and resources between the City and SqCWD to meet their respective water supply needs. In addition, all of the alternatives in this RWFPS assume that the City would provide sufficient effluent to SqCWD to support the 1.3 mgd of groundwater recharge identified in the Pure Water Soquel Project.

Like SqCWD, SVWD also does not import any water and relies on groundwater for all of their potable water supply. Unlike the City or SqCWD, SVWD has an active water recycling program where the City of Scotts Valley produces the recycled water at the Scotts Valley Water Reclamation Facility (WRF) and SVWD distributes it to customers. The Scotts Valley recycled water program produces on average 0.19 mgd (215 AFY), which is used during the dry season for irrigation. The SVWD also recently completed a recycled water planning study, the Santa Margarita Groundwater Basin Recycled Water Groundwater Replenishment Program – Facilities Planning Report (FPR) (Kennedy/Jenks 2016a). The recommended project includes groundwater replenishment in the Lompico aquifer of the Santa Margarita Groundwater Basin via two existing wells repurposed for injection and a new injection well. The source water would be from the Scotts Valley WRF and the advanced treatment facility would be located at the Scotts Valley El Pueblo site. The City's RWFPS builds upon the alternatives in the SVWD FPR to identify opportunities for sharing facilities and resources between the City, SqCWD, SVWD and SLVWD to meet their respective water supply needs.

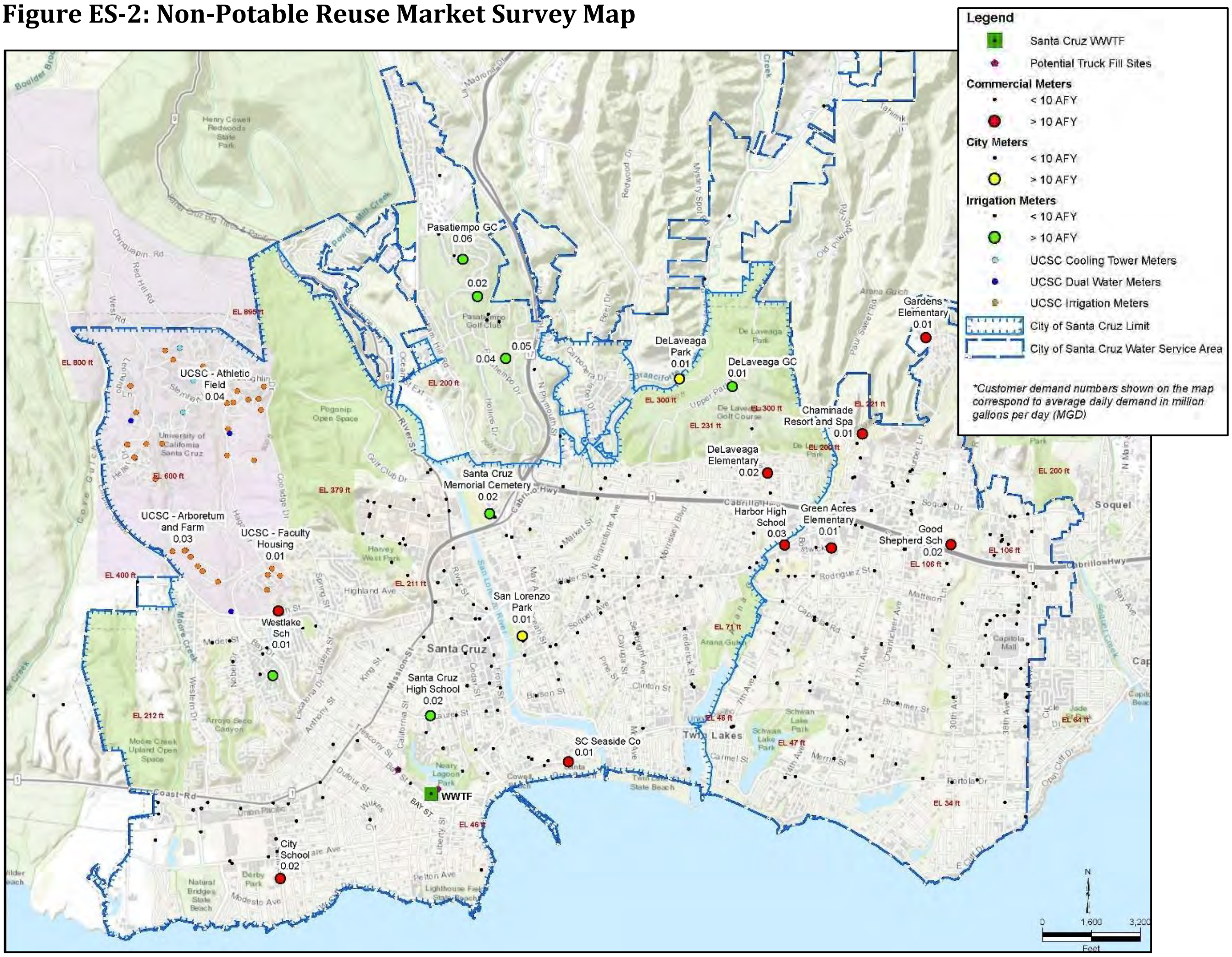
ES.4 Recycled Water Market Survey

The market assessment approach is performed in two parts: (1) a non-potable market survey and (2) a potable market survey.

For the **Non-Potable Market Survey** demands for irrigation, commercial and industrial uses are based on annual meter data provided by the City. The ability to meet non-potable demands is assessed based on the available supply in the summer months when irrigation demands are at their peak. The total amount of potential recycled water demand (from over 300 potable meters, with the potential to be retrofitted for non-potable uses) comprises about 0.77 mgd (860 AFY), which is almost 33% of the City's non-domestic residential demand (see Figure ES-2). However, more than 50% of the potential recycled water demand is from 20 larger users with individual demands greater than 0.009 mgd (10 AFY), shown as the large dots on Figure ES-2. In terms of being able to meet these demands, wastewater availability is not a limitation as there is sufficient effluent available for tertiary treatment, compared to non-potable demand.

However, the geographic distribution of potential recycled water customers in the City would make it cost prohibitive to serve many of these potential customers due to the significant amount of conveyance infrastructure that would be required.

Figure ES-2: Non-Potable Reuse Market Survey Map



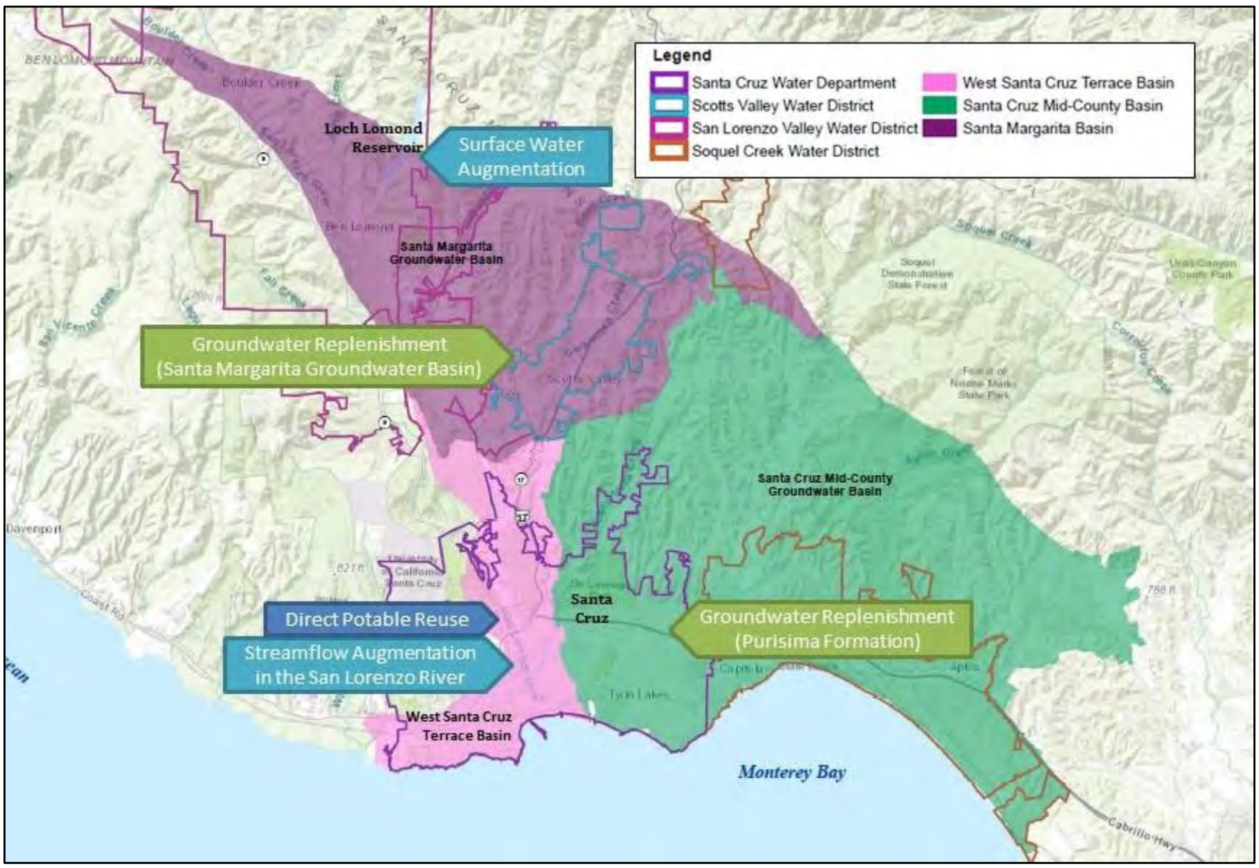
For the **Potable Market Survey,** demand estimates are not based on meter data, but rather the capacity of a suitable environmental buffer and/or future potable water demands. Figure ES-3 illustrates the potable reuse concepts explored as part of this study.

- Indirect potable demand for **groundwater recharge** is based on the available capacity of identified aquifers to receive recycled water while meeting regulatory requirements for retention (response) time.
- Indirect potable demand for **surface water augmentation** is based on the available capacity of a local reservoir to receive recycled water while meeting regulatory requirements for retention time. For the purpose of this study, **streamflow augmentation** is categorized as indirect potable reuse because it would provide additional water supply and reliability by increasing streamflow downstream to compensate for increased diversions upstream to meet potable demands. Both surface water and streamflow augmentation would be limited during the winter months when rainfall and naturally

occurring runoff utilize the available capacity in the reservoir and the stream systems. In the summer time the amount of reuse would be limited by wastewater production.

- **Direct potable reuse** demand for recycled water is based on current and future potable demands in Santa Cruz's service area. Indoor potable demands are assumed to be relatively constant throughout the year and the available supply of advanced treated water in the summer months, when wastewater production is the lowest, would limit the size of a DPR project for the City.

Figure ES-3: Potable Reuse Market Survey Map



ES.5 Alternatives Development and Evaluation

Figure ES-4 illustrates the alternatives development and evaluation approach implemented through a series of meetings, workshops, webinars and presentations, attended by Study Partners (SCWD and SCPWD) as well as potential local and regional partners. The following objectives, guidelines and criteria were developed through this process to identify, develop and evaluate recycled water opportunities.

- **Study Objectives** were developed by the Study Partners and Contributors during the kick-off meeting. They are not necessarily measurable or tangible but were used to focus the study and help develop guidelines and criteria.

- **Component Evaluation Guidelines** were developed during the Alternatives Workshop to align with the study objectives and are the metric used to better understand the extent to which combination(s) of project components (i.e. type of reuse, type of treatment and source of water) meet the study objectives. The application of the guidelines resulted in identification of alternatives for further evaluation.
- **Alternative Screening Criteria** are more definitive and were used to score and then rank the project alternatives. The screening criteria also align with the study objectives and are the metric used to score a project based on the more detailed quantitative results and qualitative findings from the alternatives evaluation.

Figure ES-4: Alternatives Development and Evaluation Approach

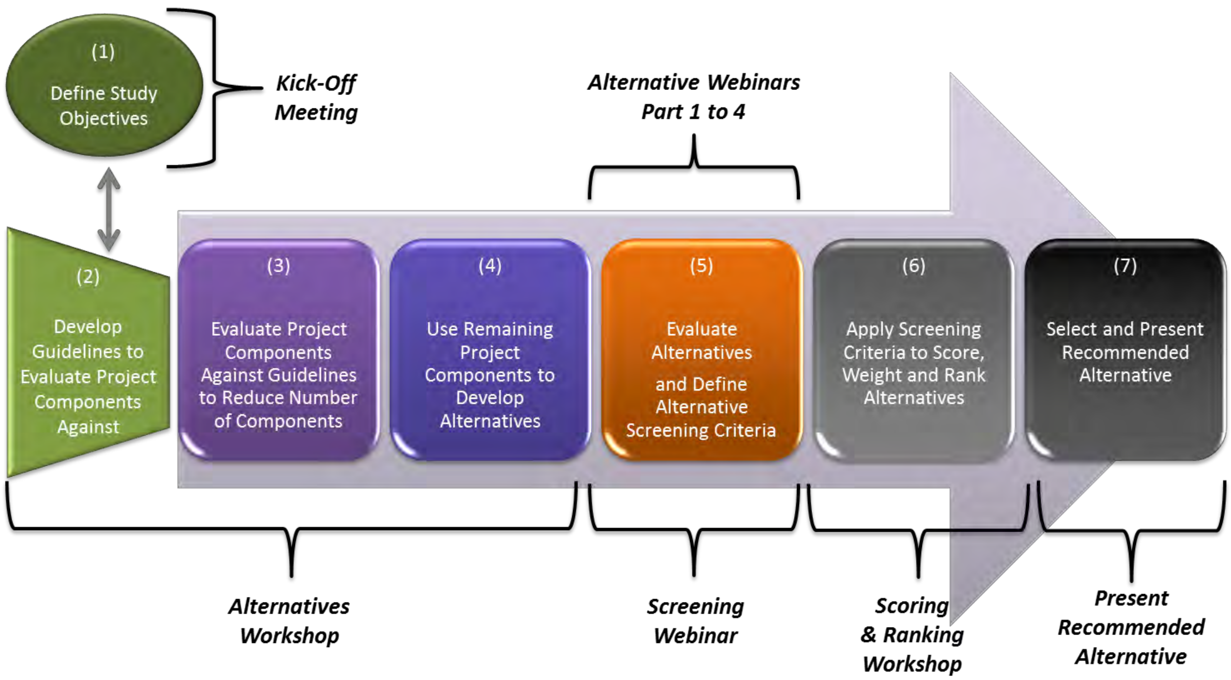


Table ES-1 provides a high-level description of the eight (8) alternatives and fifteen sub-alternatives evaluated in this RWFPS.

Table ES-1: Recycled Water Alternatives Evaluated

Alternative	Sub Alt	Description
Alternative 1 – Centralized Non-Potable Reuse (NPR)	1a	SCPWD Title 22 (tertiary) upgrades to the existing disinfected reclaimed water system at the Santa Cruz WWTF to serve in-plant uses, La Barranca Park and a new City truck fill station.
	1b	Additional tertiary treatment at Santa Cruz WWTF (or off-site) to meet identified non-potable demands within the City's service area.
Alternative 2 – Decentralized NPR	2	Satellite treatment (via membrane bioreactor (MBR)) of local raw wastewater from the UC Santa Cruz campus to meet on-campus non-potable demands. All facilities are located on or near campus.
Alternative 3 – Santa Cruz Participation in SqCWD led Groundwater Recharge Reuse Project (GRRP)	3a	Send secondary effluent from the Santa Cruz WWTF to SqCWD for their GRRP. No reuse in the City.
	3b	Expand tertiary treatment at the Santa Cruz WWTF to deliver to SqCWD for the GRRP in SqCWD, serving NPR customers along the way.
	3c	Send additional secondary effluent from the Santa Cruz WWTF to the SqCWD AWTF and return advanced treated water for groundwater replenishment and NPR in the City's service area.
	3d	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water to SqCWD for their GRRP, serving NPR customers along the way.
	3e	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water to SqCWD for their GRRP, serving NPR customers and groundwater replenishment in the City's service area along the way.
Alternative 4 – Santa Cruz GRRP	4a	AWTF at Santa Cruz WWTF (or a nearby location). Send advanced treated water for groundwater replenishment and NPR in the City's service area.
	4b	Satellite treatment of local raw wastewater from Santa Cruz County Sanitation District at DA Porath Pump Station. New MBR plus AWTF to produce advanced treated water for groundwater replenishment and NPR in the City's service area.
Alternative 5 – Surface Water Augmentation (SWA)	5	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water for blending and storage in Loch Lomond Reservoir, to be conveyed to the GHWTP and enter the City's potable water distribution system.
Alternative 6 – Streamflow Augmentation	6	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water to augment San Lorenzo River flows (downstream of San Lorenzo River Diversion) to maintain habitat, meet future fishery requirements.
Alternative 7 – Direct Potable Reuse (DPR)	7	AWTF at the Santa Cruz WWTF (or a nearby location). Blend advanced treated water with raw water at the Coast Pump Station, for further treatment at the GHWTP prior to distribution as finished water, suitable for drinking.
Alternative 8 – Regional GRRP	8a	Regional AWTF to produce advanced treated water for groundwater replenishment in the Santa Margarita Groundwater Basin. Utilize existing or new production wells to serve Santa Cruz, SVWD, SLVWD and SqCWD. Send secondary effluent from WWTF to AWTF in Scotts Valley.
	8b	Regional AWTF to produce advanced treated water for groundwater replenishment in the Santa Margarita Groundwater Basin. Utilize existing or new production wells to serve Santa Cruz, SVWD and SLVWD. Send secondary effluent from the Santa Cruz WWTF to SqCWD for their GRRP.

A conceptual-level engineering analysis was performed to evaluate each alternative project and identify major infrastructure to treat and convey recycled water for each type of use. All pipeline alignments and facility locations are assumed to be preliminary, and would be further evaluated and refined in future studies as part of the environmental review and design process. Tertiary treatment is assumed for non-potable reuse (NPR) projects. An advanced water treatment facility (AWTF) is assumed for potable reuse projects, which would employ membrane filtration (MF), reverse osmosis (RO), ultraviolet (UV) light with an advanced oxidation process (AOP), post treatment and free chlorine disinfection to meet Title 22 requirements for indirect potable reuse (IPR) with the assumed addition of ozone and biologically activated carbon (BAC) for DPR. Costs are developed at a conceptual-level, based on unit costs and recent project experience, to reflect facility requirements and operational activities to produce and deliver recycled water. The engineer's opinion of probable capital, O&M and annualized unit costs for each alternative are summarized in Table ES-2.

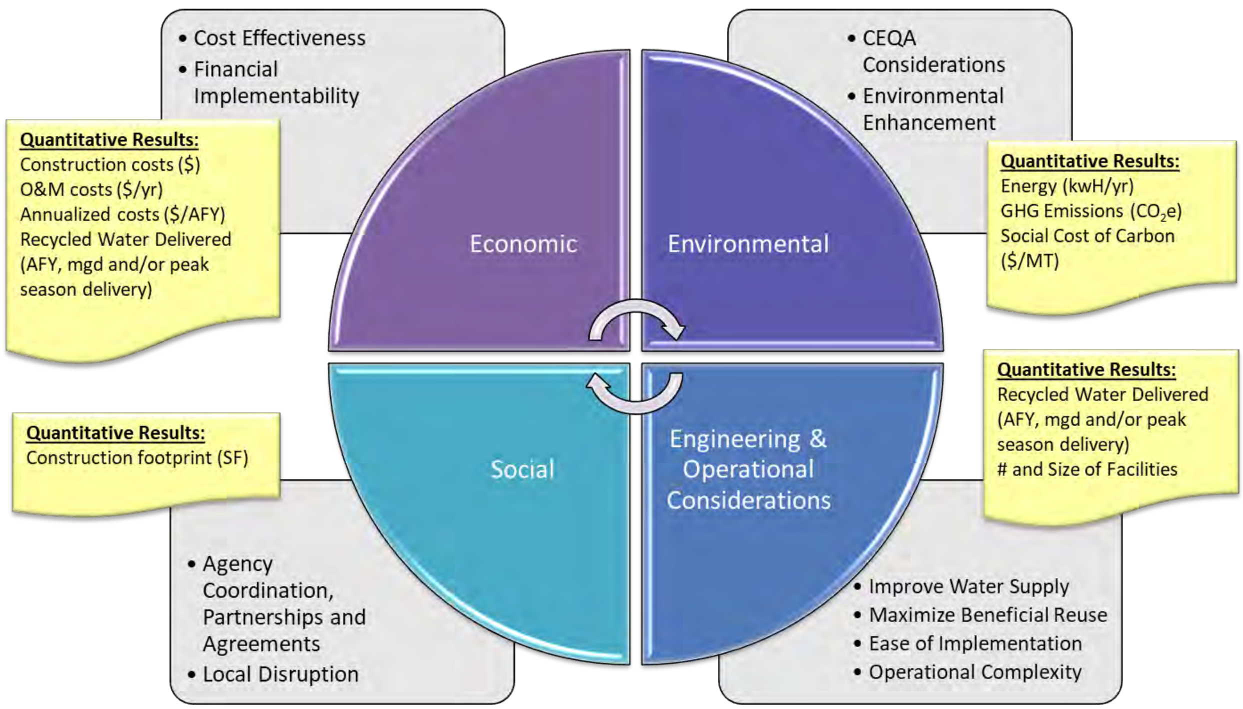
Table ES-2: Summary of Alternative Project Demands and Costs

Alternative	Project	Ave Annual Reuse in the City (mgd)	(AFY)	Total Capital Cost[1] ($mil)	Life Cycle Unit Cost ($/AF)	($/MG)	($/CCF)
Alternative 1 – Centralized NPR	Alt 1A	0.25	282	$1	$1,000	$3,100	$2.30
	Alt 1B	0.74	840	$34	$3,400	$10,400	$7.80
Alternative 2 – Decentralized NPR	Alt 2	0.14	155	$28	$12,000	$36,800	$27.50
Alternative 3 – Santa Cruz Participation in SqCWD led GRRP	Alt 3A [2]	0	0	n/a	n/a	n/a	n/a
	Alt 3B	0.49	550	$20	$2,600	$8,000	$6.00
	Alt 3C [3]	2.0	2,248	$69	$3,300	$10,100	$7.60
	Alt 3D	0.08	88	$7	$9,000	$27,600	$20.70
	Alt 3E [3]	2.1	2,368	$69	$2,900	$8,900	$6.70
Alternative 4 – Santa Cruz GRRP	Alt 4A [3]	2.1	2,389	$70	$2,900	$8,900	$6.70
	Alt 4B [3]	2.0	2,240	$99	$4,000	$12,300	$9.20
Alternative 5 – SWA	Alt 5 [4]	1.6	1,777	$107	$5,300	$16,300	$12.20
Alternative 6 – Streamflow Aug	Alt 6 [4]	1.6	1,777	$75	$3,900	$12,000	$9.00
Alternative 7 – DPR	Alt 7 [5]	3.2	3,584	$111	$3,000	$9,200	$6.90
Alternative 8 – Regional GRRP	Alt 8a [5]	3.2	3,584	$124	$3,500	$10,700	$8.00
	Alt 8b [5]	3.2	3,584	$141	$3,700	$11,400	$8.50

[1] All costs represent City's share based on the recycled water produced and conveyed to SCWD's service area.
[2] Alt 3A provides 0 AF of reuse in the City, therefore the facility capital and unit cost for the City are not calculated.
[3] Alts 3C, 3E, 4A and 4B are limited by the available GRR capacity at the Beltz Wellfield, 2.0 mgd (2,240 AFY), plus additional NPR customers along each alignment.
[4] Discharge for Alts 5 and 6 is seasonally limited to the summer and shoulder months, when there would be available capacity in the reservoir or when flows are low in the San Lorenzo River. The supply of recycled water is assumed to be limited to the average daily dry weather flow less other demands (in-plant uses plus deliveries to Pure Water Soquel) and losses from advanced treatment (i.e. brine concentrate), 3.2 mgd (3,584 AFY). Since discharge would only occur during the summer and shoulder months, an assumed 181 dry day period, the average annual reuse would be 1.6 mgd (1,777 AFY).
[5] Alts 7 and 8 have no seasonal limitations.

The Triple Bottom Line (TBL) approach (Economic, Environmental, Social) was applied to reflect the benefits gained from recycled water projects beyond financial returns. A fourth bottom line, Engineering and Operational Considerations, was added to emphasize the important role engineering and operational considerations play in project selection. Figure ES-5 depicts the qualitative screening criteria (in white boxes) and quantitative results (in yellow boxes) associated with each of the four categories. Quantitative results were developed for each project as part of the alternatives evaluation. In many cases, the quantitative data were used to inform qualitative scoring for comparing alternatives.

Figure ES-5 Quantitative Results and Qualitative Screening Criteria



Alternative projects were scored on a scale of one to five against each screening criteria to get a total raw score. A number of different weighting themes were developed to reflect a variety of perspectives about what criteria is more or less important. A weighted score for each alternative was calculated as the sum of the scores for each criterion multiplied by the weighted factor. Alternative Projects were then ranked such that the highest score receives a rank of one and the lowest score receives a rank of 15. A sensitivity analysis was performed to see how weighting criteria impacts ranking.

The outcome of the ranking and sensitivity analysis found that non-potable and GRR projects consistently rose to the top while the SWA, streamflow augmentation and DPR projects fell to the bottom. The sensitivity analysis exercise helps put the ranking of projects into perspective to understand why one project rises to the top or bottom when certain criteria are prioritized. The process of weighting priorities and the results of ranking can facilitate discussion amongst stakeholders and support the selection of a preferred project that meets the project objectives to the greatest extent. However, it is important to recognize that this exercise is just one tool used in the selection of a project(s). For example, through workshops with stakeholders it may turn out that the second or even third ranked project is the recommended project, because by scoring higher consistently across multiple weighting themes it satisfies a broader range of stakeholder priorities.

In addition to recycled water opportunities the City is looking at a number of water supply projects including the potential for conservation, groundwater recharge/storage via aquifer storage and recovery (ASR) and in lieu water transfers using winter surface water flows, as well as seawater desalination. The preferred alternative project developed in this RWFPS is a phased approach that provides for near-term local action while leaving the door open for increased regional coordination in the future as more information is available on all the alternatives.

The preferred alternative includes two projects that would provide non-potable reuse in the City:

- **Santa Cruz Public Works Department (SCPWD) Title 22 Upgrade Project** – implement a near-term non-potable reuse project to meet in-plant demands, develop a bulk water station and serve the near-by La Barranca and Neary Park (a variation of Alt 1a).
- **BayCycle Project** – expand the SCPWD Title 22 Upgrade Project to increase production and non-potable reuse to serve UCSC and City customers along the way (a phase of Alt 1b).

The City is also committed to exploring other reuse opportunities, including:

- **Coordination with Pure Water Soquel** – continue to work closely with SqCWD to support the evaluation of the Pure Water Soquel project including, but not limited to, the delivery of source water and considerations for benefits of shared infrastructure (Alts 3a, 3b or 3d).
- **Explore GRR at Beltz Wellfield** – to replenish the Santa Cruz Mid-County Groundwater Basin in the Beltz Wellfield area, through a collaborative project with Pure Water Soquel or as an independent City led project (Alt 3c, 3e, 4a or 4b)
- **Explore GRR in Santa Margarita Groundwater Basin (SMGB) –** continue regional discussions related to the benefits and limitations for a Regional GRRP in the SMGB, which has the potential to make the region more resilient in the long term (Alts 8a or 8b).

ES.6 Recommended Project

The **SCPWD Title 22 Upgrade Project** and the **BayCycle Project** are the focus of the Recommended Project identified for this RWFPS, since these projects would be constructed in the near-term. Specifically, these projects present a unique opportunity:

- ✓ For City departmental collaboration (between the Water Department, Public Works Department and the Parks and Recreation Department),
- ✓ To partner with UCSC to explore technologies and techniques to reduce potable water demand,
- ✓ To develop a redundant water supply and beneficially reuse wastewater, and
- ✓ To initiate an outreach and education program for the community to better understand and increase public acceptance of recycled water.

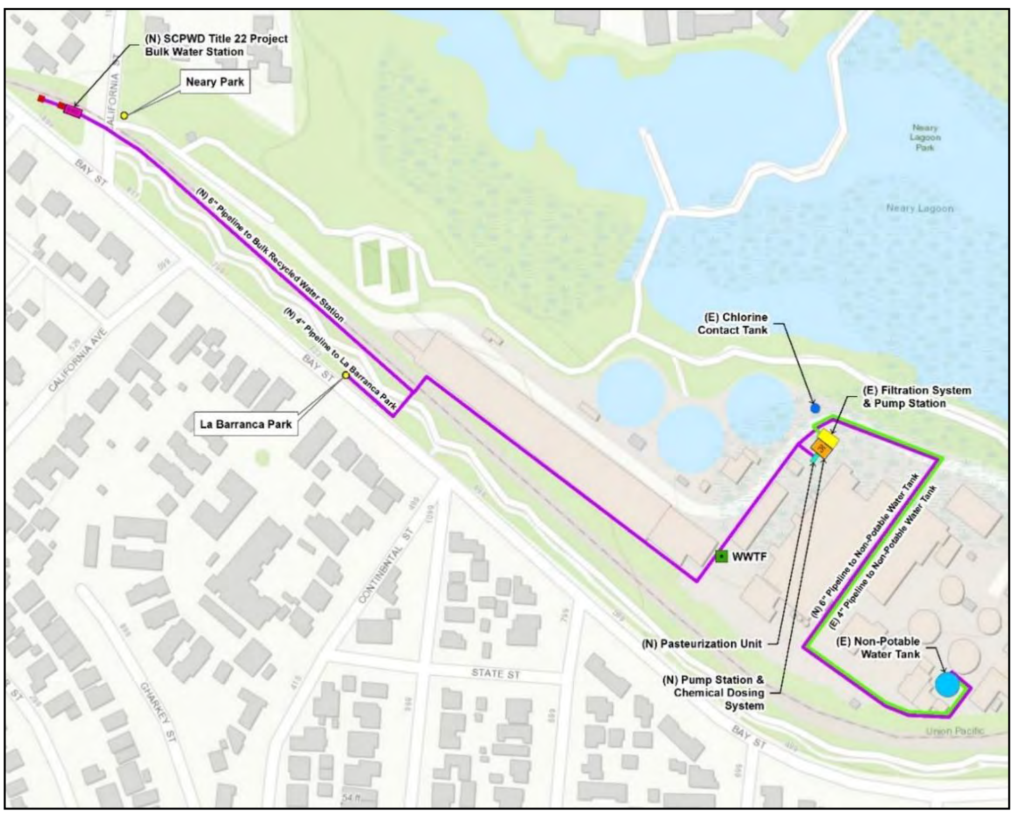
Exploring other reuse opportunities offers a unique opportunity to create a multi-beneficial project and work collaboratively with regional partners to develop local, sustainable supplies and increase resiliency in the region for the long term. Due to the unique nature of these projects additional evaluation is needed to confirm the feasibility, permitability and public acceptability of groundwater replenishment in the Santa Cruz Mid-County Groundwater Basin and SMGB.

ES.6.1 SCPWD Title 22 Upgrade Project

The Santa Cruz WWTF currently operates a reclaimed water system that treats secondary wastewater utilized for daily facility operations, such as equipment cleaning, pump priming and chemical dilution. Disinfected secondary treated wastewater effluent is diverted to the existing reclaimed water system, where it is filtered, disinfected and reused for facility applications. The existing reclaimed water system currently does not meet Title 22 standards.

The City proposes to develop a recycled water system that meets Title 22 standards to continue to avoid the use of potable water for the process system at the WWTF and to provide recycled water for off-site use. The objectives of the SCPWD Title 22 Upgrade Project are to: (1) replace the disinfected secondary reclaimed water used at the WWTF with tertiary treated recycled water, (2) meet the irrigation requirements of City parks adjacent to the WWTF, and (3) offer recycled water at a bulk water station. Figure ES-6 shows project facilities that would supply Title 22 recycled water to the WWTF, Neary Park, La Barranca Park and a new bulk water station.

Figure ES-6: SCPWD Title 22 Upgrade Project Facilities and Customers



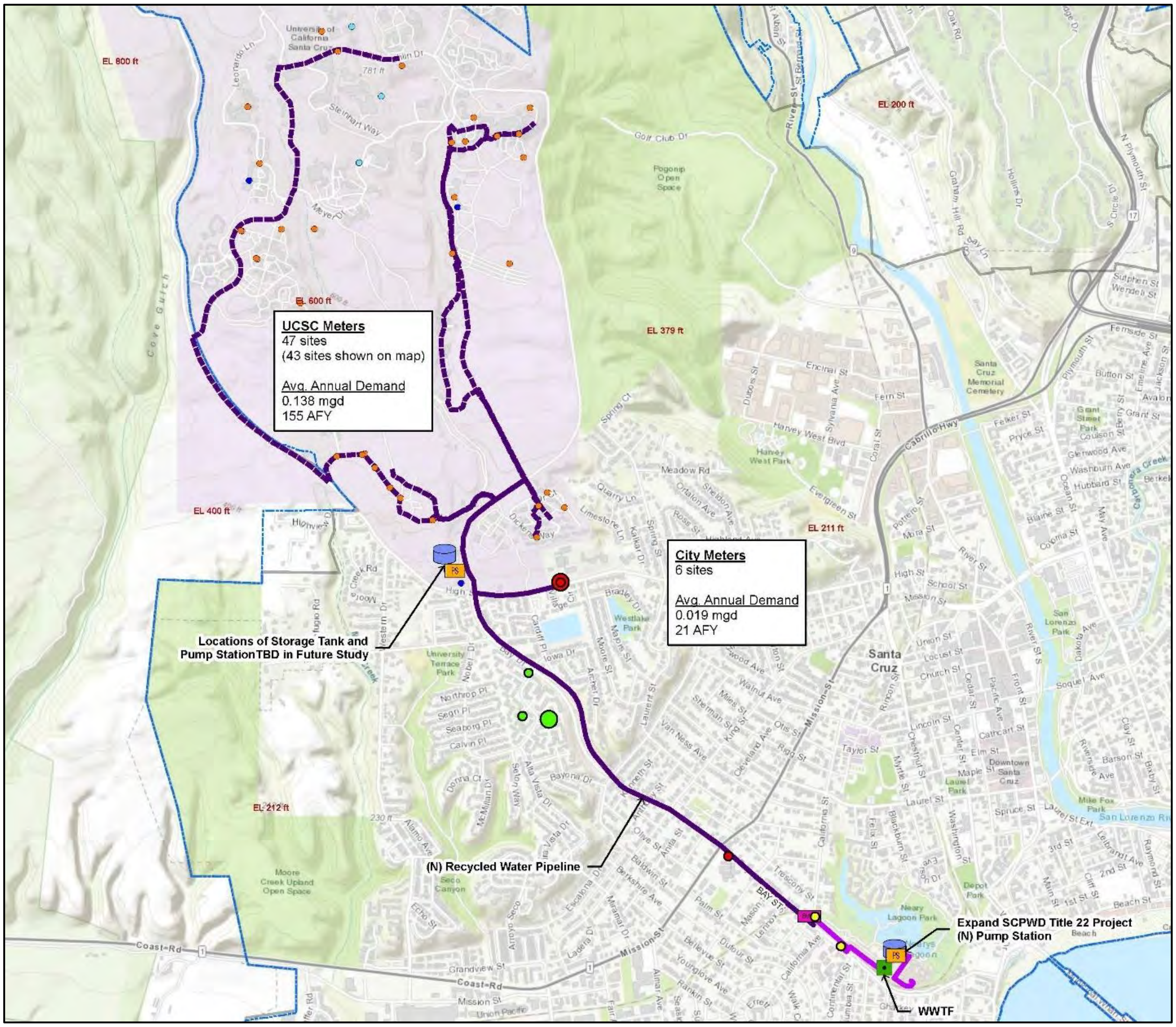
The project would produce 0.13 mgd (150 AFY) of non-potable recycled water that meets Title 22 standards for non-potable reuse. Key components of the upgrades at the WWTF include upgrading secondary effluent booster pumps, adding a Title 22 pasteurization unit, converting the existing chlorine contact tank to storage and a dedicated pipeline to the existing non-potable water tank. Off-site demands for La Barranca Park, Neary Park and a new bulk water station would be served by a new distribution system pump station and pipeline that would cross under the railroad tracks utilizing a City easement. A bulk water station would offer recycled water to trucks for dust control and other approved uses. Residential hose bibs could be included in the bulk water station or a mobile truck station program could be initiated to provide recycled water to the general public on the weekends or during the peak irrigation season.

The City of Santa Cruz would need to obtain a recycled water permit from the Central Coast Regional Water Quality Control Board and the Division of Drinking Water (DDW) for the production and distribution of recycled water which would require completion of a Title 22 Engineering Report, cross-connection testing, and establishment of a monitoring, operations and training program.

ES.6.2 BayCycle Project

This project would expand the SCPWD Title 22 Upgrade Project to increase production and non-potable reuse to serve City customers along Bay Street and the University of California, Santa Cruz (UCSC). Figure ES-7 shows project facilities and customers served.

Figure ES-7: BayCycle Project Facilities and Customers



The project would produce 0.16 mgd (176 AFY) of non-potable recycled water that meets Title 22 standards for non-potable reuse for irrigation of landscapes, organic farms, and dual plumbed institutional buildings. The treatment upgrades for the SCPWD Title 22 Upgrade Project would increase recycled water production capacity to approximately 0.30 mgd, which would be sufficient to meet SCPWD Title 22 Upgrade Project demands (0.13 mgd) plus additional non-potable demands for BayCycle Project customers (0.16 mgd). Additional treatment facilities are therefore not included in the BayCycle Project; however, filter optimization and rehabilitation may be required to reach the full capacity.

The BayCycle Project includes expansion of the pump station and a new conveyance pipeline extending from the Bulk Water Station up a major arterial street (Bay Street) to the UCSC campus (see Figure ES-7). It is assumed that the SCPWD Title 22 Upgrade Project design would allocate space to expand pumping capacity at the WWTF and size pipeline conveyance capacity outside of the WWTF to meet future anticipated demands.

The project would also include a pump station and storage tank on or near the UCSC campus, along with pipelines for distribution to campus customers. Additional hydraulic evaluation and siting studies would be conducted as part of a future alignment study to determine the optimal location for a pump station and storage on or near the UCSC Campus.

ES.6.3 Other Reuse Opportunities

Other reuse opportunities include, coordination with Pure Water Soquel, exploration of GRR in the Santa Cruz Mid-County Groundwater Basin in the Beltz Wellfield and exploration of GRR in the SMGB. These projects represent longer term efforts that would require more time to work collaboratively with regional partners and/or future studies to confirm the viability of groundwater replenishment. These projects are also aligned with the WSAC recommended strategies to address the water supply gap of 1.2 billion gallons per year (3,700 AFY) during times of extended drought.

- **Coordination with Pure Water Soquel:** The City is committed to continuing to work closely with SqCWD to support the evaluation of the Pure Water Soquel project including, but not limited to, the delivery of source water and considerations for benefits of shared infrastructure. The City and SqCWD have signed a Memorandum of Understanding (MOU) to provide reasonable certainty and clarity that the source water needed by SqCWD to make the potential Pure Water Soquel project viable would, in fact, be available to them from the City's WWTF.
- **Exploration of GRR at Beltz Wellfield:** The potential to build up drought reserves in the Beltz Wellfield area with advanced treated recycled water could become an important element in the strategy of the Santa Cruz Mid-County Groundwater Basin JPA to bring it into sustainability and protect the aquifer from seawater intrusion. The City is a partner in the Santa Cruz Mid-County Groundwater Basin JPA, which intends to submit a groundwater sustainability plan to the Department of Water Resources (DWR) by 2020. Exploration of a GRRP at the Beltz Wellfield could be accomplished through a collaborative project with Pure Water Soquel or as an independent City led project. If the City and SqCWD collaborate to plan GRRPs in a sequential manner (i.e. Alternatives 3c or 3e), SqCWD could build an AWPF that leaves room for expansion once the City has obtained approval and funding to invest in GRR. Due to the economies of scale of constructing a larger regional project, there may be financial benefits in terms of minimizing infrastructure requirements, cost sharing and competitive advantages for the regional pursuit of federal and state funding. An independent City-led GRRP (Alternative 4a or 4b) could similarly benefit the Santa Cruz Mid-County Groundwater Basin. This type of project would provide the City more flexibility in terms of timeline, since the project would not be linked to the Pure Water Soquel schedule. A flexible timeline would also provide an opportunity for the Santa Cruz community to become familiar with recycled water through the SCPWD Title 22 Upgrade

Project, BayCycle Project, and the Pure Water Soquel project. There would however be a lost opportunity to share costs and underground infrastructure with a regional partner.

- **Exploration of GRR in the Santa Margarita Basin:** There are several other regional efforts related to the management of the SMGB that would be actively considered in the development of a GRRP to make the region more resilient in the long term. The Santa Margarita Groundwater Agency (SMGWA) has become the Groundwater Sustainability Agency (GSA) for the SMGB[2], which is charged with the preparation of a groundwater sustainability plan pursuant to the requirements of the Sustainable Groundwater Management Act (SGMA). The City of Santa Cruz will continue to explore the option to do a GRR project with regional partners in the SMGB as the SMGWA considers potential projects in the future. Similar to a Mid-County GRRP, a Regional GRRP could realize benefits from shared infrastructure, economies of scale and a more competitive strategy to pursue funding and cost-sharing.

The WSAC recommendations also include the evaluation of aquifer storage and recovery (ASR) and in lieu water transfers with raw water supplies. As the City continues to work on groundwater modeling, development of regional partnerships and pilot testing for ASR, the details and opportunities for groundwater recharge would be better defined and would guide the potential opportunity for a GRRP in conjunction with or independent of an ASR/in lieu project.

ES.7 Financial Considerations

The successful implementation of recycled water facilities and services would require the cooperative efforts and cost sharing between all project partners. A comprehensive cost of service (COS) study would need to be completed in order to determine the appropriate cost allocations and to determine the recycled water rates.

A large portion of recycled water project costs are initial costs incurred to construct the system. Funding these significant construction costs is one of the largest obstacles to overcome when implementing a recycled water system. Funding mechanisms that may be considered by the City include, but are not limited to: utility rates, capacity fees, short and long-term bonds and grants and loans.

Pricing recycled water is a complex policy decision that considers not only the cost of producing the water but also factors such as the type of recycled water project being implemented, who benefits from the water/project, the level and extent of cost sharing, the age of the recycling system, the potential demand for recycled water, public perceptions, and the impacts to the other utilities.

For the **SCPWD Title 22 Upgrade Project,** the City would need to evaluate whether it is economically feasible to allocate the full amount or a proportional share of the SCPWD Title 22

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[2] Per SMGWA Agenda Report, June 14, 2017 http://smgwa.org/wp-content/uploads/2017/06/061417AgendaPacket.pdf

Upgrade Project costs to City of Santa Cruz Parks and Recreation (as the customer) and the sponsor of the Bulk Water Stations. It may be necessary to develop a reasonable, and justifiable, cost-sharing approach, where a portion of the costs are recovered through potable customers and the remainder are covered by the City.

For the **BayCycle Project** the City would need to work closely with the potential recycled water users to ensure customer buy-in, especially since such a large portion of this project relies on the participation of UCSC. And to determine appropriate cost allocations for design, construction and operations to ensure sufficient commitment to make the project a success.

ES.8 Next Steps

A potential schedule to implement the SCPWD Title 22 Upgrade and BayCycle Projects is provided in Figure ES-8. This high-level schedule indicates the potential duration and sequence of the primary activities to implement a non-potable recycled water program. Advancing the projects into predesign would be contingent on establishing agreements between City departments (for SCPWD Title 22 Upgrade Project) and with UCSC (for BayCycle Project) to identify primary cost sharing responsibilities, as well as consultant selection as-required to perform the work.

Other considerations for implementation include:

- Changes at the WWTF will likely trigger an update to the NPDES permit even if discharge limits don't change.
- A new RWQCB/DDW Permit would be required for recycled water production, distribution and use for the SCPWD Title 22 Project, which ideally would be set up to allow for an update to expand for the BayCycle Project.
- Due to the size of the SCPWD Title 22 Project and the nominal benefit towards water supply, the monetary benefits may not be worth the effort spent trying to pursue grant funding or CWSRF low interest loan programs, which are accessed through a single application. It would likely be simplest for the City to fund construction costs through utility rates.
- Due to the significant infrastructure requirements and costs for the BayCycle Project, this project has a greater potential for obtaining grant funding or low interest rate loans, as it is designed to supplement the City's existing water supply. It is anticipated the City would pursue CWSRF loans or other low interest rate loans.

Figure ES-8: Potential Schedule for Recommended Project

Primary Activities	2017	2018	2019	2020	2021	2022	2023	2024
Potential Schedule - SCPWD Title 22 Project								
Predesign								
Permitting								
Design								
Construction								
Commissioning								
Potential Schedule - BayCycle Project								
Institutional/Funding								
Predesign								
Permitting								
Design								
Construction								
Commissioning								

The City is committed to continuing to work with the various stakeholders to evaluate the feasibility and interest in these non-potable reuse projects. While preliminary conversations have been held, the issues of partnerships, cost sharing, rate structuring, etc. require additional consideration. In addition, and as reflected in the average demand values, these two projects would not represent a significant reduction in water demand (0.3 mgd), although there are other benefits worth considering. With regards to the other reuse opportunities focused on groundwater replenishment, these are more aligned with the WSAC work plan in terms of supplemental supply. As the City continues to work on groundwater modeling, development of regional partnerships, pilot testing of aquifer storage and recovery (ASR) and conducting the loop testing program to understand the in-lieu water transfer potential, the ability of each water supply element to play a role in long term water reliability will be better understood.

One final note, while surface water augmentation, streamflow augmentation and direct potable reuse did not rank well given the criteria and weighting themes explored for this study, primarily due to the high costs and uncertainty related to the ability to provide a reliable supply by 2025, the City will continue to follow regulatory developments and environmental drivers to track these projects for future consideration.

Section 1: Introduction

The Santa Cruz Region relies entirely on rainfall, surface water, and groundwater within watersheds located in the County with no access to imported water from outside the region. Due to the historical and ongoing droughts in California and the resulting fluctuations in water supply, the City of Santa Cruz (City) continues to face water supply challenges. Two of the primary water management challenges in the region are the lack of adequate surface water supply during droughts, and depletion of the aquifers. To remedy this situation, local water agencies in the region are actively pursuing supplemental supply alternatives. One of the options that is being considered to address water supply reliability involves the potential to use recycled water locally or at a regional level.

This Recycled Water Facilities Planning Study (RWFPS) evaluates opportunities to determine the most appropriate way to beneficially reuse treated wastewater to offset potable water demands and improve water supply reliability. This document will help guide the City to identify a preferred recycled water project for the future.

1.1 Background

The City of Santa Cruz provides the water supply to approximately 94,000 customers in Santa Cruz County and operates the Santa Cruz Wastewater Treatment Facility (WWTF) that currently treats and disposes of locally generated wastewater in the region. The City's water supply is primarily dependent on local surface water runoff, with groundwater contributing only 5 percent of the annual water supply and no connection to an imported water source. The strong reliance on surface water is the primary threat to water supply reliability and the ongoing drought and the future uncertainties of climate change are further jeopardizing the sustainability of the City's current water supply system.

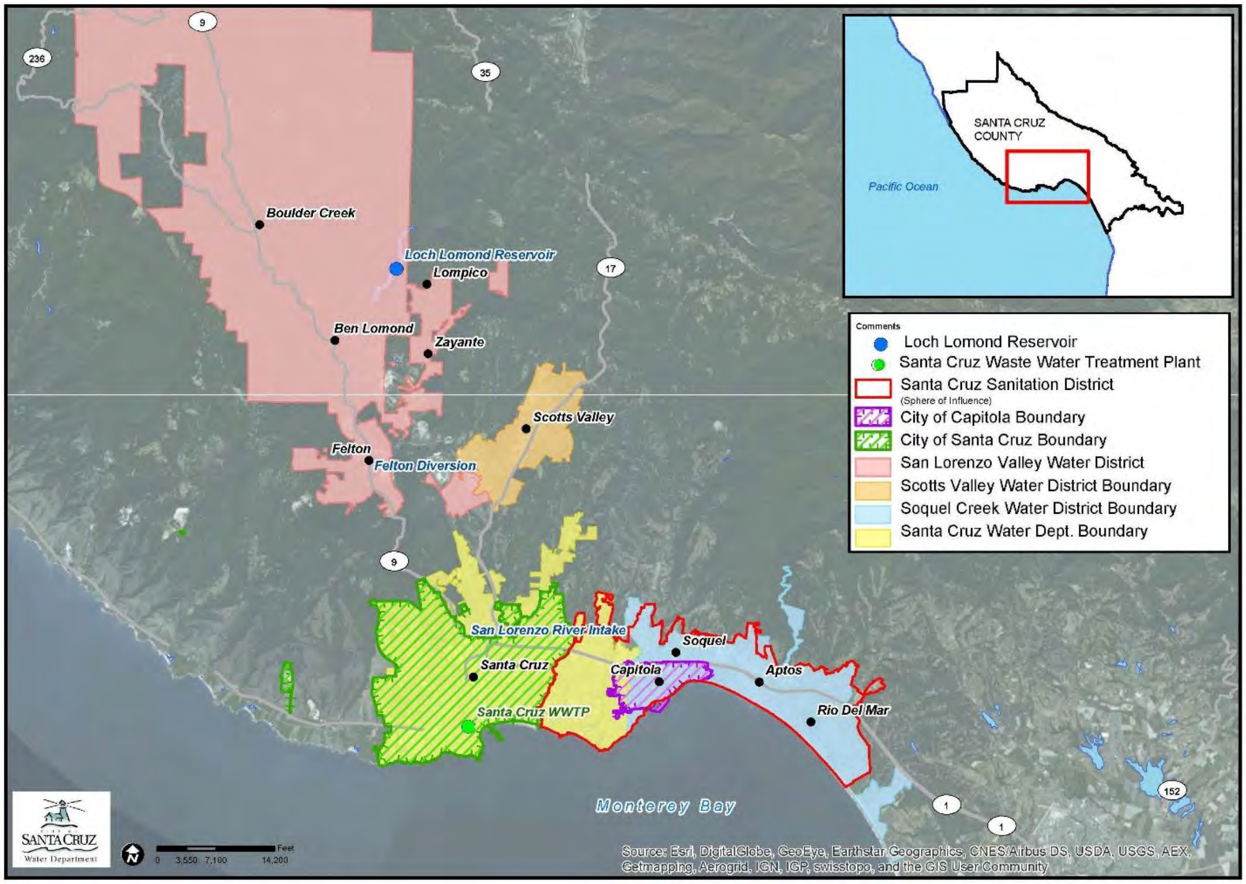
Other regional water supply entities and wastewater authorities in the Santa Cruz Region include the San Lorenzo Valley Water District (SLVWD), Scotts Valley Water District (SVWD), Soquel Creek Water District (SqCWD) and Santa Cruz County Sanitation District (SCCSD). The boundaries of their respective service areas are shown in Figure 1-1.

The acceptance and use of recycled water is gaining momentum in Santa Cruz County. SVWD has worked in cooperation with the City of Scotts Valley to develop a water recycling program for the Scotts Valley area where the City of Scotts Valley produces the recycled water at the Scotts Valley Water Reclamation Facility (WRF) and SVWD distributes it to customers. The Scotts Valley recycled water program produces on average 0.19 million gallons per day (mgd) or 215 acre-feet per year (AFY), which is used during the dry season for irrigation. The SVWD also recently completed a recycled water planning study, the Santa Margarita Groundwater Basin (SMGB) Recycled Water Groundwater Replenishment Program – Facilities Planning Report (FPR)

(Kennedy/Jenks 2016a), that evaluates the potential for expanding the use of recycled water by developing a groundwater replenishment program.

SqCWD currently has no recycled water program but recently completed a RWFPS, which also explored the feasibility of developing a groundwater replenishment program (Carollo 2016).

Figure 1-1: Santa Cruz Region



Source: County of Santa Cruz, Health Services Agency, Environmental Health Division, Water Resources Program, Santa Cruz Integrated Regional Water Management Plan (Santa Cruz IRWM) (County of Santa Cruz 2014)

1.2 Study Partners

This study is a joint project between the City's Water Department and the City's Public Works Department. The **Santa Cruz Water Department (SCWD)** is responsible for potable water supply in the City's service area to 24,504 connections and a population of approximately 95,224. The **Santa Cruz Public Works Department (SCPWD)** is responsible for wastewater and operates the Regional Santa Cruz WWTF.

The City has also collaborated with the following local and regional stakeholders to prepare this RWFPS:

- The **Soquel Creek Water District (SqCWD)** provides potable drinking water and groundwater resource management within its service area in mid-Santa Cruz County, serving ~ 13,570 connections and a population of ~ 37,000.
- The **City of Scotts Valley** is served by the **Scotts Valley Water District (SVWD)**, a public agency that manages and supplies water to an estimated 10,800 people through 4,220 connections in the City of Scotts Valley and adjacent unincorporated areas of the County.
- The **San Lorenzo Water District (SLVWD)** supplies water to 7,300 connections in the San Lorenzo Valley.
- The **Santa Cruz County Sanitation District (SCCSD)** is a special district operated through the Santa Cruz County Public Works Department. SCCSD provides wastewater collection service for the City of Capitola and the unincorporated communities of Aptos, Soquel, and Live Oak.
- The **Environmental Health Services (EHS)**, a division of the County Health Services Agency, has been designated as responsible for coordinating the County's water resource management efforts. This **Water Resources Program** works in collaboration with other county departments, agencies, special districts and non-governmental organizations to solve water resources and environmental issues through long-range water supply planning, water quality protection, and watershed management.

Staff or representatives from these agencies and groups have participated in key meetings and workshops to provide a unique point of view of opportunities to increase reuse in the region.

1.3 Study Objectives

A regional goal that has been defined in the 2014 Integrated Regional Water Management (IRWM) Plan with respect to water supply is …

> *"to ensure a reliable and sustainable local water supply through strategies that diversify the supply portfolio, develop production from alternative/supplemental sources, protect and enhance surface and groundwater, protect against seawater intrusion, and maximize efficient delivery and use" (County of Santa Cruz, 2014; Ch4-8).*

In 2014, the City of Santa Cruz Council appointed a Water Supply Advisory Committee (WSAC) to…

> *"… explore, through an iterative, fact-based process, the City's water profile, including supply, demand and future risks; analyze potential solutions to deliver a safe adequate, reliable, affordable and environmentally sustainable water supply; and, to develop recommendations for City Council consideration." (WSAC 2015)*

The adopted recommendations from the WSAC were to pursue a strategy of water conservation and enhanced groundwater storage, with a back-up option of advanced treated recycled water or desalinated water.

This RWFPS includes an evaluation of the recycled water options identified in the WSAC recommendation along with other opportunities to beneficially reuse effluent from the Santa Cruz WWTF to meet the broader IRWM Plan goal to ensure a reliable and sustainable local water supply.

Study objectives and goals developed by the City and Study Partners include the following:

1. Assess beneficial reuse of wastewater from a resource recovery perspective.
2. Meet or reduce the water supply gap as identified by the WSAC.
3. Evaluate local and regional recycled water projects.
4. Identify a phased approach to reuse in Santa Cruz.
5. Identify potential impacts to Santa Cruz WWTF operations.
6. Initiate plan for continued recycled water outreach and education.
7. Meet State Water Resource Control Board (SWRCB) grant requirements.
8. Meet schedule and intent of WSAC Outcome Element #3.

1.4 Relevant Studies

This work will build on previous planning and design documents by the City and regional partners. Table 1-1 lists some of the more recent and relevant work performed in the Santa Cruz Region that provides background information or has a nexus with this RWFPS.

Table 1-1 Relevant Studies

Study	Agency	Reference(s) (author date)	Relevance to the RWFPS
WSAC Final Report on Agreements and Recommendations	Santa Cruz	(WSAC 2015)	The adopted recommendations from the WSAC were to pursue a strategy of water conservation and enhanced groundwater storage, with a back-up option of advanced treated recycled water or desalinated water.
SqCWD Groundwater Replenishment Feasibility Study	SqCWD	(Carollo 2016)	SqCWD's recommended projects are used to develop alternatives where the City partners with the District for a regional alternative.
SVWD Santa Margarita Groundwater Basin Replenishment Program – Facilities Planning Report	SVWD	(Kennedy/Jenks 2016a)	SVWD's recommended projects are used to serve as a foundation for regional alternatives that utilize the Santa Margarita Groundwater Basin (SMGB).
UCSC Campus Water Reuse Study	UCSC	(Carollo 2009)	Provides the basis of the work done over the last 10 years to identify opportunities for reuse at UCSC.
City of Santa Cruz Integrated Water Plan (IWP)	City	(Fiske and Assoc. 2003)	These water supply planning documents provide the background information to define study area characteristics and existing and anticipated future available water and wastewater supplies.
Santa Cruz IRWM	Santa Cruz County	(County of Santa Cruz 2014)	
City of Santa Cruz 2015 Urban Water Management Plan (UWMP)	Santa Cruz	(SCWD 2016)	
Scotts Valley Water District 2015 UWMP	SVWD	(Kennedy/Jenks 2016b)	
SqCWD 2015 UWMP	SqCWD	(WSC 2016)	
Producing Tertiary Disinfected Recycled Water at Santa Cruz WWTF	Santa Cruz	(Trussell 2015)	Describes SCPWD's plan to update the existing tertiary treatment and disinfection process at the Santa Cruz WWTF to produce Title 22 water for in-plant use, truck filling and nearby irrigation.
White Papers on opportunities and limitations for reuse for the scwd^2 Regional Seawater Desalination Project	SCWD and SqCWD	(Kennedy/Jenks 2010, 2013a)	These documents were crafted to respond to public comments regarding recycled water opportunities during the **scwd^2** Regional Seawater Desalination Program environmental process.
TM Conceptual-Level Cost Comparison of Water Supply Alternatives	SCWD and SqCWD	(Kennedy/Jenks 2013b)	Provides conceptual-level costs for recycled water alternatives throughout the region; developed during the **scwd^2** Regional Seawater Desalination Project.

1.5 Plan Organization

This RWFPS is funded in part by a SWRCB grant and is organized to align with the SWRCB Water Recycling Funding Program (WRFP) Guidelines - Division of Financial Assistance, Appendix B - Recommended Planning Outline for Water Recycling Projects. A crosswalk is provided in Table 1-2 to indicate how and/or where each outline item is addressed in the report. Inclusion of the elements from the guidelines will also serve to facilitate future applications for funding through the State Revolving Fund (SRF) program.

The RWFPS is organized as follows:

- **Section 1: Introduction** – provides background for the project, including study partners, goals and objectives and previous relevant studies this work builds on.
- **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 Cruz Region.
- **Section 3: Water Supply Characteristics and Facilities –** describes wholesale and retail entities, water supplies and usage, water supply reliability and future sources of additional demand.
- **Section 4: Wastewater Characteristics and Facilities –** presents an overview of wastewater treatment facilities, effluent flows and wastewater quality in the Santa Cruz Region.
- **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 non-potable recycled water users within the Santa Cruz service area and estimates annual and peak demands. Describes opportunities for potable reuse within the Santa Cruz Region.
- **Section 7: Development of Project Alternatives –** describes the approach used to develop alternatives based on a long list of project components and the screening approach and selection considerations for identifying a recommended project.
- **Section 8: Project Alternatives Analysis –** describes the eight alternatives considered and the planning and design criteria used to evaluate each alternative along with other considerations for expanding and implementing recycled water. Quantitative results (e.g. flows, costs and energy) and qualitative results are provided for each alternative.
- **Section 9: Recommended Project –** describes the recommended project(s) and phasing based on the results of the scoring and ranking effort and input from the project partners.
- **Section 10: Construction Financing Plan and Revenue Program –** presents funding and financing options for the proposed recommended project. Discusses potential pricing policies, funding opportunities, avoided costs and lost revenues to provide a more comprehensive view of the true cost and benefit of expanding the recycled water program.

The appendices include the following information:

- **Appendix A: Regulatory Requirements and Treatment for Reuse**
  - A.1 TM #1a Evaluation of Treatment Requirements for Recycled Water in California (Trussell, 2017)
  - A.2 Recycled Water Uses Allowed in California (EBMUD, 2013)
  - A.3 TM #1b Evaluation of Treatment Facilities (Trussell, 2017)
  - A.4 PTF X-500 Pasteurization System – Proposal for Santa Cruz WWTF
- **Appendix B: Non-Potable Demands Data**
  - B.1 Recycled Water Demand Projection
  - B.2 Meter Data Account Types
  - B.3 Major Demands by Account Types
  - B.4 Peaking Factors
  - B.5 Demand Tables Associated with Alternatives
- **Appendix C: Groundwater Replenishment Reuse - Supporting Information**
  - C.1 TM #2a Beltz Wellfield Area Injection Well Capacity and Siting Study
  - C.2 TM #2b Santa Margarita Basin Injection Well Capacity and Siting Study
- **Appendix D: Surface Water Augmentation**
  - D.1 TM #3 Surface Water Augmentation
- **Appendix E: Streamflow Augmentation**
  - E.1 TM #4 Streamflow Augmentation
- **Appendix F: Engineers Opinion of Probable Costs**
  - F.1 Capital Cost Assumptions
  - F.2 O&M Cost Assumptions
  - F.3 Alternative Project – Engineers Opinion of Probable Costs
  - F.4 Regional Cost Sharing Approaches
  - F.5 Recommended Project– Engineers Opinion of Probable Costs
- **Appendix G: Scoring and Ranking Evaluation**
  - G.1 Scoring Criteria Guidelines
  - G.2 Environmental Evaluation
  - G.3 Social Cost of Carbon Evaluation
  - G.4 Scoring and Ranking Results
- **Appendix H: Other Supporting Materials**
  - H.1 MOU between City and SqCWD for Pure Water Soquel, Groundwater Replenishment and Seawater Intrusion Prevention Project
  - H.2 Letters of Interest
  - H.3 Water Rates and Fees (Santa Cruz, SqCWD and SVWD)
- **Appendix I: Meeting Materials**
  - Agendas, presentations and other materials from meetings, workshops, and webinars

Table 1-2 provides a crosswalk between the report content and the WRFP recommended outline.

Table 1-2 Report Content Crosswalk with WRFP Recommended Outline (Appendix B)

App B Sec. #	Title / Report Element	Corresponding Report Location
A	**Maps and Diagrams**	
1	Vicinity Map.	Figure 2-1
2	Detailed map and GIS shape file of study area boundaries.	Figure 2-1
3	Topographic map.	Figure 2-2
4	City boundaries.	Figure 2-1
5	Wholesale and retail water supply entity boundaries within study area and adjacent to study area.	N/A
6	Wastewater agency boundaries within and adjacent to study area.	Figure 1-1 and Figure 2-1
7	Existing recycled water distribution pipelines, storage, and customers.	N/A
8	Ground water basin boundaries, major streams, streams receiving waste discharges.	Figure 2-3, Figure 2-4, Figure 2-6 and Figure 3-2
9	Present and projected land use.	Figure 2-7
10	Each recycled water facilities alternative (including recommended project), showing locations of potential customers and approximate pipeline routes.	Figures 8-1 to 8-13, 8-15 and 8-16
11	Wastewater treatment schematic - existing and proposed.	Figure 4-1 and Figure 8-1
B	**Study Area Characteristics**	**Section 2: Study Area Characteristics**
1	Hydrologic features.	Section 2.3 Major Hydrologic Features
2	Ground water basins, including quantities extracted by all users, natural and artificial recharge, losses by evapotranspiration, inflow and outflow of basins, and safe yield or overdraft.	Section 2.3.2 Groundwater Basins
3	Water quality - ground water and surface water	Section 2.4 Water Quality
4	Land use and land use trends.	Section 2.5 Land Use
5	Population projections of study area.	Section 2.6 Population Projections
6	Beneficial uses of receiving waters and degree of use, portion of flow that is effluent.	Section 2.7 Beneficial Uses of Receiving Waters
C	**Water Supply Characteristics and Facilities**	**Section 3: Water Supply Characteristics and Facilities**
1	Description of all wholesale and retail entities.	Section 1.2 Study Partners Section 3 (all subsections)
2	All sources of water for study area and major facilities, their costs, (costs should be broken down into fixed and variable), subsidies, and customer prices.	Section 3.1 Water Sources Appendix H.3 – SCWD, SqCWD and SVWD Water Rates and Fees

App B Sec. #	Title / Report Element	Corresponding Report Location
3	Capacities of present facilities, existing flows.	Section 3.2 Major Water Supply Facilities
4	Ground water management and recharge, overdraft problems.	Section 2.3.2 Groundwater Basins
5	Water use trends and future demands, prices and costs.	Section 3.4 Historical Water Use Trends Section 3.5 Projected Water Use Trends Appendix H.3 – SCWD, SqCWD and SVWD Water Rates and Fees
6	Quality of water supplies.	Section 3.6 Quality of Water Supplies
7	Sources for additional water and plans for new facilities (for both the local entity and the wholesalers).	Section 3.7 Potential Future Water Sources
D	**Wastewater Characteristics and Facilities**	**Section 4 – Wastewater Characteristics and Facilities**
1	Description of entities.	Section 4.1 City of Santa Cruz Wastewater Treatment and Collection Facilities
2	Description of major facilities, including capacities, present flows, plans for new facilities, description of treatment processes, design criteria.	Section 4.1 City of Santa Cruz Wastewater Treatment and Collection Facilities
3	Water quality of effluent and any seasonal variation.	Section 4.1 City of Santa Cruz Wastewater Treatment and Collection Facilities
4	Additional facilities needed to comply with waste discharge requirements.	N/A
5	Sources of industrial or other problem constituents and control measures.	Section 4.1.2 Wastewater Water Quality
6	Existing recycling, including users, quantities, contractual and pricing arrangements.	Section 4.2 Existing Recycled Water System
7	Existing rights to use of treated effluent after discharge.	Section 4.1 City of Santa Cruz Wastewater Treatment and Collection Facilities
8	Wastewater flow variations - hourly and seasonal.	Section 4.1 City of Santa Cruz Wastewater Treatment and Collection Facilities
E	**Treatment Requirements for Discharge and Reuse**	**Section 5: Treatment Requirements**
1	Required water qualities for potential uses.	Section 5.3 Non-Potable Reuse Requirements Section 5.4 Potable Reuse Treatment Requirements TM #1a - Evaluation of Treatment Requirements for Recycled Water in California (Appendix A.1)
2	Required health-related water qualities or treatment requirements for potential uses, operational and on-site requirements (such as backflow prevention, buffer zones).	Section 5.2 Overview of Regulatory Requirements TM #1a (Appendix A.1)

App B Sec. #	Title / Report Element	Corresponding Report Location
3	Wastewater discharge requirements, anticipated changes in requirements.	Section 5.2 Overview of Regulatory Requirements Section 5.4.5 Brine Disposal Requirements Section 5.5 Streamflow Augmentation Treatment Requirements
4	Water quality-related requirements of the RWQCB to protect surface or ground water from problems resulting from recycled water use.	Section 5.2 Overview of Regulatory Requirements TM #1a (Appendix A.1)
F	**Recycled Water Market**	**Section 6: Recycled Water Market**
1	Description of market assessment procedures.	Section 6.1 Market Assessment Approach
2	Descriptions of all users or categories of potential users, including type of use, expected annual recycled water use, peak use, estimated internal capital investment required (on-site conversion costs), needed water cost savings, desire to use recycled water, date of possible initial use of recycled water, present and future source of water and quantity of use, quality and reliability needs, and wastewater disposal methods.	Section 6.2 Non-Potable Reuse Market Assessment Section 6.3 Potable Reuse Market Assessment Section 8: Project Alternatives Analysis (all sections) Section 9: Recommended Project (all sections)
3	Summary tables of potential users and related data.	Section 6.2.5 Summary of Potential Non-Potable Reuse Demand Appendix B (supporting tables) Table 8-12: Summary of Alternative Project Demands and Costs
4	Definition of logical service area based on results of market assessment.	Section 8: Project Alternatives Analysis Figure 8-2, Figure 8-11, Figures 8-15 and 8-16
G	**Project Alternative Analysis**	**Section 8: Project Alternatives Analysis**
1	Planning and design assumptions	Section 8.1 Conceptual-Level Engineering Analysis
a	Delivery and system pressure criteria.	Section 8.1.1 Design Criteria
b	Peak delivery criteria.	Section 8.1.1 Design Criteria Appendix B.4: Peaking Factors
c	Storage criteria.	Section 8.1.1 Design Criteria
d	Cost basis: cost index, discount rate, useful lives, etc.	Section 8.1.3 Engineer's Opinion of Probable Cost Appendix F: Engineers Opinion of Probable Costs
e	Planning period.	Section 8.1.4 Planning Period
2	Water Recycling Alternatives to be Evaluated	Section 8.2 Description of Recycled Water Alternatives
a	Treatment alternatives:	TM #1b - Evaluation of Treatment Facilities (Appendix A.3)

App B Sec. #	Title / Report Element	Corresponding Report Location
i	Alternative levels of treatment.	Section 5: Treatment Requirements TM #1a (Appendix A.1) TM #1b (Appendix A.3)
ii	Alternative unit processes to achieve a given level of treatment.	Section 5.6 Summary of Treatment Processes and Credits
b	Pipeline route alternatives.	Section 8.2 Description of Recycled Water Alternatives
c	**Alternative markets:**	**Section 6: Recycled Water Market**
i	Based on different levels of treatment.	Section 6.2 Non-Potable Reuse Market Section 6.3 Potable Reuse Market
ii	Geographical areas.	Figure 6-1 and Figure 6-5
d	Alternative storage locations.	Section 8.2 Description of Recycled Water Alternatives
e	Sub alternatives of selected alternative:	Section 8.2 Description of Recycled Water Alternatives Section 9: Recommended Project
i	Marginal analysis for selected alternative for certain categories of users or certain geographic areas.	Section 10.3.1 Potential Allocation of Costs to Users
ii	Varying storage, pump rates, and pipeline diameters.	Section 8.1.1 Design Criteria
iii	Use of water blending during peak irrigation months.	Section 8.1.1 Design Criteria
3	Non-recycled water alternatives.	Section 7.6 Nexus with Other Projects
a	Discussion of other potentially viable new sources of water.	Section 3.7 Potential Future Water Sources
b	Provide economic costs.	Section 7.6 Nexus with Other Projects
4	Water conservation/reduction analysis.	Section 7.6.1 Water Conservation Measures and Water Supply Reliability Studies
a	Analysis.	Section 7.6.1
b	Impact on recycling, if any.	Section 7.6.1
c	Recommendation.	Section 7.6.1
d	Implementation.	Section 7.6.1
5	No project alternative.	Section 7.5 No Project Alternative
6	Information supplied for each alternative to include, but not be limited to:	**Section 8: Project Alternatives Analysis**
a	Cost tables for each alternative with breakdown of costs by total capital (without grants), O&M, unit processes, and with equivalent annual cost and per acre-foot cost.	Section 8 alternative summary cost tables Appendix F detailed cost tables

App B Sec. #	Title / Report Element	Corresponding Report Location
b	Lists of potential users assumed for each alternative.	Section 8 description for each alternative Appendix B.5 Demand Tables Associated with Alternatives
c	Economic analysis.	Table 8-14
d	Energy analysis for each alternative, including direct and construction energy.	Appendix F detailed cost tables Table G-2, Appendix G.3 Social Cost of Carbon Valuation
e	Water quality impacts:	Section 8 alternative descriptions Criteria, weighting and scoring reflected in Tables 8-14, 8-16, G-1 and G-3
i	Effect on receiving water by removing or reducing discharge of effluent, including effect on beneficial uses resulting from reduced flow.	Section 8 alternative descriptions Criteria, weighting and scoring reflected in Tables 8-14, 8-16, G-1 and G-3
ii	Ground water impacts.	Section 8 alternative descriptions Appendix C: Groundwater Replenishment Reuse – Supporting information (TM #2a and #2b)
7	Comparison of above alternatives and recommendation of specific alternative.	Section 8.4 Alternative Ranking Results Section 8.5 Preferred Alternative Projects
H	**Recommended Project**	**Section 9: Recommended Project**
1	Description of all proposed facilities and basis for selection.	Section 8.5 Preferred Alternative Projects Section 9.1 Description of Recommended Project
2	Preliminary design criteria and refined pipeline routes.	Section 9.1 Description of Recommended Project Section 9.2 Preliminary Design Criteria
3	Cost estimate based on time of construction.	Section 9.3 Engineer's Opinion of Probably Costs
4	List of all potential users, quantity of recycled water use, peak demand, and commitments obtained.	Section 9.4 Summary of Potential Users Appendix H.1 MOU between City and SqCWD Appendix H.2 Letters of Interest
5	Reliability of facilities as compared to user requirements.	Section 9.4.3 Non-Potable Use Reliability
6	Implementation plan:	Section 9.5 Implementation Plan
a	Coordination with water suppliers, determination of recycled water supplier and needed agreements or ordinances.	Section 9.5.1 Coordination
b	Ability and timing of users to join system and make on-site investments.	Section 9.5.2 Ability and Timing of Users to Join System
c	Tentative water recycling requirements of RWQCB.	Section 9.5.4 Water Recycling Requirements
d	Commitments from potential users.	Section 9.5.5 Commitment from Potential Users Appendix H.1 and H.2

App B Sec. #	Title / Report Element	Corresponding Report Location
e	Water rights impact.	Section 9.5.6 Water Rights Impact
f	Permits, right-of-way, design, construction.	Section 9.5.7 Permits, Right-of-Way, Design and Construction
g	Detailed schedule.	Section 9.5.8 Detailed Schedule
7	Operational plan - responsible people, equipment, monitoring, irrigation scheduling, etc.	Section 9.6 Operational Plan
I	**Construction Financing Plan and Revenue Program**	**Section 10: Construction Financing Plan and Revenue Program**
1	Sources and timing of funds for design and construction.	Section 10.1 Construction Funding Sources and Considerations
2	Pricing policy for recycled water.	Section 10.2 Recycled Water Pricing Policy Options
3	Costs that can be allocated to water pollution control.	Section 10.3.4 Costs That Can be Allocated to Water Pollution Control
4	Annual projection of:	Not available: Future cost of service and rate studies will be conducted to establish recycled water prices.
a	Water prices for each user or category of users.	Pricing considerations discussed in Section 10.2.3 and 10.2.4 for recommended projects
b	Recycled water used by each user.	Section 9.4 Summary of Potential Users
c	Annual costs (required revenue) of recycling project.	Table 10-3 SCPWD Title 22 Upgrade Project - Cost Summary Table 10-5 BayCycle Project - Cost Summary
d	Allocation of costs to users.	Section 10.3.1 Potential Allocation of Costs to Users
e	Unit costs to serve each user or category of users.	Table 10-7 and Table 10-8
f	Unit price of recycled water for each user or category of users.	Section 10.3.2 Potential Unit Prices of Recycled Water
g	Sensitivity analysis assuming portion of potential users fail to use recycled water.	Section 10.3.3 Sensitivity Analysis to Underutilization of Recycled Water
5	Sunk costs and indebtedness.	Section 10.3.5 Sunk Costs and Indebtedness
J	**Appendices**	**Appendices A-H**
1	Tables of all abbreviations.	Acronyms and Abbreviations (before Executive Summary)
2	Copies of letters of interest or intent from recycled water users, or other documentation of support from potential users.	Appendix H.2: Letters of Interest
3	Draft of recycled water mandatory use ordinance or model user contract.	N/A – Updates to local-ordinances will be developed as-needed
4	Drafts of necessary agreements, such as wholesale-retail agreement, joint powers agreement	Appendix H.1 MOU between City and SqCWD (future agreements to be developed as-needed)

App B Sec. #	Title / Report Element	Corresponding Report Location
5	Hydraulic calculations	***Facility Sizing:*** Standard hydraulic calculations were used to size pipelines, pump stations and storage tanks. Appendix F.3 lists assumptions related to facility sizing for each alternative in the notes section of the detailed cost sheets. A hydraulic model was not developed for the alternatives evaluation; however, the results of prior hydraulic models were used where applicable. ***Groundwater:*** TM #2a – Beltz Wellfield Area Injection Well Capacity and Siting Study TM #2b – Santa Margarita Groundwater Basin Injection Well Capacity and Siting Study ***Surface Water Augmentation:*** TM #3 Surface Water Augmentation at Loch Lomond Reservoir ***Streamflow Augmentation*** TM #4 Streamflow Augmentation (Attachment A.2 – results of confluence model)

Section 2: Study Area Characteristics

2.1 Study Area

The City is a small-sized community located in Santa Cruz County, south of the San Francisco Bay Area at the north end of the Monterey Bay. The area has a Mediterranean climate with a cool, dry summer and a mild, wet winter. The average annual rainfall is approximately 31.35 inches but can range from 14 to 60 inches (SCWD 2016). The City is located in a seismically active area west of the San Andreas Fault zone. The total population in the Santa Cruz regional area includes over 132,000 people in the SCWD and SqCWD service areas and an estimated 40,000 people in the SLVWD and SVWD areas. The community in and around the City includes schools, commercial, light industrial, residential, and recreational areas. The study area includes the Santa Cruz Region (previously shown in Figure 1-1) with a focus on the City's service area, as shown in Figure 2-1.

2.2 Santa Cruz Region Background

The Santa Cruz Region's reliance on rainfall, surface water, and groundwater, without a source of imported water supply, results in water management challenges due to lack of adequate surface water supply during droughts, and increased groundwater pumping which has resulted in overdrafting of the aquifers. Storing surface water is a challenge in the region. Groundwater pumping has exceeded natural recharge replenishment. To remedy this situation, local water agencies in the region are actively pursuing supplemental supply alternatives.

2.2.1 City of Santa Cruz Water Gap

If the City were faced with drought conditions similar to the 1976-77 drought, the City would not have enough water to meet current demands. Drought-related curtailment has historically been estimated to be as high as 45 percent. Even with ongoing conservation efforts and up to 15 percent water-use restrictions during drought conditions, additional water supplies are needed to meet potable water needs for public health and safety, economic stability, and provide water for protection of endangered species.

As part of the City's Integrated Water Plan (IWP) (Fiske & Assoc. 2003), the City's supplemental water supply objective was a project that can provide up to 2.5 mgd (2,800 AFY) of new potable water during dry and critically dry years. The WSAC Agreement and Recommendations Report further investigated opportunities to provide significant improvements to the sufficiency and reliability of the Santa Cruz water supply by 2025. The WSAC members agreed upon a worst-case gap of 1.2 billion gallons per year (bgy) (3.3 mgd or 3,700 AFY) between water supply and water demand during times of extended drought (WSAC 2015).

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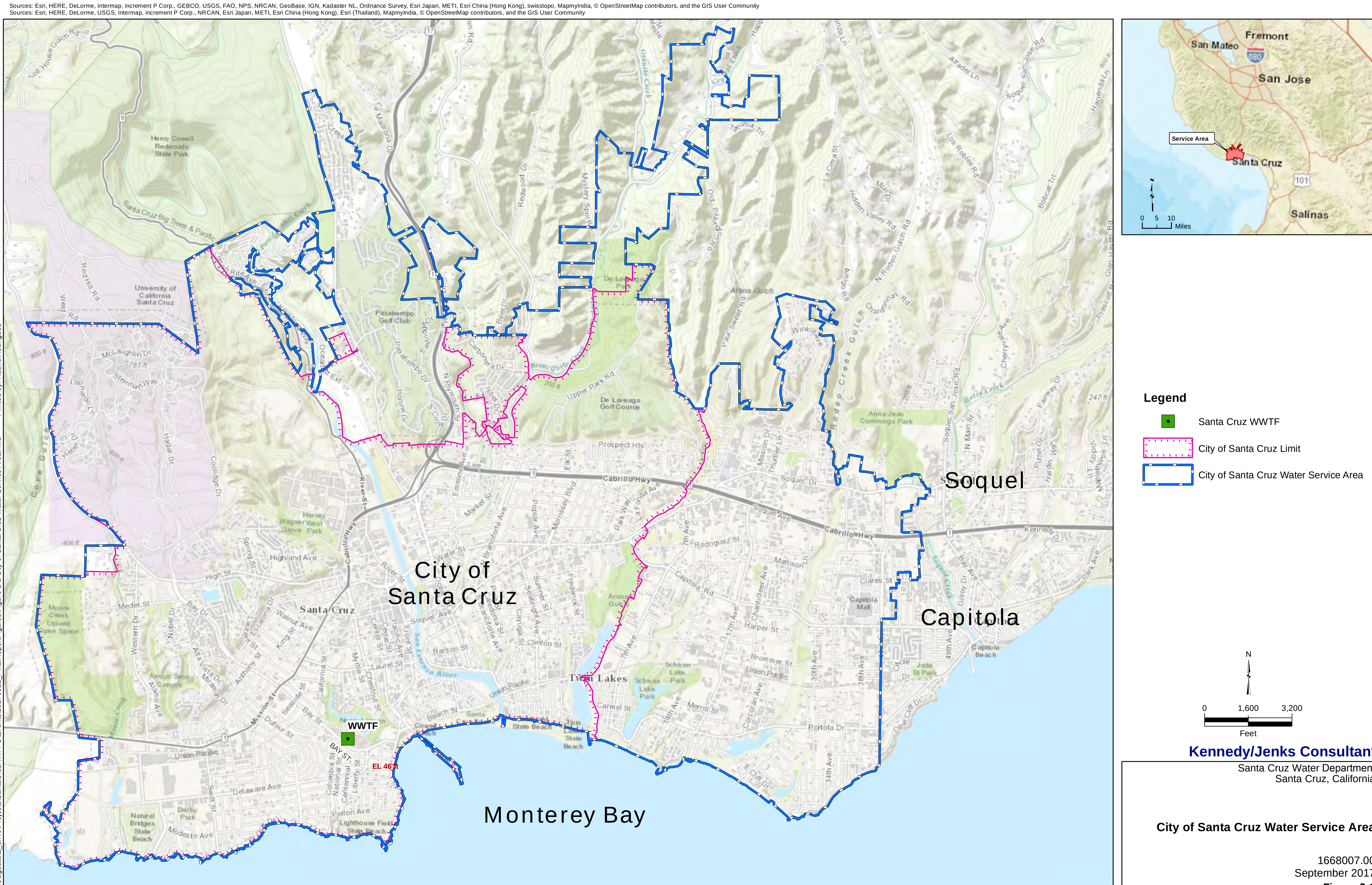

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

City of Santa Cruz Water Service Area

1668007.00
September 2017
Figure 2-1

\\sfoisgdata\Z_drive\Projects\SantaCruzRWFPS\Events\20170921_FinalReportFigures\Figure 2-1 City of Santa Cruz Water Service Area.mxd

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2.2.2 SqCWD Water Gap

Similar to the City, the SqCWD does not have access to imported supplies from federal, state or other sources outside the Santa Cruz area. SqCWD obtains 100 percent of its water supply from two groundwater aquifers within the Santa Cruz Mid-County Groundwater Basin via production wells. The primary threat to SqCWD's water supply is overdrafting of the aquifers and the subsequent potential for seawater intrusion. The basin currently is in a state of critical overdraft, and the cumulative impact of pumping in excess of sustainable yields will eventually lead to seawater intrusion and to potential contamination of the groundwater basin and drinking water (Carollo 2016). SqCWD's 2012 Integrated Resource Plan Update (SqCWD 2012) and the 2015 Community Water Plan (SqCWD 2015) are long-term water plans that offer a diversified strategy emphasizing water-use efficiency through demand management (e.g. conservation efforts), groundwater management, and supplemental supply development. The reports serve as a roadmap through 2030 for maintaining water supply reliability for SqCWD's customers and protecting the local environment by establishing water supply planning objectives to recover the groundwater basin and maintain protective levels.

SqCWD's Groundwater Replenishment Feasibility Study identifies the need to limit groundwater pumping to prevent seawater intrusion and alternative water sources to supplement a supply shortfall of between 1.25 mgd (1,410 AFY) and 1.52 mgd (1,700 AFY) (Carollo 2016). The SqCWD Feasibility Study documents methods and costs to close this gap with advanced treated recycled water for potable reuse (Carollo 2016).

2.2.3 SVWD Gap

Similar to the City and SqCWD, SVWD also does not import any water. Unlike the City or SqCWD, SVWD has an existing recycled water program that serves 0.19 mgd (215 AFY) of tertiary recycled water to 43 customers, some with multiple services, for irrigation uses. Similar to SqCWD, SVWD relies on groundwater for all of their potable water supply. The Scotts Valley Groundwater Subarea, one of two subareas in the regional Santa Margarita Groundwater Basin (SMGB), is primarily used by SVWD for water supply. In the 1980s and 1990s, significant water level declines occurred as a result of population growth, increased pumping, and reduced recharge from urbanization. Since development of SVWD's recycled water program in 1999 and implementation of intensive water conservation measures, water levels have stabilized. While DWR has not classified these basins as overdrafted, overdraft of the groundwater basin remains a significant concern especially in times of extended droughts and associated impacts on reliability (Kennedy/Jenks 2016a). SVWD is working toward raising the groundwater levels with active groundwater replenishment through injection of 560 AFY of advanced treated water into the SMGB Lompico Aquifer. Raising the groundwater levels could also provide approximately 1,955 MG (6,000 AF) of water storage that could be tapped during droughts (Kennedy/Jenks 2016a).

2.3 Major Hydrologic Features

2.3.1 Surface Hydrology

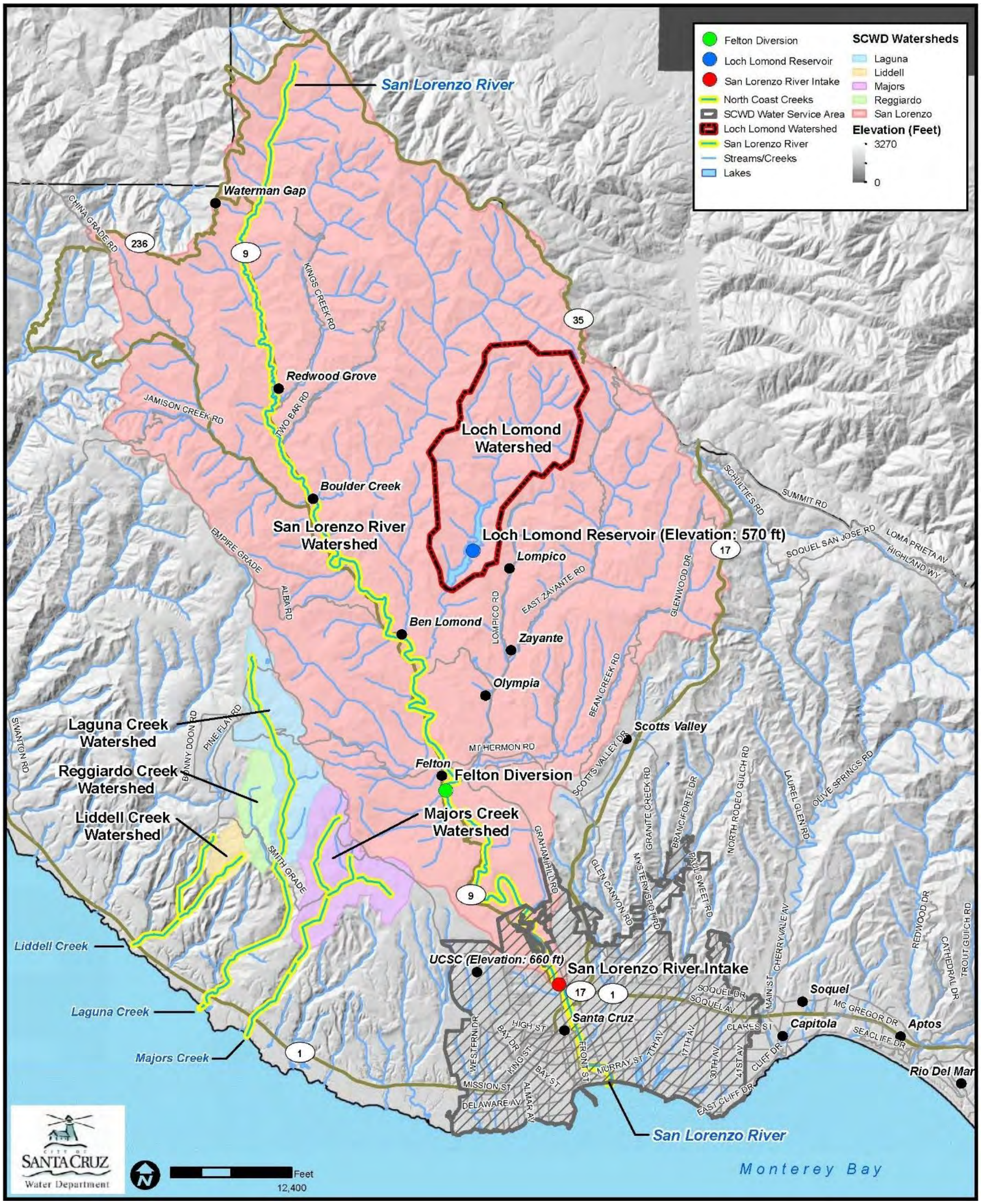
The City's water system relies predominantly on local surface water supplies, which include the North Coast sources, the San Lorenzo River, and Loch Lomond Reservoir. Together, these surface water sources represent approximately 95% of the City's total annual water production. All surface water diversions are operated within the boundaries of various water rights as well as instream flow requirements. Figure 2-2 depicts the varied topography and major hydrologic features in the County. Regional partners' hydrologic features are not described in detail in this report.

North Coast Sources - The North Coast sources consist of surface diversions from three coastal streams and a natural spring located approximately 6 to 8 miles northwest of downtown Santa Cruz and supply approximately 26% of the City's total annual water production. These sources are: Liddell Spring, Laguna Creek, Reggiardo Creek, and Majors Creek. The use of these sources by the City dates back as far as 1890. The diverted flows are transported via a gravity flow transmission line to a pump station then up to the Graham Hill Water Treatment Plant (GHWTP); this facility treats all surface water in the City's system.

San Lorenzo River - The San Lorenzo River is the City's largest source of water providing approximately 55% of the total supply. A 138-square mile watershed drains into the 25-mile-long river as it winds down the Santa Cruz Mountains into Monterey Bay. There is wide variation in the annual discharge based upon precipitation; the average runoff for the past 100 years is 30.3 billion gallons (bg) (93,000 AFY), with a minimum of 3 bg (9,500 AF) in 1977 and maximum of over 91.2 bg (280,000 AF) in 1983 (SCWD, 2016). SCWD operates two diversions on the San Lorenzo River.

- The San Lorenzo River Diversion, sends water to the GHWTP via the Coast Pump Station. This diversion dates back to the 1920s and the current water right allows for diverting up to 7.8 mgd with no annual diversion limit.
- The other is the Felton Diversion, which is an inflatable dam and intake structure built in 1974, located about six miles upstream from the San Lorenzo River Diversion. Current water rights allow for diverting up to 977 MG (3,000 AF) annually with maximum diversion rates imposed depending upon the time of year. Water is pumped from this diversion up to Loch Lomond.

Figure 2-2: Topological Hydrological Features Map for the Santa Cruz Region



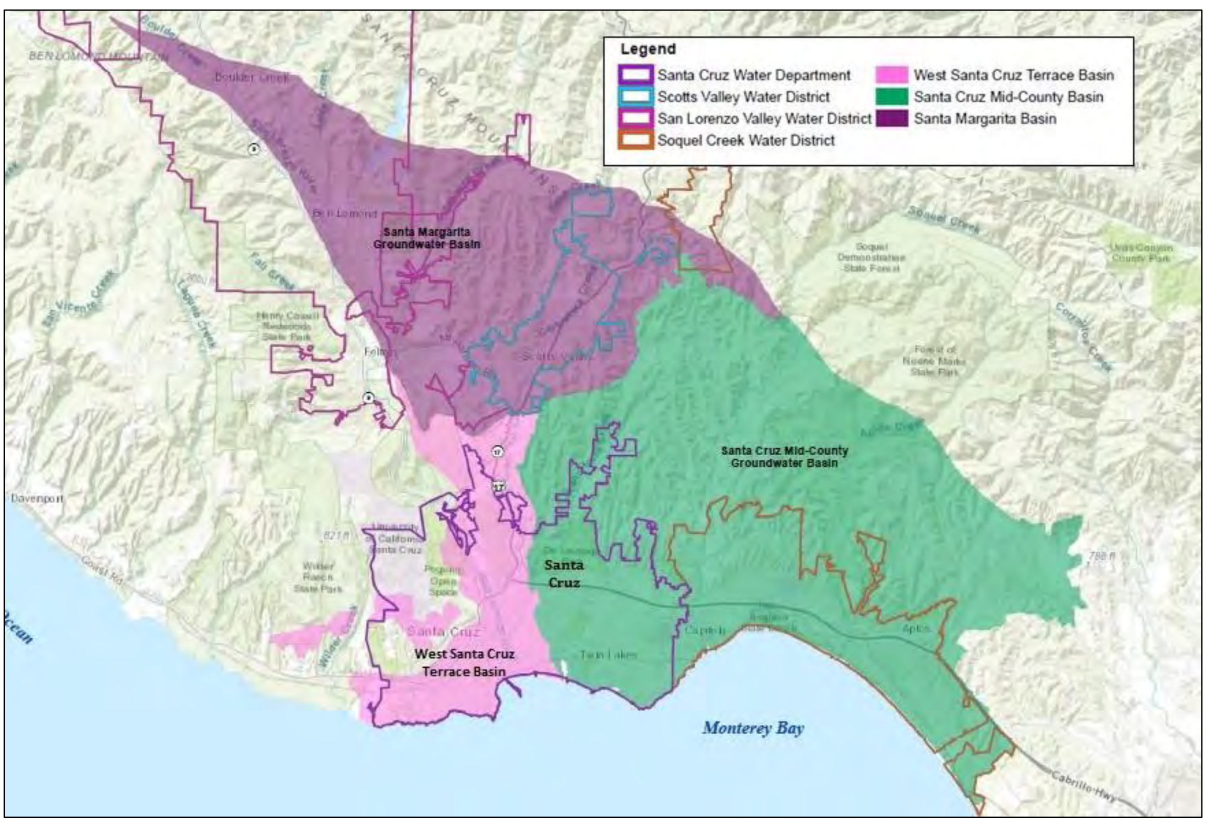
Source: Santa Cruz Water Department

Newell Creek and Loch Lomond Reservoir - The City's only reservoir, Loch Lomond, is located in the Santa Cruz Mountains. Constructed in the 1960s, it has a drainage area of about 9 square miles and a capacity of 2,810 MG (8,600 AF). Loch Lomond is used to primarily collect and store water from the Newell Creek watershed, as well as to store water diversions from the San Lorenzo River via the Felton Diversion. The City is allowed a maximum collection to storage from Newell Creek of 5,600 AFY (1,825 MG) and a maximum withdrawal of 3,198 AFY (1,042 MG). There is no limit on the maximum diversion rate (SCWD 2016). Newell Creek and Loch Lomond supply an average of 14% of the City's water supply. In addition to the City, the SLVWD is entitled by contract to receive a portion of the water stored in Loch Lomond.

2.3.2 Groundwater Basins

The Santa Cruz Region utilizes several groundwater basins including Santa Cruz Mid-County Groundwater Basin, the SMGB and the West Santa Cruz Terrace Groundwater Basin. The relative location of these major groundwater basins is shown in Figure 2-3. The Mid-County Groundwater Basin consists of the Purisima Aquifer Formation and the Aromas Red Sands Aquifer. The SMGB includes the Santa Margarita, Monterey, Butano and Lompico aquifers. The West Santa Cruz Terrace Groundwater Basin's western and eastern boundaries coincide roughly with the City's water service area (CA DWR Bulletin 118) and consists primarily of the Purisma Aquifer Formation.

Figure 2-3: Groundwater Basins in Santa Cruz Region



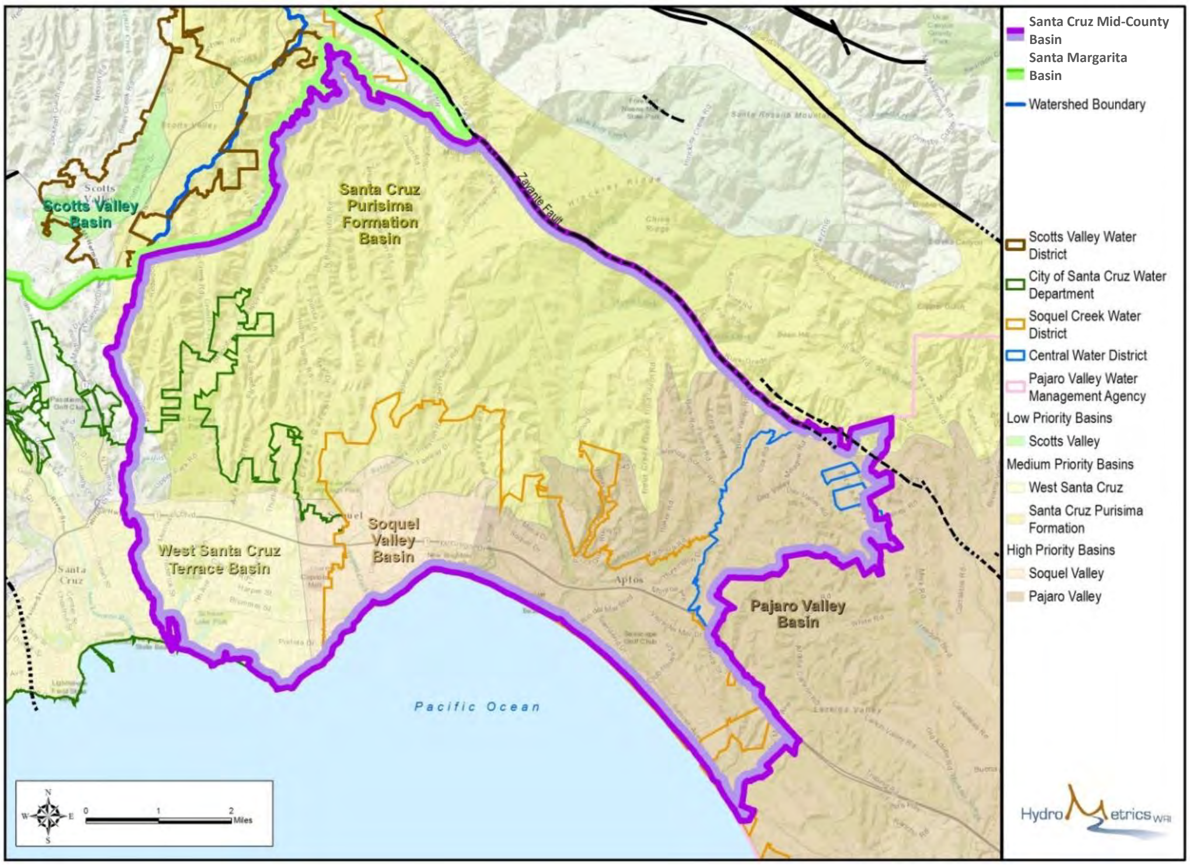
Source: DWR Groundwater Basin Boundary Assessment Tool digitized boundaries based on 2016 DWR solicited basin boundary modification requests from local agencies. https://gis.water.ca.gov/app/bbat/'

Details on the groundwater basins and their potential for groundwater recharge and replenishment are described in TM #2a Beltz Wellfield Area Injection Well Capacity and Siting Study and TM #2b Santa Margarita Injection Well Capacity and Siting Study, which are included in Appendix C.

City of Santa Cruz Groundwater Basins

Approximately 5% of the City's water supply comes from groundwater, all of which is extracted from wells in the Mid-County Groundwater Basin area, shown in Figure 2-4.

Figure 2-4: Santa Cruz Mid-County Groundwater Basin

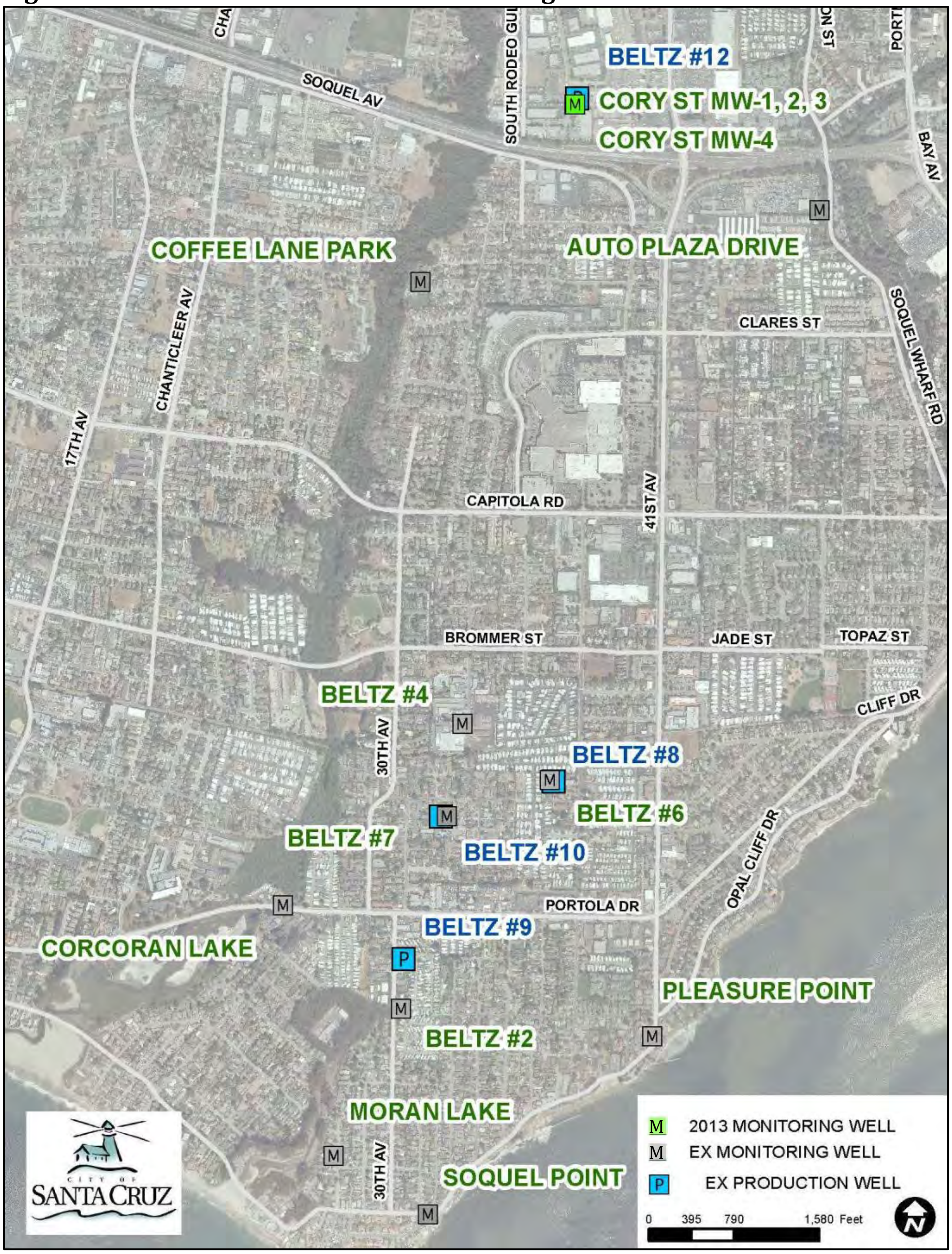


Source: SqCWD Groundwater Replenishment Feasibility Study (Carollo 2016). The basin boundary shown represents the expanded and renamed Santa Cruz Mid County Groundwater Basin.

The Beltz Well system (Figure 2-5) includes the four groundwater production wells within the Beltz Wellfield and two Beltz Treatment Plants. Three of the wells are near the coast and draw directly from the Purisima Formation and the fourth well, Beltz 12 is a deeper well farther inland that draws from both the Purisima and Santa Margarita Aquifers. During the summer and fall, groundwater from these wells is used to supplement the surface water sources. The wells provide approximately 0.43 mgd (485 AFY) of groundwater.

There is an ongoing risk of seawater intrusion into permeable units of the Purisima Formation that could jeopardize the future production of groundwater by the City. This condition is due to coastal groundwater levels dropping below protective elevations which results in saltwater being drawn into and toward the freshwater zones of the aquifer (SCWD 2016).

Figure 2-5: SCWD's Beltz Wellfield Monitoring and Production Well Sites



Source: SCWD provided map

SqCWD Groundwater Basins

SqCWD obtains 100 percent of its water supply from groundwater aquifers located within two geologic formations that underlie SqCWD's service area, the Purisima Formation and the Aromas Red Sands aquifer. The Purisima Formation provides the majority of SqCWD's annual water needs. The primary threat to SqCWD's water supply is over-drafting of the aquifers and the subsequent potential for seawater intrusion. The basin currently is in a state of critical overdraft (Carollo 2016). These aquifers provide groundwater to SqCWD as well as other municipal utilities (such as the City, Central Water District, and the City of Watsonville), small mutual water districts or companies, and private well owners. SqCWD has practiced groundwater management for over 25 years and continually monitors for changes in water quality and groundwater levels.

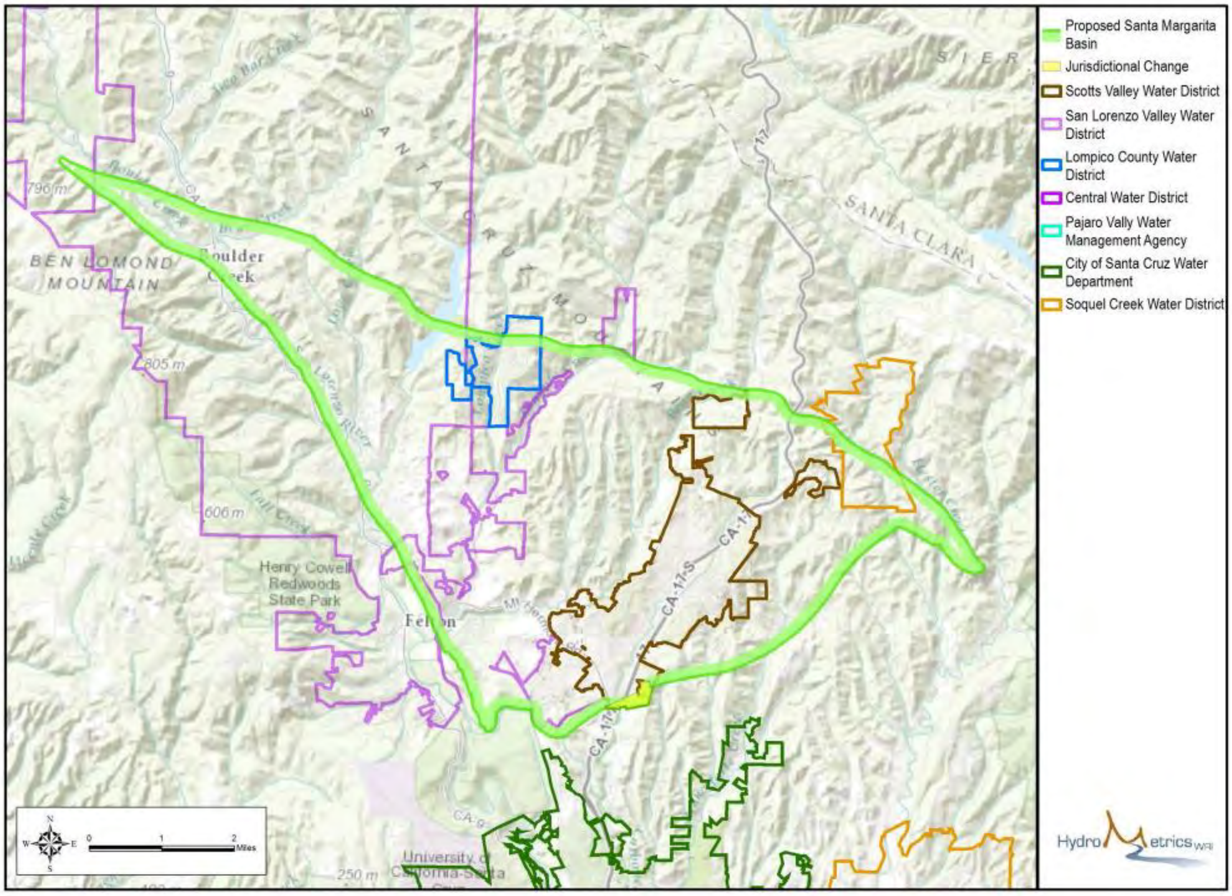
SVWD Groundwater Basins

Groundwater from the SMGB is SVWD's sole source of potable water supply, as shown in Figure 2-6. Since 1983, the SVWD has actively monitored and managed the SMGB through an integrated climatic, surface water and groundwater monitoring program, and regular reporting of water conditions. Prior to 1980, groundwater levels in the Scotts Valley area were generally higher than those in most other areas of the SMGB. Therefore, the Scotts Valley area was a major recharge area for the basin, and groundwater flowed outward to the surrounding areas. After 1980, groundwater levels declined, due to several factors including (1) increased groundwater pumping to meet the water demand of a growing population, (2) reduced recharge from the surface to groundwater due to an increase in paved areas and other land use changes associated with urbanization, and (3) reduced groundwater recharge due to the drought of the late 1980s and early 1990s (Kennedy/Jenks 2016a). A significant portion of the groundwater storage in the SMGB was depleted during this time and has not recovered sufficiently to be considered a viable source of supply for SVWD. Production in other aquifers has been developed to replace the SMGB supply (Kennedy/Jenks 2011).

SLVWD Groundwater Basins

SLVWD obtains between 40% to 60% of potable water from groundwater. From 2011 to 2015 SLVWD served customers more groundwater during the extended drought, averaging 1,291 AFY. Future total groundwater pumping averages are expected to be lower, in the range of 887 AFY (WSC 2016). SLVWD operates three sets of wells east of the San Lorenzo River near Felton and Ben Lomond. The SLVWD service area overlies the areas of the SMGB and the Felton Area Basin. Figure 2-6 shows the where the SMGB is located in relation to SLVWD.

Figure 2-6: Santa Margarita Groundwater Basin



Source: Santa Margarita Groundwater Basin Boundary Revision Request (Hydrometrics, 2015)

2.4 Water Quality

2.4.1 Surface Water Quality

Surface water sources used in the Santa Cruz water system vary in quality depending on the watershed from which the water is derived as well as the amount of rainfall. Total Organic Carbon (TOC) levels affect the disinfection byproduct (DBP) formation potential and are closely monitored. The City utilizes the source water with the lowest TOC levels where possible. But during droughts, limited surface water options are available.

The North Coast and Tait Street Wells (near the San Lorenzo River Diversion along the San Lorenzo River) sources provide the highest quality source waters that are generally less than 2 milligrams per liter (mg/L) in TOC during regular conditions, and rise to between 2 – 4 mg/L during droughts. Water stored in Loch Lomond Reservoir contains TOC greater than 5 mg/L, which, without blending with other sources of water with lower TOC, has a higher DBP formation potential.

2.4.2 Groundwater Quality

During the late spring, summer and early fall seasons, when surface water flows may be inadequate to meet the daily customer water demand, supplemental groundwater supply is pumped from the four Beltz Wells and treated on-site at two groundwater treatment plants and distributed to customers in the southeast service area. Local groundwater does not have significant water quality problems. The groundwater treatment plants remove iron and manganese from the groundwater prior to distribution. Details on groundwater quality are provided in TM #2a.

2.5 Land Use

The City is predominately built out (approximately 97%), with only a small amount of land that remains undeveloped. The same is true in the parts of the County and City of Capitola served by the City WWTF and SCWD (Figure 1-1). Because of the relative scarcity of raw land, the majority of future growth in the area is likely to be achieved through redevelopment, remodeling, increased density on underutilized land, and infill development in the urban core and along major transportation corridors, along with new construction on the little amount of vacant land remaining (SCWD 2016).

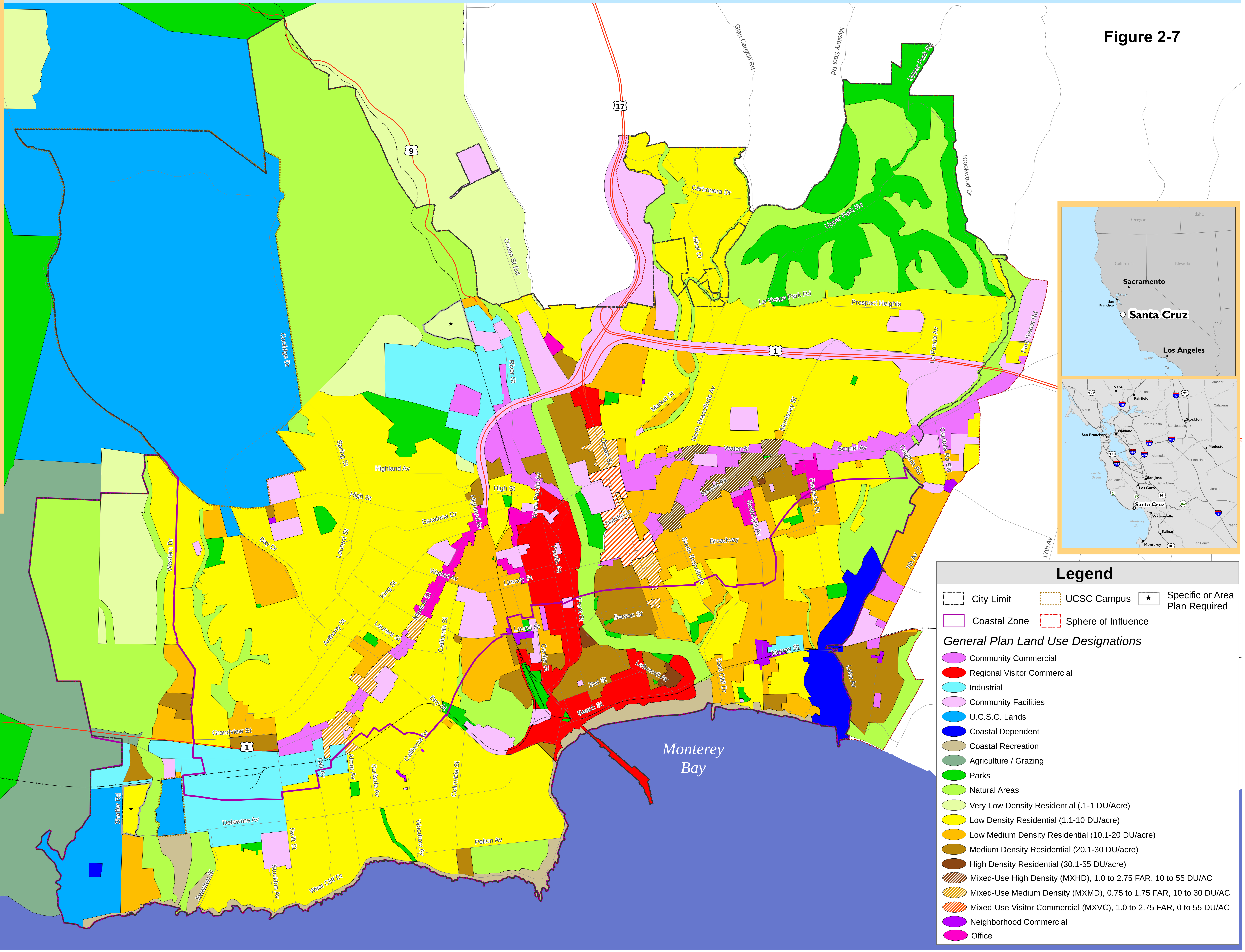
The City of Santa Cruz General Plan 2030 envisions residential and commercial intensification along the major street corridors (Water Street, Soquel Avenue, Mission Street and Ocean Street) through private and public redevelopment of opportunity sites. The Plan also encourages intensification in the downtown area including the Front Street corridor and lower Pacific Avenue. New land use designation for these areas include ground floor commercial with upper residential and densities ranging from 20.1 to 55 dwelling units/acre. Most, if not all of this growth will occur as infill development of vacant and underutilized parcels throughout the City. The City of Santa Cruz General Plan 2030 land use map is shown in Figure 2-7.

General Plan Land Use Designations

City of Santa Cruz
Planning Department
809 Center St. Room 206
Santa Cruz, CA 95060
Ph: 420-5100

SANTA CRUZ 2030

Figure 2-7



The Land Use Diagram is intended to be used in conjunction with the General Plan 2030 Goals, Policies and Programs Document. The document describes the guidelines, standards, and description of the land use designations on the map.

Projection: California State Plane Nad 83 Zone 3 (Feet)

Disclaimer:
City of Santa Cruz has provided this map to allow easy access and a visual display of City in formation. We have made considerable effort to assure the accuracy of the maps and data provided; nevertheless, some information may be inaccurate. The data available includ ing all maps, tables, numbers, graphics, and text (hereinafter collectively referred to as the "information,") is provided on an "AS IS," basis.

City of Santa Cruz shall assume no liability for any errors, omissions or inaccuracies in the in formation provided regardless of how accessed or provided.

2.6 Population Projections

The current population residing in the Santa Cruz water service area is estimated to be 95,251 people. Approximately two thirds of the total population, almost 64,000, lives inside the City limits. Within the City, about 9,100 people including students, faculty, staff, and their families reside on the University of California Santa Cruz (UCSC) campus. It is estimated that another 31,462 people, or 34 percent of the service area population, live outside the City limits (SCWD 2016).

In the SCWD service area, a regional growth forecast prepared by the Association of Monterey Bay Area Governments (AMBAG 2014) predicts the total number of people receiving SCWD water service is expected to grow by about 17,000 people and reach more than 112,000 in 2035. This equates to a population growth rate of less than one percent per year. This is substantially lower than the Santa Cruz County estimated population growth of 18% over the same 25-year period. As of 2015, there are 19,029 single family houses and 17,974 multifamily houses in the service area. While it is projected that 1,149 total housing units will be added within the SCWD water service area, in the last five years, only 204 new single-family units, and 6 multifamily projects have been built (SCWD 2016). The corresponding county-wide increase in households is predicted to be 15% (AMBAG 2014). The projected population is shown in Table 2-1.

Table 2-1: Population Projections for the Santa Cruz Water Department Water Service Area

Population Served	2015	2020	2025	2030	2035
City of Santa Cruz	63,789	66,860	70,058	73,375	76,692
County of Santa Cruz, City of Capitola	31,462	32,543	33,562	34,614	35,698
Total	**95,251**	**99,403**	**103,620**	**107,989**	**112,390**

Source: 2014 Regional Growth Forecast (AMBAG 2014) and City GIS section.

It is worth noting that according to the SWRCB[3], Santa Cruz was in the handful of water suppliers in California in February 2015 where residential consumption was 44 gallons per capita per day, which was lower than the State average of 76.7 gallons. Due to a variety of factors explained in Section 3.5, the forecasted growth in population in the SCWD service area is not expected to result in an overall increase in water demand.

2.7 Beneficial Uses of Receiving Waters

The Water Quality Control Plan for the Central Coast Region (Basin Plan) contains the beneficial uses of receiving waters in the Santa Cruz Region (CCRWQCB 2011). The Basin Plan provides water quality control planning, sets water quality objectives for the Central Coast Region and identifies the beneficial uses of waters of the State within its jurisdictional area. The Basin Plan also incorporates the Water Quality Control Plan for the Waters of California (Ocean Plan).

[3] http://www.waterboards.ca.gov/press_room/press_releases/2015/pr040715_rgcpd_febconservation.pdf

Effluent from the Santa Cruz WWTF and the Scotts Valley WRF that is not treated to tertiary standards is discharged via an ocean outfall pipeline to the Pacific Ocean. Local stormwater runoff flows into surface waters such as the San Lorenzo River, which ultimately drains to the Pacific Ocean.

Beneficial uses for local surface waters in the SCWD and Santa Cruz WWTF service areas, including Loch Lomond Reservoir, the Pacific Ocean between Point Año Nuevo to Soquel Point and Monterey Bay are listed in Table 2-2. No treated effluent is discharged into Loch Lomond Reservoir. Treated effluent is discharged approximately one mile from the shoreline in Monterey Bay at a depth of approximately 100 feet. In 2015, an average daily effluent flow of 7.1 mgd was discharged. Wastewater discharge requirements and specific water quality objectives are described further in Section 4.

Table 2-2: Summary of Designated Beneficial Uses

Local surface waters[1]	Loch Lomond Reservoir	Pacific Ocean[2]	Monterey Bay
(Basin Plan, Table 2-1, p.2-6)	*(Basin Plan, Table 2-1, p.2-3)*	*(Basin Plan, Table 2-2, p.2-16)*	*(California Ocean Plan 2015)*
municipal and domestic supply	municipal and domestic supply		
agricultural supply	agricultural supply		
groundwater recharge	groundwater recharge		
freshwater replenishment	freshwater replenishment		
water contact recreation	water contact recreation	water contact recreation	water contact recreation
non-contact water recreation	non-contact water recreation	non-contact water recreation	non-contact water recreation
warm fresh water habitat			
wildlife habitat	wildlife habitat	wildlife habitat	
cold fresh water habitat	cold fresh water habitat		
migration of aquatic organisms	migration of aquatic organisms		Fish migration
spawning, reproduction, and/or early development	spawning, reproduction, and/or early development		Fish spawning and shellfish harvesting
preservation of biological habitats of special significance			preservation and enhancement of designated ASBS[3]
rare, threatened, or endangered species	rare, threatened, or endangered species		rare and endangered species
estuarine habitat		marine habitat	marine habitat
navigation	navigation	navigation	navigation
commercial and sport fishing	commercial and sport fishing	commercial and sport fishing	commercial and sport fishing
shellfish harvesting	shellfish harvesting	shellfish harvesting	
industrial service supply	industrial service supply	industrial service supply	industrial water supply
mariculture			mariculture

[1] Local surface waters in the SCWD and Santa Cruz WWTF service areas
[2] Pacific Ocean between Point Año Nuevo to Soquel Point, including Santa Cruz Harbor, and the San Lorenzo Estuary
[3] ASBS = Areas of Special Biological Significance

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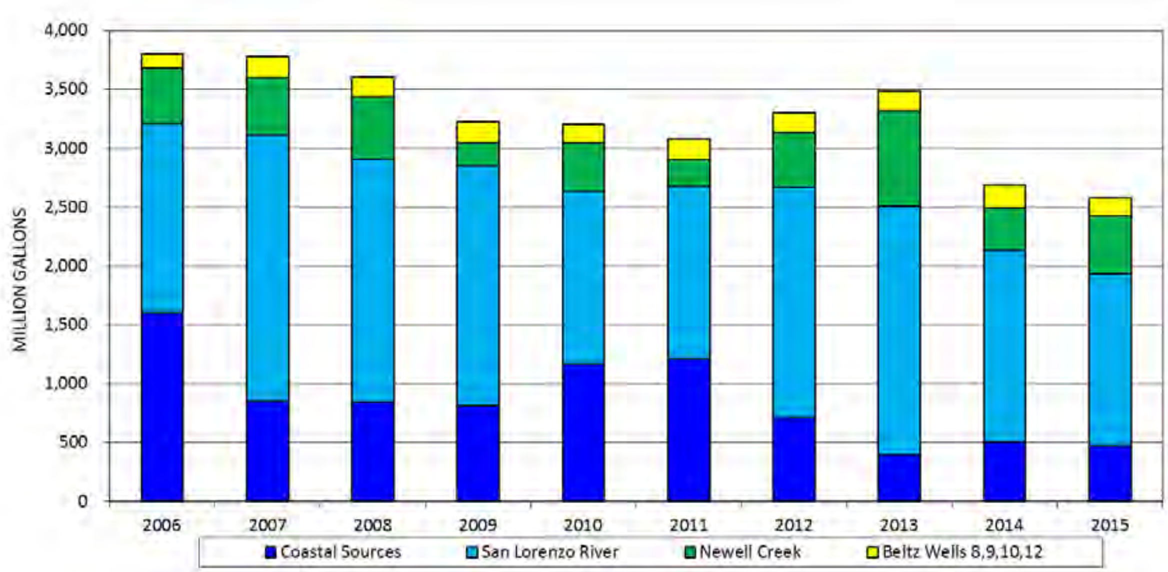
Section 3: Water Supply Characteristics and Facilities

3.1 Water Sources

Water supplies for the Santa Cruz Region are solely derived from surface water runoff and rainwater that percolates into the local groundwater basins. SCWD relies predominantly on local surface water supplies, which include the North Coast sources, the San Lorenzo River and Newell Creek / Loch Lomond Reservoir. Together, these surface water sources represent approximately 95 percent of the City's total annual water production. The balance of the City's supply comes from groundwater, all of which is extracted from wells. Gross annual production volumes from the City's surface and groundwater sources over the past 10 years are shown in Figure 3-1.

Figure 3-1: Annual Production Volume by Source of Supply



Source: City of Santa Cruz 2015 Urban Water Management Plan (SCWD 2016)

The strong reliance on surface water to provide nearly all of its water supply is the primary threat to the City water system. Stream flows vary for a number of reasons including seasonal variations, drought, and potential long-term impacts from climate change.

3.2 Major Water Supply Facilities

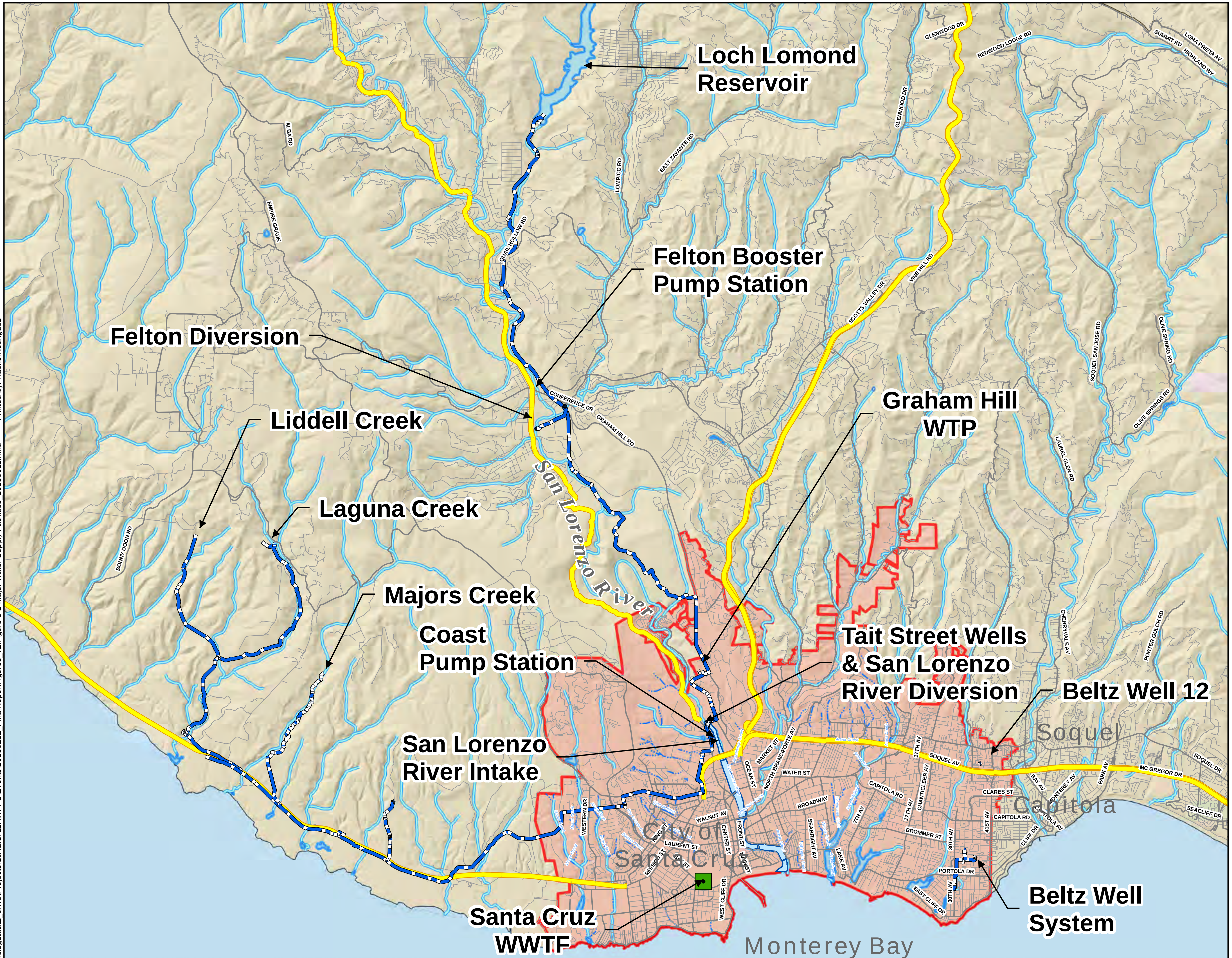
SCWD's major supply facilities and capacities are described in Table 3-1 and shown in Figure 3-2. SCWD's water rates and fees for 2017 to 2020 are provided in Appendix H.3.

Table 3-1: SCWD Major Water Supply Facilities

Type of Water	Source of Water	Facility	Description
Surface Water	All Surface Water	Graham Hill Water Treatment Plant (GHWTP)	SCWD's only surface water treatment plant. GHWTP has a capacity of 16 mgd, with average daily production of 10 mgd (49 AFD), and maximum daily production of 15 mgd (46 AFD) in the summer.
		Treated Water Storage Facilities	16 treated water storage reservoirs with a total potable water storage capacity of 19 MG (58 AF) throughout SCWD's service area.
	North Coast Sources	Surface Diversions	4 diversions for Laguna Creek, Majors Creek, Reggiardo Creek, and Liddell Spring.
		Coast Transmission Main	16-mile long pipeline that delivers raw water from North Coast sources to Coast Pump Station by gravity.
		Coast Pump Station	Located next to San Lorenzo River Diversion. Receives water from North Coast sources, and pumps it to GHWTP.
	San Lorenzo River (SLR)	Surface Diversions	2 diversions at San Lorenzo River and Felton: ▪ San Lorenzo River Diversion – Sends SLR water to GHWTP ▪ Felton Diversion – Sends water to Loch Lomond
		Surface Water Wells	Tait Wells - Auxiliary wells located near San Lorenzo River Diversion that are hydraulically connected to the SLR.
	Newell Creek and Loch Lomond Reservoir	Loch Lomond Reservoir	Constructed in 1960 and has a maximum capacity of 2,810 MG (8,600 AF).
		Newell Creek Pipeline	9-mile long pipeline that delivers raw water from Loch Lomond Reservoir to GHWTP.
Groundwater	Beltz Well System	Beltz Wells	There are currently 4 active Beltz Wells (#8, #9, #10, #12)
		Beltz Treatment Plant	Treatment process involves aeration and filtration to remove iron and manganese, followed by chlorination. Treated water is directly injected into the drinking water system.
		Beltz 12 Treatment Plant	Treatment process includes filtration to remove iron and manganese followed by chlorination. Treated water is directly injected into the drinking water system.

Source: Adapted from City of Santa Cruz 2015 Urban Water Management Plan (SCWD 2016)

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



Legend

- Santa Cruz WWTF
- Raw Water Main
- Lakes
- Streams
- Creeks
- Water Service Area

Printed by: RachelRodriguez

\\sfoisgdata\Z_drive\Projects\SantaCruzRWFPS\Events\20180222_FinalReportFigures_v2\Figure 3-2 Major Water Supply Facilities_20180611.mxd

Note: Service laterals to individual meters are not shown

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Major Water Supply and Wastewater Treatment Facilities

1668007.00
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Figure 3-2

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3.3 Groundwater Management

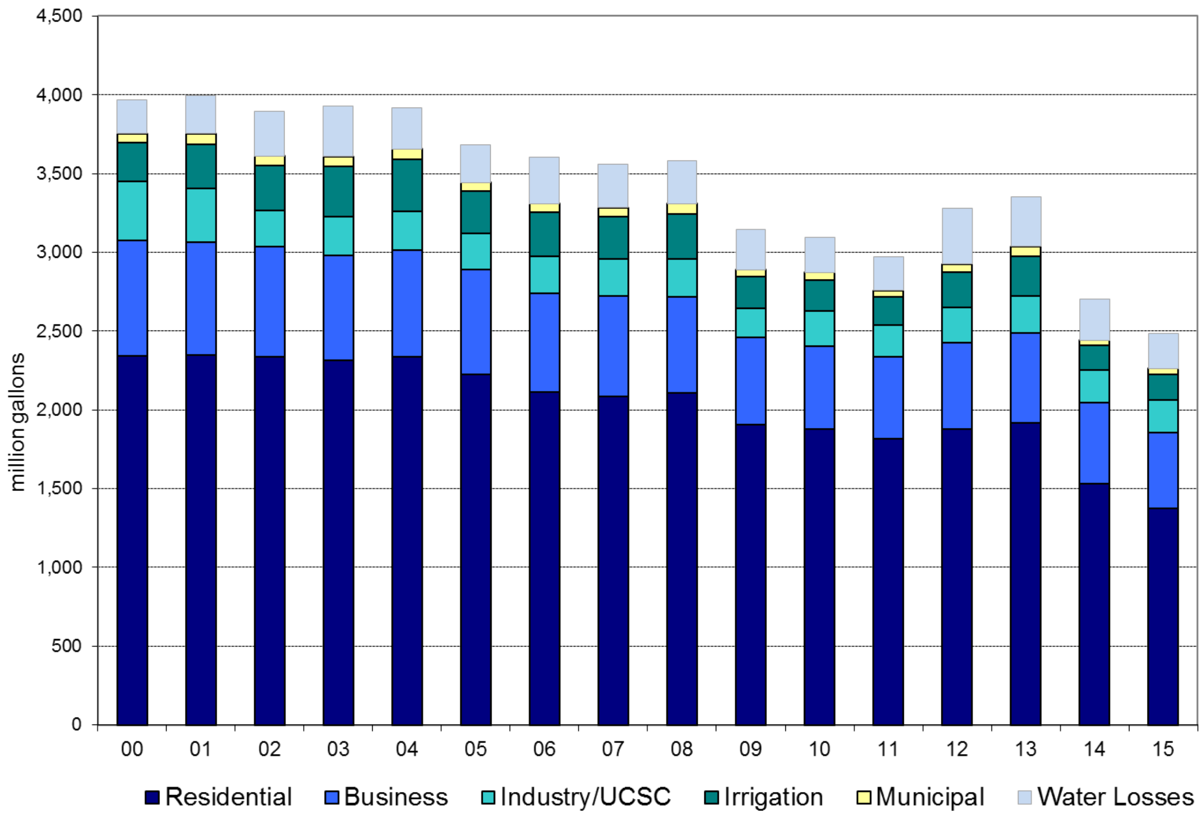
The two primary groundwater basins in the Santa Cruz Region are managed by the following agencies and participating members.

1) **Santa Cruz Mid-County Groundwater Basin**: In March 2016, a Joint Powers Agreement (JPA) was signed between SqCWD, Central Water District, the City of Santa Cruz, the County of Santa Cruz, and three private well representatives to form the Santa Cruz Mid-County Groundwater Agency (MGA). This agency serves as the Groundwater Sustainability Agency (GSA) for the Santa Cruz Mid-County Groundwater Basin and has the authority to plan for and implement a required Groundwater Sustainability Plan (GSP). This basin is classified as critically overdrafted. The GSP is currently being developed and will be submitted to the State in 2020 (SCWD 2016, WSC 2016)
2) **Santa Margarita Groundwater Basin**: SVWD, SLVWD and County of Santa Cruz are working together to form a GSA and develop a GSP for the Santa Margarita Groundwater Basin. This basin is not classified as critically overdrafted. However, overdraft of the basin especially in times of extended droughts present a concern for reliability (Kennedy/Jenks 2016a).

3.4 Historical Water Use Trends

Historically, water use in SCWD's service area rose in parallel with account and population growth over time, except during two major drought periods in the late 1970s and the early 1990s. Around 2000, this pattern changed and system demand began a long period of decline, accelerated by pricing changes, drought, economic downturn, and other factors. In 2015, after 2 years of water rationing, annual water use fell to a level of about 2.45 billion gallons, similar to the level experienced during the 1970s drought (SCWD 2016). A breakdown of annual water consumption by SCWD's major customer classes since 2002 is shown in Figure 3-3.

Figure 3-3: Historical Annual Water Consumption by Customer Category



Source: City of Santa Cruz 2015 Urban Water Management Plan (SCWD 2016)

3.5 Projected Water Use Trends

An econometric analysis of demand and forecast for SCWD's service area was prepared as part of its 2015 UWMP update. The forecast covered the period 2020 – 2035, assumes average weather and normal income and growth, and includes adjustments for future effects of water rates, plumbing codes and the City's baseline conservation program and updated information on passive and active conservation savings. The resulting water demand projection, by customer class, is presented in Table 3-2. System water demand in the service area is expected to decline and then stabilize at a level of about 3.2 billion gallons per year.

Table 3-2: Projected Annual Water Consumption by Customer Category

Use Type	Additional Description	Projected Water Use (mgy)			
		2020	2025	2030	2035
Single Family	Individually metered dwellings	1,277	1,223	1,191	1,170
Multi-Family	2 or more dwelling units	772	714	690	678
Commercial		574	541	525	519
Industrial		56	59	60	61
Institutional/ Governmental	Municipal (city) accounts	46	42	40	40
Landscape	Dedicated Irrigation	112	119	134	144
Landscape	Golf Irrigation	58	52	47	47
Other	UC Santa Cruz	196	234	271	308
Water Losses		236	241	247	253
	TOTAL Annual Use (mgy)	**3,327**	**3,225**	**3,205**	**3,220**
	Average Daily Use (mgd)[1]	**9.1**	**8.8**	**8.8**	**8.8**

Source: City of Santa Cruz Water Demand Forecast (M.Cubed 2015a) and Water Conservation Master Plan (Maddaus 2017)
[1] Average Daily Use (mgd) = Total Annual Use (mgy) / 365 days

3.6 Quality of Water Supplies

3.6.1 Treated Surface Water Quality

Surface water from the City's 3 sources (North Coast, San Lorenzo River and Newell Creek / Loch Lomond Reservoir) is treated at the GHWTP. Drinking water produced at GHWTP complies with all drinking water standards set by the USEPA and SWRCB Division of Drinking Water (DDW) (SCWD 2016).

The current treatment challenge is to reduce the formation of disinfection byproducts in storage reservoirs in drought (SCWD 2016). This challenge is a result of changes in the City's source water mix, driven in part by instream flow requirements that reduces the City's flexibility when selecting sources of supply. The City is addressing the issue in multiple ways, through upgrading treatment processes at the GHWTP, replacing the Tait Wells that will add a supply with low TOC, and installing aeration systems in storage tanks. A study of source water has begun to collect samples from the sources to develop strategies to potentially treat more turbid source water with higher amounts of TOC.

3.6.2 Treated Groundwater Quality

Groundwater from the four Beltz Wells are treated on-site at two groundwater treatment plants to remove iron and manganese before distribution to customers in the southeast service area. There are currently no drinking water quality issues.

3.7 Potential Future Water Sources

The City is currently implementing a supply augmentation plan with the goal of reaching supply sufficiency by 2025. As stated in the Water Supply Advisory Committee Final Report on Agreements and Recommendations, p. 73-74 (WSAC 2015), "the portfolio of measures for improving the reliability of water supply includes the following Elements:

- **Element 0:** Additional water conservation with a goal of achieving an additional 200 to 250 million gallons of demand reduction by 2035 by expanding water conservation programs;
- **Element 1:** Passive recharge of regional aquifers by working to develop agreements for delivering surface water as an in-lieu supply to the Soquel Creek Water District and/or the Scotts Valley Water Districts so they can rest their wells, help the aquifers recover, and effectively store water for use by SCWD in drought years;
- **Element 2:** Active recharge of regional aquifers by using existing infrastructure (wells, pipelines, and treatment capacity) and potential new infrastructure (wells, pipelines and treatment capacity) in the regionally shared Purisima aquifer in the Soquel-Aptos basin[4] and/or in the Santa Margarita/Lompico/Butano aquifers in the Scotts Valley area to store water that can be available for use by Santa Cruz in drought years;
- **Element 3:** A potable water supply using advanced treated recycled water as its source, as a supplemental or replacement supply in the event the groundwater storage strategies described above prove insufficient to meet the Plan's goals or cost effectiveness, timeliness or yield. In the event advanced treated recycled water does not meet the needs, desalination would then become Element 3."

For more information about policies related to potential future water sources, refer to Section 7.4 of the UWMP.

[4] Now recognized as the Santa Cruz Mid-County Groundwater Basin

Section 4: Wastewater Characteristics and Facilities

4.1 City of Santa Cruz Wastewater Treatment and Collection Facilities

The City of Santa Cruz owns and operates the regional Santa Cruz WWTF that treats municipal wastewaters to secondary standards for discharge through an outfall to the Pacific Ocean. The plant is operated by the SCPWD.

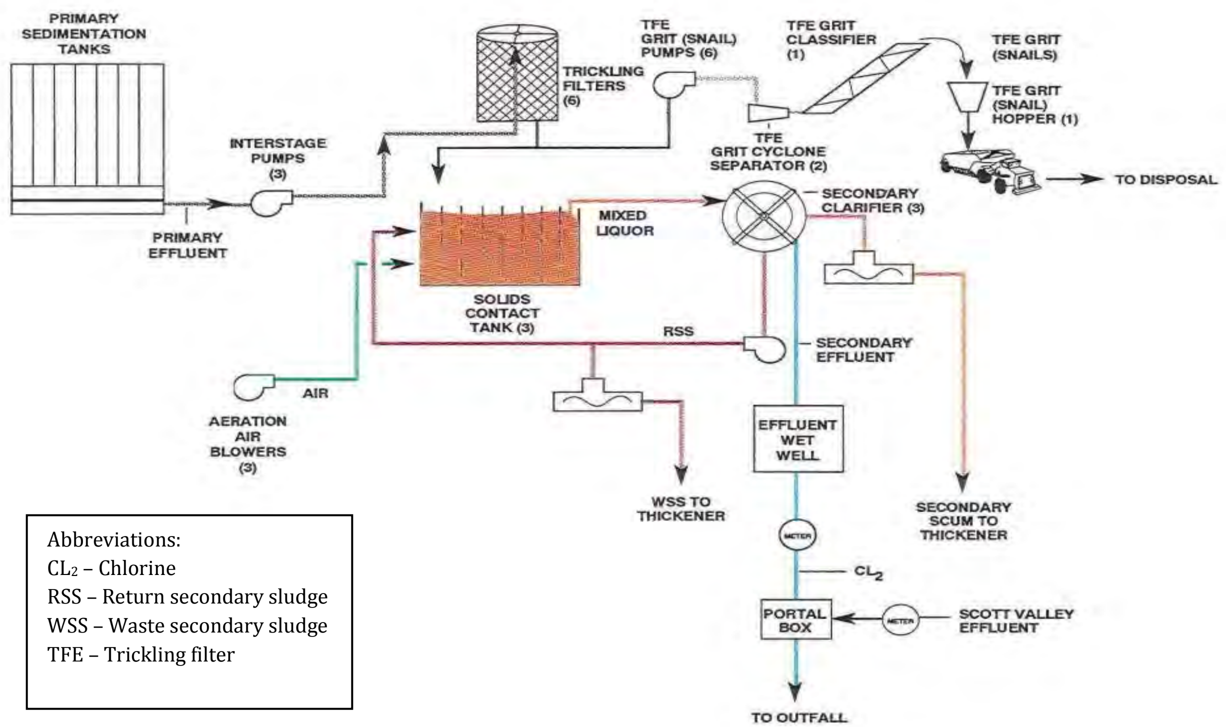
The Santa Cruz WWTF is located in the southwest area of the City. The plant was originally commissioned in 1928 as a primary treatment facility and the City continuously upgrades the treatment facility to accommodate population growth, to respond to regulatory and environmental challenges, and to implement improved technologies for wastewater treatment. These improvements include the addition of the trickling filter/solids contact units to the primary treatment plant, the commissioning of a new ocean outfall, the upgrade from advanced primary to full secondary treatment and conversion from chlorine gas disinfection to ultraviolet disinfection. The Santa Cruz WWTF key treatment facilities and a process flow diagram are shown in Figure 4-1.

Municipal wastewater generated within the City's limits is delivered to the Santa Cruz WWTF by a collection system that is operated by the SCPWD. SCCSD collects wastewater outside of the City limits - from Live Oak, Capitola, Soquel, Aptos and Seacliff areas – via a central pumping facility in Live Oak where the wastewater is then pumped to the Santa Cruz WWTF. The plant also treats dry weather flows from Neary Lagoon, septage from unsewered areas and grease trap pumping. The treatment plant comprises screening, aerated grit removal, primary sedimentation, biological tower trickling filters, solids contact stabilization, secondary clarification, and disinfection with ultraviolet light.

Federal guidelines have been established for treatment to secondary standards for ocean discharges. Treated wastewater from the Santa Cruz WWTF is discharged approximately one mile from the shoreline in Monterey Bay at a depth of approximately 100 feet. SVWD also adds its treated wastewater to the treated effluent for combined disposal through the outfall. Treated effluent is discharged into the Pacific Ocean under the Regional Board Order No. R3-2010-0043, National Pollutant Discharge Elimination System (NPDES) permit No CA0048194.

Biosolids are processed by anaerobic digestion and centrifuge dewatering. Stabilized solids are transported to Merced County and applied to farmlands. Methane gas produced by anaerobic digestion is used to generate power and heat the treatment plant's digesters.

Figure 4-1: City of Santa Cruz Wastewater Treatment Facility



Abbreviations:
CL_2 – Chlorine
RSS – Return secondary sludge
WSS – Waste secondary sludge
TFE – Trickling filter

4.1.1 Wastewater Flow Variations

Santa Cruz WWTF has an average dry weather design capacity of 17 mgd and a peak wet weather capacity of 81 mgd. In 2015, the average daily flow was approximately 7.1 mgd, with the average daily flow dropping to 6.1 mgd in June (dry weather flow). The average daily flow for each month of 2015 is shown in Table 4-1. These flows incorporate the latest drought and conservation measures implemented over the past few years, including a number of measures implemented in 2015.

Table 4-1: Santa Cruz WWTF 2015 Average Daily Flows for each Month

Month	Influent (mgd)	Effluent (mgd)
Jan	7.53	7.76[1]
Feb	8.11	7.90
Mar	7.29	7.28
Apr	7.56	7.61
May	7.07	6.92
Jun	6.68	6.11
Jul	6.63	6.53
Aug	6.59	6.65
Sep	6.47	6.58
Oct	6.70	6.54
Nov	7.11	6.93
Dec	8.25	8.39
Average	**7.16**	**7.10**
Min Daily Flow	**6.10**	**5.44**
Max Daily Flow	**20.56**	**20.93**

[1] Due to the inherent range of accuracy in typical flow measurement meters, coupled with the multiple meters at the point of measurement, the average daily effluent flow can sometimes be higher than the influent flow on a given month.

Dry weather flows and wet weather flow typically occur in June and December respectively. The average daily flows for June and December for the period 2008 to 2016 (excluding 2012 because the effluent meter failed in 2012), and how these flows compare to 2015 flows is shown in Table 4-2.

Table 4-2: Santa Cruz WWTF 2008 to 2016 Average Daily Dry Weather and Wet Weather Flows

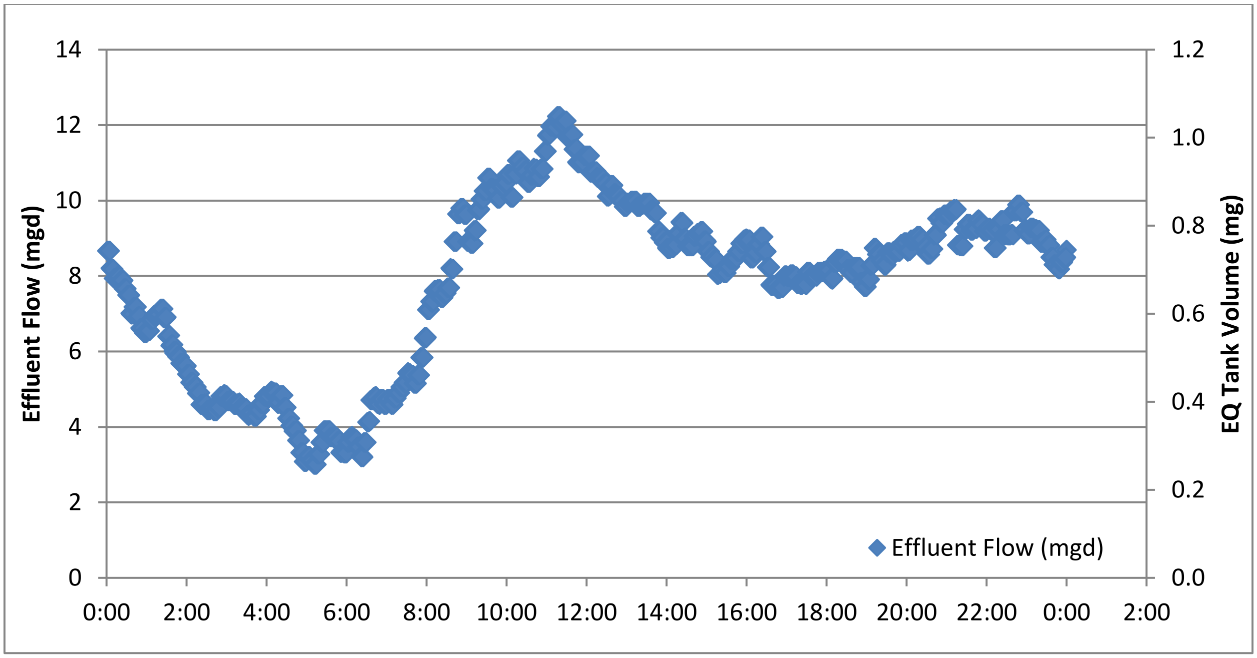
	Effluent (mgd)	2015	2008 - 2016 Average[3]
Dry Weather Flow (June)	Average[1]	6.1	7.1
	Minimum[2]	5.4	5.1
Wet Weather Flow (Dec)	Average[1]	8.4	9.0
	Maximum[2]	20.9	28.8

[1] Based on the average of daily effluent flows during the listed month.
[2] Based on the minimum daily effluent flow measured during the listed month.
[3] 2008 to 2016 average does not include 2012 data because of effluent meter failure.

Based on the SCWD's 2015 Econometric Analysis of Demand and Forecast (M.Cubed 2015b), the average annual wastewater flow is projected to increase by only 0.18 mgd (about 1%) from 2014 to 2035. To minimize stranded recycled water treatment capacity at all times, even during droughts, the 2015 average daily dry weather flow is used as the wastewater available for recycled water supply. The diurnal effluent flow for a typical dry weather flow day is shown in

Figure **4-2**. June 2016 data is used. It shows the highest flow at around 11am and lowest flow at around 5am. An equalization tank could be needed to ensure constant flow to the recycled water treatment facility. The costs of equalization storage at the Santa Cruz WWTF have not been included in this report.

Figure 4-2: Typical Dry Weather Flow at Santa Cruz WWTF



4.1.2 Wastewater Water Quality

The Santa Cruz WWTF effluent consistently meets the requirements set forth in their NPDES permit and the Basin Plan for discharges to the Pacific Ocean. A summary of average effluent water quality concentrations from 2012 to 2015 is presented in Table 4-3.

As part of its Wastewater Source Control Program, the City of Santa Cruz PWD provides inspection, sampling and monitoring of business and industrial establishments to limit discharge of harmful constituents into the sanitary sewer system and storm drain system, issues wastewater discharge permits to industrial discharges and also issues citations and levies fines for code violations. This program is a requirement of the State of California and U.S. Environmental Protection Agency.

Based on the 2015 Santa Cruz Annual Pretreatment Report, one industrial user has episodic discharges of wastewater with TOC and caffeine at levels higher than established local limits. The discharger was fined substantially and made to install better engineering controls in September 2015. However, since episodic detections of these pollutants continue, the City of Santa Cruz Public Works Department continues to engage the management of this discharger.

Table 4-3: Santa Cruz WWTF Annualized Summary of Commonly Analyzed Chemicals

Analyte	Units	Average Effluent 2015	2014	2013	2012	4-year Average
Bromide by IC	mg/L	0.93	0.77	0.5	1.3	**0.87**
Chloride by IC	mg/L	359	323	285	196	**290.80**
Fluoride by IC	mg/L	0.24	0.23	0.2	5.5	**1.57**
Nitrate by IC	mg/L	12.7	8.9	6.1	7.2	**8.71**
Nitrite by IC	mg/L	1.80	0.53	NS	NS	**1.17**
Ortho-phosphate by IC	mg/L	6.90	6.57	6.3	6.5	**6.56**
Sulfate by IC	mg/L	117	109	100	85	**102.86**
Conductivity	uS/cm	1832	2033	1.9	1.4	**967.18**
Aluminum	ug/L	<RL	<RL	<RL	<RL	**<RL**
Antimony	ug/L	0.67	<RL	<RL	0.51	**0.59**
Arsenic	ug/L	1.64	1.15	1.28	1.825	**1.47**
Barium	ug/L	16	16	16	16	**15.77**
Beryllium	ug/L	<RL	<RL	0.5	<RL	**0.50**
Boron	ug/L	345	355	280	265	**311.25**
Cadmium	ug/L	<RL	<RL	0.25	<RL	**0.25**
Chromium	ug/L	0.71	0.66	0.68	0.52	**0.64**
Cobalt	ug/L	0.74	0.68	1.16	<RL	**0.86**
Copper	ug/L	6.2	5.3	3.70	3.33	**4.61**
Cyanide	ug/L	6.5	2.0	4.5	3.2	**4.05**
Hexavalent Chromium	mg/L	<RL	NS	NS	NS	**NS**
Iron	ug/L	330	205	90	118	**185.75**
Lead	ug/L	<RL	<RL	0.5	<RL	**0.50**
Mercury	ug/L	<RL	<RL	0.079	<RL	**0.08**
Molybdenum	ug/L	6.28	4.75	5.82	4.18	**5.26**
Nickel	ug/L	3.46	3.28	2.72	2.5	**2.99**
Potassium	ug/L	29,000	27,500	24,000	20,000	**25,125**
Selenium	ug/L	0.57	0.82	0.675	<RL	**0.69**
Silver	ug/L	0.37	<RL	<RL	<RL	**0.37**
Thallium	ug/L	<RL	0.5	0.5	<RL	**0.50**
Vanadium	ug/L	0.74	0.60	0.62	0.70	**0.66**
Zinc	ug/L	31	36	22	24	**28.27**
Ammonia by ISE	mg/L	28.0	28.9	33.1	29.5	**29.87**
Total Kjeldahl Nitrogen	mg/L	26	27	38	26	**29.13**
Total Organic Carbon (TOC)	mg/L	14.4	14.3	12.753	11.761	**13.32**
Total Phenolics	mg/L	3.96	0.71	8.50	3.33	**4.12**
Total Phosphorus	mg/L	4.65	2.4	2.9	2.1	**3.01**
Total Sulfide	mg/L	<RL	<RL	<RL	<RL	**<RL**
Total Suspended Solids (TSS)	**mg/L**	**8.98**	**7.67**	**5.30**	**5.28**	**6.81**
Turbidity	NTU	3.50	5.08	4.18	3.02	**3.94**

Source: Commonly analyzed parameters from 2012-2015 provided to the RWQCB by the SCPWD to fulfill NPDES general reporting requirements.

4.1.3 Overview of Laws and Codes Related to Recycled Water Ownership

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, summarized below, that cover property and water rights as well as changes to instream flows if discharge of treated wastewater occurs.

- Clean Water and Water Bond Law of 1978 established that treated wastewater is the property of the treatment facility that produced it and that this property could be sold or transferred for beneficial use regardless of detriment to downstream users.
- California Department of Fish and Game Code, Section 1600 covers changes to surface waters and could be relevant to protect fish or wildlife resources in the event that a project changes the flow regime in a water body such as the San Lorenzo River or its tributaries.
- Water Code (WC), Sections 1210, 1211, 1702, and 2010 address different aspects of wastewater ownership as follows
  - ✓ WC Section 1210 describes the ownership of treated wastewater from within and outside of the watershed of discharge and that discharged water that supports instream or riparian habitat may accrue environmental water rights that supersede those of the treatment plant owner.
  - ✓ WC Section 1211 addresses changes in point of discharge, place of use or purpose of use of treated wastewater to surface water bodies similar to changes required of appropriative water rights.
  - ✓ Since the Legislature did not intend either WC Section 1210 or 1211 to affect the rights of downstream water users to the treated wastewater under common law (i.e. statutory "no-injury" rule), WC section 1702 codifies the common law no injury rule and therefore should be interpreted consistently with case law that interprets and applies the common law rule.
  - ✓ WC Section 2010 assigns ownership of the treated wastewater to the owner of the wastewater treatment plant and assigns no ownership to a discharger of the raw wastewater unless in a separate agreement.

In all cases, 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.

4.1.4 Rights to Santa Cruz WWTF and City of Scotts Valley Treated Wastewater

The Santa Cruz WWTF treats wastewater from the City of Santa Cruz as well as up to 8 mgd (24.5 AFD) from the SCCSD as described in a 1990 agreement between both parties. The agreement includes a treatment fee to the City by SCCSD according to flow, biochemical oxygen demand and total suspended solids, and states that the cost of Santa Cruz WWTF upgrades will be shared proportional to flow. The agreement is silent on the ownership of the effluent. Before pursuing a project using raw wastewater from the collection system or effluent from Santa Cruz WWTF, agreements will have to be made between the interested parties to determine ownership and rights.

The City of Scotts Valley holds the water rights to the secondary effluent from their WWTF. A portion of this effluent is filtered and disinfected and assigned to SVWD, by agreement, for distribution to irrigation customers. Another portion of the secondary effluent will be provided to the Pasatiempo Golf Course, in the SCWD service area, where it will be treated at Pasatiempo Golf Course to a tertiary level and used for irrigation. Treated wastewater that is not being used as recycled water for irrigation is currently being discharged directly to the Pacific Ocean through the Santa Cruz WWTF outfall.

4.2 Existing Recycled Water System

The SCWD currently does not supply recycled water within its service area. However, since 1998, a small amount of recycled water is used within the Santa Cruz WWTF for on-site activities. The in-plant recycled water demand is approximately 126,000 gallons per day (gpd) (0.38 AFD) and increases to approximately 193,000 gpd (0.59 AFD) during peak demands (Trussell 2015). Uses include providing water for on-site pump seals, chemical dilution and maintenance activities such as tank washdown. In-plant use of recycled water has reduced potable water demand at Santa Cruz WWTF by about 90 percent.

The SCPWD is planning to expand the internal reuse water system at the Santa Cruz WWTF to produce Title 22 tertiary treated water and to build a small distribution system for off-site use. The maximum amount of recycled water production from this system would be about 0.25 mgd; about half of which would be used within the plant and the other half potentially available for off-site demand for bulk water use (truck fill) or landscape irrigation at La Barranca Park adjacent to the Santa Cruz WWTF. A Title 22 recycled water permit would be required to serve these out of plant uses.

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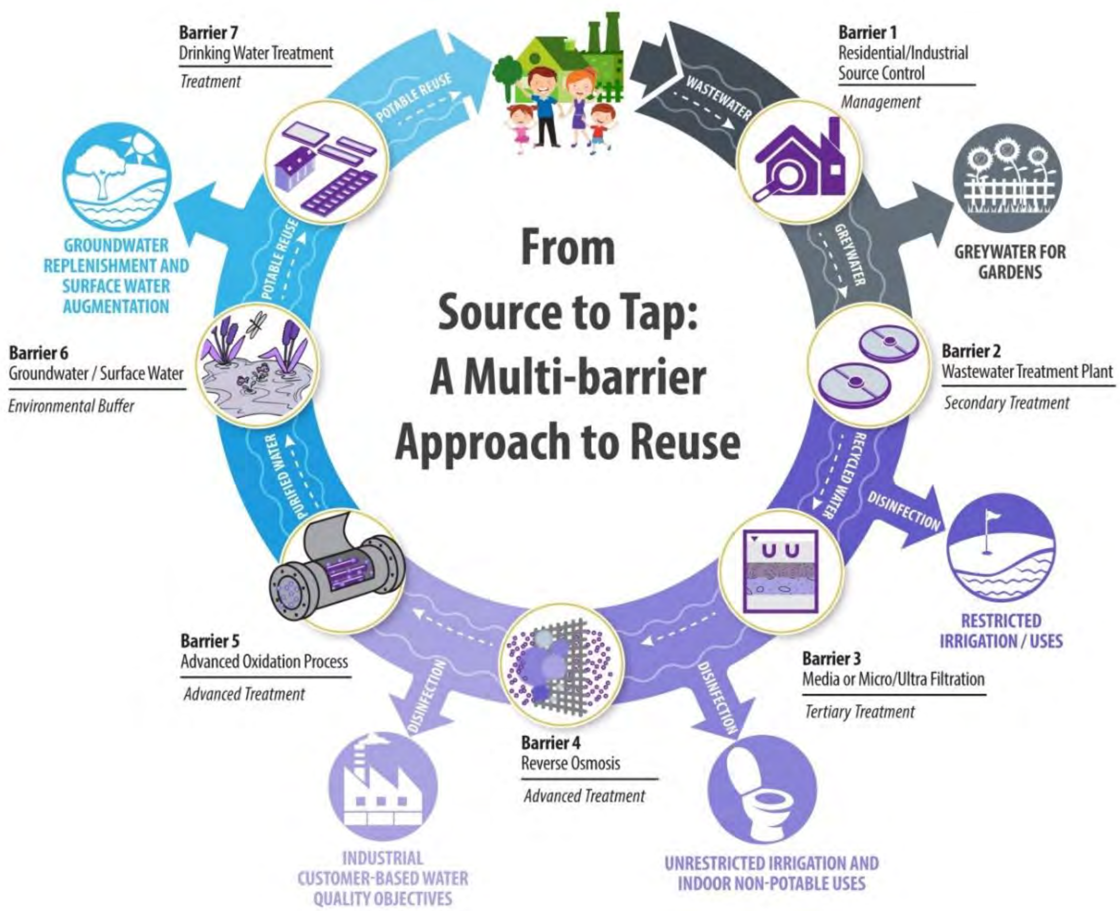
Section 5: Treatment Requirements

This section discusses regulations and treatment requirements for recycled water use to protect public health, including the most recent regulatory landscape for potable reuse. Supporting information is provided in Appendix A: Regulatory Requirements for Reuse, which includes TM #1a Evaluation of Treatment Requirements for Recycled Water in California and a matrix of Recycled Water Uses Allowed in California.

5.1 Multi-Barrier Approach to Reuse

Recycled water begins as wastewater and undergoes a series of treatment steps, using a multi-barrier approach, to remove organic matter and pollutants. The production and use of recycled water must adhere to strict regulations stipulating the levels of treatment, allowable types of reuse and water quality requirements. Figure 5-1 illustrates the multi-barrier approach to reuse, highlighting the increasing level of treatment necessary to produce the right quality of water for the right use.

Figure 5-1: Multi-Barrier Approach to Reuse



This RWFPS focuses on non-potable and potable reuse, as defined below:

- **Non-potable reuse** refers to the use of tertiary treated municipal wastewater for a specific purpose 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 is ongoing throughout the state 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 advanced treated or advanced treated 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 advanced treated 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 advanced treated water must be added to a specified volume of surface water during reservoir augmentation. Travel time between the point of addition and eventual extraction for treatment at a drinking water treatment plant is clearly specified. 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. Draft SWA regulations were released for public comment on July 21, 2017 and are anticipated to be adopted by the end of 2017.

      For the purpose of this study, streamflow augmentation would provide additional water supply and reliability by increasing streamflow downstream to compensate for increased diversions upstream to meet potable demands. Since there is no existing regulatory requirement or established criteria for streamflow augmentation, it was assumed that if the water treatment is suitable for reservoir augmentation, it would also be suitable for streamflow augmentation. For the purpose of this study, streamflow augmentation is categorized as an indirect potable reuse project.

    - **Direct potable reuse (DPR)** is the purposeful introduction of advanced treated 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. Currently, DPR is not yet included as an allowable use in California; however, the DDW released the DPR feasibility analysis at the end of 2016, which concluded that it is feasible to develop and adopt regulations for using recycled water as drinking water, provided that certain research and key knowledge gaps are addressed.

Meeting regulatory requirements is an integral part of implementing any non-potable or potable recycled water project. The following sections and TM #1a summarize the regulatory requirements and administrative responsibilities, with an emphasis on regulations relating distribution and use of recycled water in California. A discussion of the most recent regulatory landscape for potable reuse is also provided.

5.2 Overview of Regulatory Requirements

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.

Federal requirements relevant to the discharge of recycled water, or wastewater, and any other liquid wastes to "navigable waters" are contained in the federal Clean Water Act (CWA). The CWA 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.

In the **State of California**, recycled water requirements are administered by the State Water Resources 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 California Code of Regulations (CCR) -Title 22 and Title 17[5]

- **Title 22** stipulates the levels of treatment for different uses of recycled water, permissible types of reuse, and minimum recycled water quality requirements. In 2014 Title 22 was revised to include regulations for a Groundwater Replenishment Reuse Project (GRRP). Water meeting standards for non-potable reuse is considered safe for non-drinking purposes while compliance with GRRP requirements renders water safe for drinking purposes. Routine monitoring is required to ensure that the intended quality is consistently being produced.
- **Title 17** focuses on the protection of drinking (potable) water supplies through control of cross-connections[6] with potential contaminants, including non-potable water supplies such

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[5] 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).

[6] 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

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.

Local requirements vary by county and city and typically provide additional guidance to meet local health agency or public water supplier guidelines and permit/code requirements.

5.2.1 State Recycled Water Policy

In 2009, the SWRCB adopted a Recycled Water Policy (RW Policy) 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.

The RW Policy requires that salt and nutrient management plans (SNMP) be developed for every groundwater 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 and are intended to coordinate salinity management regionally. Some of the planned use areas in Santa Cruz overlie portions of the West Santa Cruz Terrace groundwater basin, which is west of the Santa Cruz Mid-County groundwater basin described in Section 2.3.2. While the West Santa Cruz Terrace groundwater basin is not actively used by the City, it is a medium priority basin per DWR's Groundwater Information Center Interactive Map (DWR 2017). An alternative approach to compliance with SNMP may be to conduct an anti-degradation analysis for the use of recycled water at agronomic rates to demonstrate that the recycled water will not result in negative water quality impacts. This approach should be vetted with the Regional Board staff as the project proceeds to implementation.

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. The RW Policy was revised in 2013[7] to include monitoring requirements for CECs based on the recommendations from the Panel. In fall of 2016, the SWRCB started the process of revising the RW Policy to reaffirm support for the development of salt and nutrient management plans, reconvene the Science Advisory Panel on CECs in recycled water[8], and direct staff to initiate a

[7] http://www.swrcb.ca.gov/water_issues/programs/water_recycling_policy/docs/rwp_revtoc.pdf
[8] https://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/recycledwater_cec.shtml

stakeholder process to update the recycled water policy. Once started, this process is expected to take between twelve and eighteen months.

5.2.2 Statewide General Order

On June 7, 2016, the SWRCB adopted Water Reclamation Requirements for Recycled Water Use[9] (General Order). Similar to the RW Policy, the intent of the General Order is to streamline the permitting of recycled water use statewide and encourage the use of recycled water as a valuable resource. The General Order is used to permit non-potable recycled water distribution and use. The production of recycled water at a wastewater treatment facility would require separate coverage under a RWQCB permit.

5.3 Non-Potable Reuse Requirements

The forms of non-potable reuse that are permitted in California vary based on (1) the degree of treatment required and (2) the intended use of the recycled water (CDPH 2014b). As a general rule, when more treatment is provided, the final use of the water is less restricted. The levels of treatment, from the lowest level (with the highest restrictions) to the highest level (with the lowest restrictions), per the regulatory classifications (CDPH 2014b) are:

- Undisinfected secondary recycled water
- Disinfected secondary – 23 recycled water
- Disinfected secondary – 2.2 recycled water
- Disinfected tertiary recycled water

Disinfected secondary -23 recycled water and disinfected secondary – 2.2 Recycled Water differ in the degree of disinfection required to achieve different total coliform bacteria concentrations after disinfection. Appendix A includes a summary table of allowable uses of recycled water in California and the associated treatment level.

5.3.1 Non-Potable Treatment Processes

Wastewater from a sanitary sewer undergoes primary and secondary treatment. **Primary treatment** removes large solids, scum and debris, and heavier sludge that settle out in primary holding tanks. **Secondary treatment** utilizes micro-organisms to break down and consume organic matter. Together these processes produce secondary effluent to meet land discharge or discharge (NPDES) requirements to a waterway, bay or the ocean.

Additional treatment is typically required to produce recycled water for non-potable reuse. **Tertiary treatment** provides filtration to remove suspended solids and other pollutants through the use of sand or media filtration or membrane filters. **Disinfection** serves to destroy bacteria or

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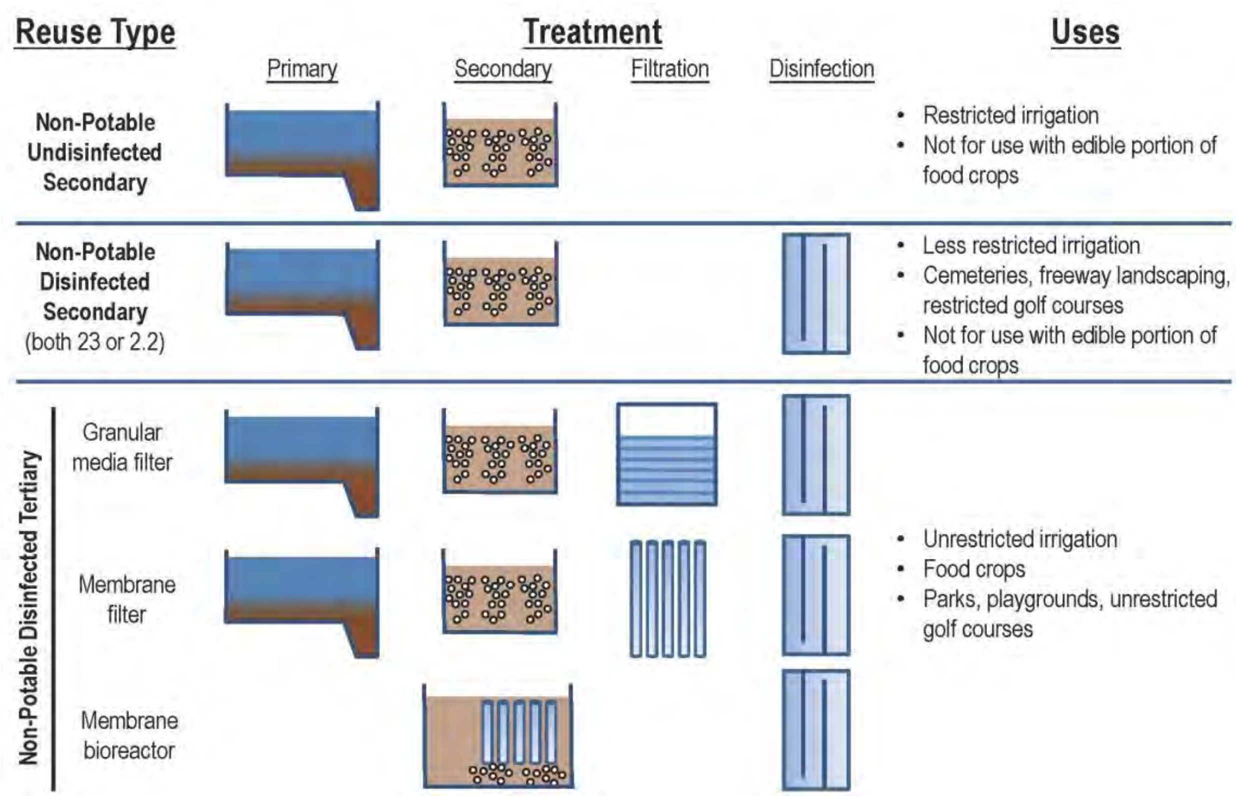
[9] http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2016/wqo2016_0068_ddw.pdf

viruses through the addition of chemicals (such as chlorine) or ultraviolet (UV) light. Disinfection may follow secondary or tertiary treatment, depending on the intended reuse type.

Figure 5-2 provides a summary of the non-potable reuse options, the associated treatment required, and the allowable uses for each type of non-potable reuse. Additional detail about treatment criteria for each type of use is provided in TM #1a. The treatment processes assumed for implementation of non-potable reuse in the City will be described as part of the alternatives analysis in Section 8.

Figure 5-2: Types of Non-Potable Reuse and Associated Treatment Processes



Source: TM #1a (included in Appendix A).

5.3.2 Customer Based Water Quality Objectives

Recycled water quality requirements for a specific use may also have to adhere to customer based water quality standards that go beyond the minimum regulatory requirements. 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 5-1 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]			Santa Cruz WWTF Effluent[b]
			None	Slight to Moderate	Severe	
Boron	Toxicity to Plants	mg/L	< 0.7	0.7 to 3.0	> 3.0	0.3
Chloride	Ion toxicity, Spray (Overhead) Irrigation	mg/L	< 100	>100		290
	Surface irrigation	mg/L	< 140	140 to 350	> 350	
pH	Misc. Effects	--	Normal Range 6.5 to 8.4			7.1
Residual chlorine	Leaf Burn from Spray (Overhead) Irrigation	mg/L	< 1	1 to 5	> 5	0.029
Salinity as TDS	Plant Response	mg/L	< 450	450 to 2,000	>2,000	1,300[c]

Notes: TDS = total dissolved solids; N/A = not available

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.

(b) Data downloaded from CIWQS on 18 November 2016

(c) TDS calculated from effluent Electrical Conductivity (Carollo 2016).

Commercial/Industrial

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 for eliminating color and odor; 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 prefer receiving a water source with a consistent water quality to achieve specific water quality requirements that align with 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 Reverse Osmosis (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 the elements of the specific cooling system and their current practices and needs.

5.4 Potable Reuse Treatment Requirements

Potable reuse was first explored in California by the Los Angeles County Sanitation District. The Montebello Forebay Project started surface spreading of recycled water for groundwater replenishment in 1962, at a time when there were no regulations governing GRR. The first draft GRR regulations were published over a decade later in 1976, and soon after the Water Factory 21 at Orange County Water District became the first subsurface injection GRR project. These two pioneering projects were instrumental in helping regulators understand the risks and control tools needed for reliable, safe potable reuse. These projects played a large role in guiding the final GRR regulations, which were published in June 2014. GRR is the only form of potable reuse currently in practice in California, with seven projects providing approximately 200 mgd (614 AFD) of potable reuse water.

Legislative action, namely California Senate Bill 918 (SB 918), mandated that the GRR regulations be finalized by December 2013 and also set out two additional potable reuse goals: (1) to develop uniform criteria for surface water augmentation (SWA) by December 2016, and (2) to assess the feasibility of developing future regulations for DPR by December 2016. DDW released the DPR feasibility analysis at the end of 2016, which concluded that it is feasible to develop and adopt regulations for using recycled water as drinking water, provided that certain research and key knowledge gaps are addressed. Draft SWA regulations were released in September 2017 and are anticipated to be finalized by the end of 2017. The content and requirements of these three forms of potable reuse—groundwater replenishment reuse, surface water augmentation, and direct potable reuse—are discussed in the following sections.

5.4.1 Potable Treatment Processes

For indirect and direct potable reuse, additional treatment processes are added beyond secondary treatment to remove dissolved solids and other contaminants. An advanced water treatment facility (AWTF) or advanced water purification facility (AWPF) provides additional steps to purify recycled water. The specific combination of treatment processes needed for a given project will depend on the quality of the treated wastewater and the intended use.

Typically, an AWTF would begin with **microfiltration/ultrafiltration** (MF/UF) as pretreatment prior to an **advanced filtration process**, such as a high-pressure, semi-permeable reverse osmosis RO membrane, that allows water to pass through while rejecting most other contaminants. The next step would employ an **advanced oxidation process (AOP)**, which typically combines UV treatment with the addition of hydrogen peroxide (UV/H_2O_2) or ozone/H_2O_2 to degrade most natural and synthetic organic compounds. Other treatment processes which could serve as an additional pathogen barrier may include **ozone**, and/or **Biologically Activated Carbon (BAC)**.

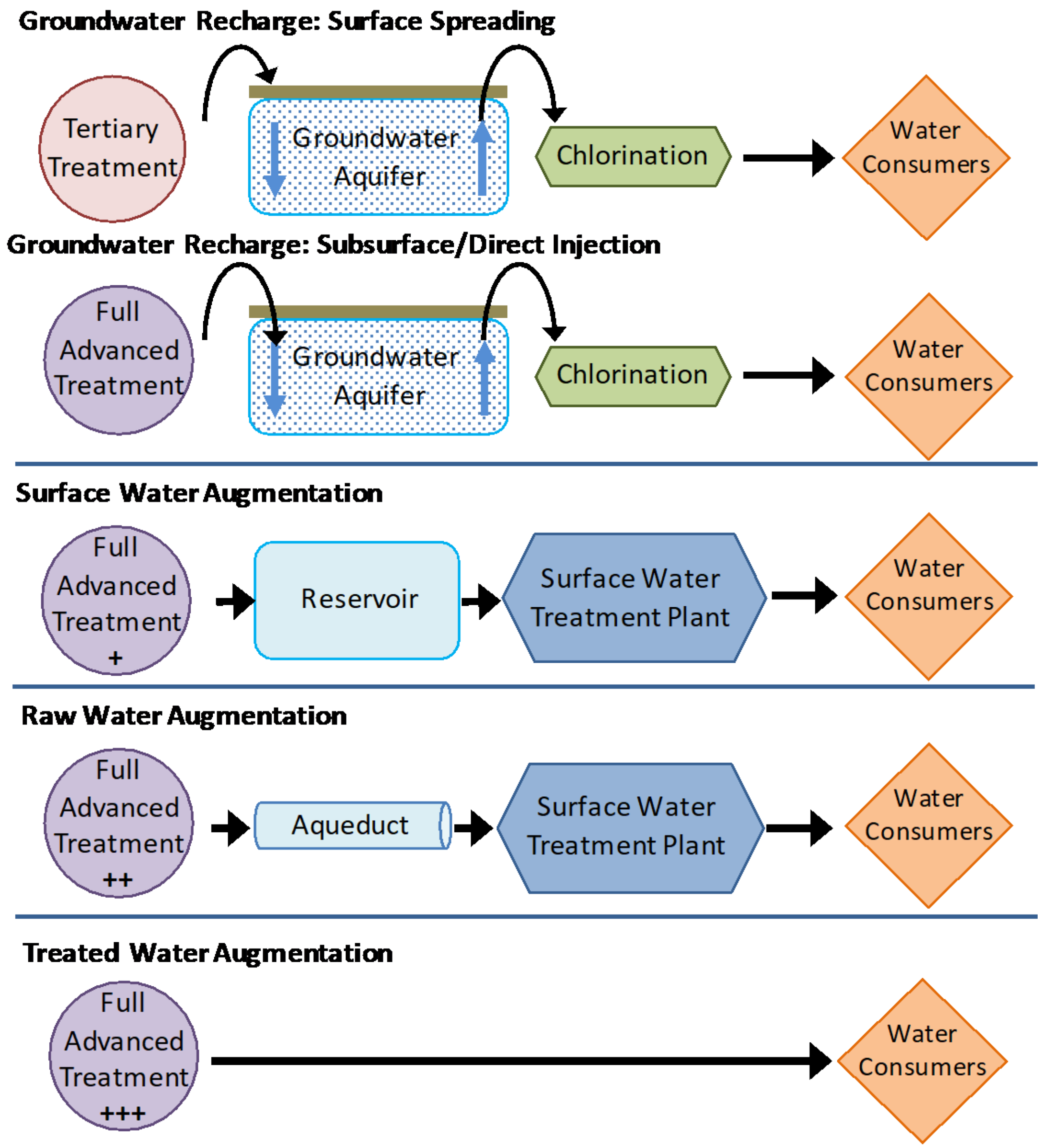
Section 5.6 provides a description of these treatment processes, the treatment benefits and removal credits associated with each.

For indirect potable reuse, an environmental buffer, such as a groundwater aquifer or a surface water reservoir, serves as an additional barrier. A drinking water treatment facility may offer another barrier before the advanced treated water is delivered for potable use.

The range of treatment train configuration options for potable reuse is shown on Figure 5-3. One way to differentiate the various forms is based on the degree of separation—both in time and space—between the treatment of water and its ultimate consumption by the public. Viewed through this lens, the different forms of potable reuse lie along a spectrum of varying degrees of “directness.”

The potable reuse options considered as part of this RWFPS are described in the following sections. TM#1b (provided in Appendix A) provides a detailed assessment of treatment requirements and potential treatment processes to meet existing and anticipated regulations for (1) GRR, (2) SWA, and (3) DPR. A summary is provided herein. The AWTF process assumed for implementation of each potable reuse alternative will be described as part of the alternatives analysis in Section 8.

Figure 5-3: Types of Potable Reuse



Source: TM #1a (included in Appendix A)

5.4.2 Groundwater Recharge Reuse Treatment Requirements

Groundwater replenishment requirements are described in terms of (1) surface spreading and (2) subsurface/direct injection (herein referred to as direct injection). Both of these GRR options are governed by the GRR Regulations, which were promulgated on June 18, 2014. The City has determined that space limitations and hydrogeologic conditions constrain any GRR project to direct injection. Hence, the focus of this section is on regulations related to direct injection projects. Table 5-2 summarizes the GRR Regulations for direct injection.

In direct injection, recycled water that has gone through a full advanced treatment (FAT) process, at an AWTF or AWPF, is directly injected into the saturated groundwater zone. The implementation of full advanced treatment (i.e. MF, RO and an AOP) allows for the use of up to 100% recycled water (i.e., no dilution requirement) and as little as a 2-month minimum retention time, if the 12/10/10 microbial log-removal for virus, Giardia, and Cryptosporidium (V/G/C) requirements are met. Section 5.6 provides additional detail about removal credits associated with each treatment process.

The GRR Regulations have specific requirements for the RO and AOP technologies in the AWTF. Each RO membrane element 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.

Table 5-2: Summary of GRR Regulations for Direct injection

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	**Direct injection with full advanced treatment** - Oxidation, RO, AOP - No Diluent water required
Other Selected Constituents	
• Treatment train shall consist of at least 3 separate treatment processes to achieve the pathogenic (microorganism) control • For each pathogen (i.e., *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 • Performance Requirements for RO (minimum salt rejection, permeate TOC within specific limits)	

Notes: MCL = maximum contaminant level, TOC = Total Organic Carbon
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 Regulations 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.

5.4.3 Surface Water Augmentation Treatment Requirements

A 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. Draft SWA regulations were released for public comment on July 21, 2017. After the public comment period ends in September 2017, further modifications may be made prior to adoption. It is anticipated that the SWA regulations will be adopted by the summer 2018. Based on the most recent publicly available 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 theoretical retention time (calculated as total volume at the end of the month divided by total outflow during that month) no less than 180 days; however, an alternative minimum theoretical retention time less than 180 days but no less than 60 days may be considered for approval.

A project that delivers recycled water to a surface water reservoir, with the reservoir providing some benefits, but lacking the full complement of benefits provided by IPR with SWA, would be considered direct potable reuse and is referred to as “Raw Water Augmentation”, as indicated in Figure 5-3.

The Draft SWA regulations look very similar to the GRR Regulations for treatment requirements, particularly with regards to pathogenic microorganism control. The Draft SWA regulations require that any 24-hour input of recycled water into the reservoir must be mixed such that water withdrawn for use as drinking water never contains more than 1% (or 10% with an additional 1-log treatment) recycled water. Details on the estimated retention time in Loch Lomond are described as part of the alternatives analysis in Section 8:.

Where treatment credits are concerned, the principal difference between GRR via spreading, GRR via direct injection and reservoir augmentation is that the latter two required advanced water treatment at an AWTF prior to use, whereas GRR via spreading provides pathogen removal credit for soil aquifer treatment that occurs in the ground. For this study, groundwater recharge and reservoir augmentation alternatives both require treatment at the AWTF since Santa Cruz’s groundwater recharge is via direct/subsurface injection.

The proposed treatment system concept for SWA in the City would be to achieve the likely required 8/7/8 log removal requirement for V/G/C through an AWTF for 100:1 dilution and 9/8/9 log removal requirement for V/G/C through an AWTF for 10:1 dilution. The downstream drinking water treatment would provide an additional buffer, but credits for log virus removal are no longer assigned in the regulatory framework. TM #3 – Surface Water Augmentation at Loch Lomond (Appendix D) summarizes the suitability of Loch Lomond Reservoir for complying with the anticipated SWA requirements.

5.4.4 Direct Potable Reuse Treatment Requirements

A 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, which they did. 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 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 which uses full advanced treatment with the addition of ozone and BAC as pretreatment (for further information see TM#1 included as Appendix A) will be used for the DPR alternative for this RWFPS.

5.4.5 Brine Disposal Requirements

The advanced treatment of wastewater for potable reuse using an RO membrane would produce a brine or concentrate for disposal. It is assumed that brine from the RO train would be blended with secondary wastewater and discharged via the City’s existing ocean outfall pipeline to the Pacific Ocean, which is covered in the Regional Board Order No. R3-2010-0043, NPDES permit No CA0048194. Several issues need to be considered for discharges to the Pacific Ocean. These include TDS concentration in the brine relative to the receiving waters; toxicity issues related to the concentration of some constituents (like arsenic); and initial dilution requirements of the existing permit.

The anticipated TDS concentration of brine from the AWTF could be on the order of 6,000 and 7,000 mg/L TDS, which is approximately 25 percent of the TDS of the ocean. SWRCB Resolution No. 88-63 resolves that all surface and ground waters are suitable for or potentially suitable for municipal or domestic water supply but allows for exceptions to suitability for waters with TDS levels greater than 3,000 mg/L. Therefore, because of the high levels of TDS in the Pacific Ocean, the receiving waters for discharges from the Santa Cruz WWTF meet this exception to Resolution No. 88-63. Thus, it is anticipated that TDS may not be a limiting factor in brine discharge.

Toxicity requirements may influence the ability and approach to discharge brine, particularly relating to initial dilution concentrations when brine is more than 25 percent of the ocean discharge. This could be challenging during summer months, if the majority of available effluent is treated at the AWTF and brine dominates the outfall discharge flow. Some of these concerns may be addressed through the design of an engineered diffuser that utilizes discharge mixing nozzles to rapidly disperse brine into the surrounding water to achieve the background salinity and meet toxicity requirements within the initial zone of dilution. This approach has been used successfully for salinity management pipeline outfalls throughout California.

5.5 Streamflow Augmentation Treatment Requirement

There are currently no regulatory requirements and/or criteria for the beneficial use of recycled water for streamflow augmentation in California. Any discharge to navigable surface waters would require an NPDES permit from the RWQCB. The potential market opportunity for streamflow augmentation in Santa Cruz is discussed in Section 6.

5.6 Summary of Treatment Processes and Credits

The SWRCB allocates treatment credits—calculated as log reduction values or LRVs—on a case-by-case basis for each project. Factors discussed in this section that may influence the LRV that is credited for a given unit process include the type of monitoring provided and the performance of the unit process. This section describes the treatment processes used in water reuse applications, and the credits that have been awarded for past projects. This information is later used to identify which unit processes can be combined to meet the treatment requirements of different reuse alternatives developed for this RWFPS.

Table 5-3 summarizes the treatment processes considered for this study and Table 5-4 provides a probable range of LRVs for each unit process. Table 5-4 can be used as a guide for planning purposes; however, it should be recognized that the SWRCB allocates treatment credits on a case-by-case basis for each project based on monitoring provided and the performance of the unit process. TM #1a and TM #1b provide additional background and detail on the treatment processes and basis for the range of LRV credits. The AWTF process assumed for implementation of each potable reuse alternative will be described as part of the alternatives analysis in Section 8:.

Table 5-3: Summary of Treatment Technologies

Treatment Process	Description
Tertiary Filtration	A common wastewater treatment process that provides filtration to remove suspended solids and other pollutants through the use of sand or media filtration.
Microfiltration/ Ultrafiltration (MF/UF)	A membrane-based, pressure-driven separation process that provides a barrier to the passage of solids and microorganisms. MF/UF does not remove salts (i.e., TDS) or other dissolved constituents like ammonia. For potable reuse applications, the primary goal of MF/UF is to provide pre-treatment for the RO membranes, and to remove suspended particulate matter.
Membrane Bioreactors (MBR)	A MBR combines a bioreactor and microfiltration into one-unit process. The microfiltration membrane (cassette) is submerged in the bioreactor and a vacuum draws the water through the membrane. MBRs are currently used in non-potable applications in California, but have thus far not been utilized for potable reuse.
Reverse Osmosis (RO)	A membrane-based, pressure-driven separation process that provides a barrier to the passage of dissolved salts, particles, colloids, organics, bacteria and pathogens. RO produces a very low-TDS product stream and a concentrate stream using a high-pressure membrane separation process. Initially, RO was considered to be completely effective at removing all pathogens and chemicals; however, with improving analytical methods, trace organic compounds have been detected in RO permeate. This gave rise to the required advanced oxidation process following RO (discussed below).
Ultraviolet (UV) Disinfection	Transfers electromagnetic energy from a mercury arc lamp to water, emitting a broad spectrum of radiation with intense peaks at certain wavelengths. UV light penetrates an organism's cell walls and disrupts the cell's genetic material, making reproduction impossible. With the proper dosage, UV irradiation has proven to be an effective disinfectant for bacteria, protozoa, and viruses in water, while not contributing to the formation of disinfection byproducts (DBPs).
UV-based Advanced Oxidation Process (AOP)	Transfers electromagnetic energy from a mercury arc lamp to an auxiliary oxidant that has been added to the wastewater, such as hydrogen peroxide, ozone or chlorine. Photo-excited oxidants quickly degrade to form highly reactive free radicals, which are strong oxidants capable of degrading most natural and synthetic organic compounds present in wastewater. The design of a UV-AOP typically requires UV doses in great excess of those needed for disinfection alone.
Ozone	To generate ozone (O_3), energy is added to oxygen (O_2), splitting the molecules into individual atoms which then collide with oxygen forming ozone. Ozone is then bubbled into water where it forms hydrogen peroxyl (HO_2) and hydroxyl (OH), which oxidize certain contaminants. No permitted projects have utilized ozone as a pathogen barrier for potable reuse; however drinking water systems have received pathogen inactivation credits based on the ozone dose applied.
Biological activated carbon (BAC)	A biologically enhanced carbon process that combines ozonation and granular activated carbon (GAC) to remove dissolved organics through adsorption by the activated carbon and biodegradation of bacteria attached on the activated carbon. BAC has not been used in a full-scale potable reuse project in California to date, but is currently being pursued for the City of San Diego's SWA project.
Chlorine-based Disinfection	The most common disinfection technology in wastewater treatment and reuse. Chlorine inactivates a diverse group of pathogens, including viruses, and residual chlorine prevents pathogen re-growth during storage and distribution. Free chlorine disinfection can be implemented to achieve virus and *Giardia* credits at multiple places in a potable reuse treatment train. Currently, California water recycling regulations do not differentiate between free and combined chlorine disinfection.

Table 5-4: Summary of Potential LRV Credits for Unit Treatment Processes

	Virus	*Giardia*	*Cryptosporidium*
Wastewater Treatment			
Through Tertiary Filtration[a]	0–2	0–2	0–1.2
MBR[b]	Unknown	Unknown	Unknown
Membrane Filtration[c]	0–4	4	4
Reverse Osmosis[d]	1.5 - 3.5	1.5 - 3.5	1.5 - 3.5
UV and AOP	6	6	6
Ozone[e]	1-6	1-6	1-3
BAC[f]	Unknown	Unknown	Unknown
Chlorine	1-6	1-3	0
Surface Water Treatment Plant	4	3	2

Source: TM #1a Evaluation of Treatment Requirements

a See TM #1a Section 4.1 and Olivieri et al. (2016)

b MBRs have not been credited for pathogen removal performance in potable reuse in California (TM #1a Section 4.3)

c Protozoa removal based on EPA (2005). See TM #1a Section 4.2 for discussion of virus removal credits.

d Most potable reuse facilities receive between 1 and 2 LRV credit, though options for higher credits are being pursued (TM #1a Section 4.4).

e None of the permitted potable reuse projects utilize ozone disinfection, though projects under development will pursue ozone credit.

f While removal credits for BAC may be attainable, none of the existing or planned projects in California are seeking LRV credit for this process.

5.7 Summary of Non-Potable and Potable Reuse

There are a wide range of non-potable and potable reuse scenarios, with growing acceptance from the industry, regulators and the public to allow for an increasingly more diverse range of opportunities to beneficially reuse wastewater. There are many factors that should be considered in evaluating non-potable and potable reuse opportunities, which include recognizing the benefits and risks of pursuing different forms of reuse. Table 5-5 provides a summary of the types of water reuse discussed in this section, and pros and cons associated with each type.

Table 5-5: Summary of Pros and Cons for Each Reuse Type

Non-Potable	*Pros*	*Cons*
Undisinfected Secondary	• Requires no modifications to the Santa Cruz Wastewater Treatment Facility	• Restricted end uses • Does not provide a new source of potable water for the City • Public perception is uncertain
Disinfected – 23 Secondary	• Requires only the implementation of disinfection at the SCWTF	
Disinfected – 2.2 Secondary	• Requires only the implementation of disinfection at the SCWTF	• Somewhat restricted end uses • Does not provide a new source of potable water for the City • Public perception is uncertain
Disinfected Tertiary	• Unrestricted end uses for non-potable applications	• Does not provide a new source of potable water for the City • Public perception is uncertain
IPR	**Pros**	**Cons**
GRR through Surface Spreading	• Requires the least amount of above-ground treatment for potable reuse • Been in practice in CA for over 50-yrs • General public perception is o.k. • Finalized regulations exist • Infiltration removes some CECs	• Requires large land area for surface spreading • Requires access to drinking water aquifer large enough to meet project demands • Does not remove all CECs
GRR through Subsurface Injection	• Requires less land area than spreading • Been in practice in CA for over 40-yrs • General public perception is o.k. • Finalized regulations exist • Removes majority of known CECs to below the very low detection limit ranges	• Requires additional treatment beyond what is required for surface spreading: RO and UV/AOP • Requires access to drinking water aquifer large enough to meet demand needs
Surface Water Augmentation	• Offers an alternative to communities without access to an aquifer • Draft regulations released • Multiple projects currently being pursued in CA • Removes majority of known CECs to below very low detection limit	• No existing local project in operation • Requires access to drinking water reservoir that meets dilution requirements • Regulations are not finalized • Public perception is less certain
DPR	***Pros***	***Cons***
Source Water Augmentation using a reservoir	• Most similar to SWA and therefore easier to implement than more direct types • Offers an alternative to communities without access to an aquifer or reservoir that meets dilution/retention time requirements • Removes majority of known CECs to below very low detection limit	• No existing local project in operation • Regulations are not expected in the near future • Public perception is less certain
AWT water as an approved drinking water supply	• Offers an alternative to communities without access to any form of engineered or environmental buffer • Potentially lower costs due to reduced infrastructure needs • Greatest potential for wide geographic distribution • Removes majority of known CECs to below very low detection limit	• Shortest response times will necessitate strict requirements for treatment, monitoring, failure response, etc. • No existing local project in operation • Regulations are not expected in the near future • Likely years away from project implementation • Public perception is less certain

Source: TM #1a (Appendix A)

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Section 6: Recycled Water Market

This section summarizes the market and types of uses that are currently approved for recycled water applications and those that are anticipated to be approved in the future. Supporting information is provided in:

- Appendix B: Non-Potable Demand Data
- Appendix C: Groundwater Replenishment Reuse Supporting Information
- Appendix D: Surface Water Augmentation Supporting Information
- Appendix E: Streamflow Augmentation Supporting Information
- Appendix F: Engineers Opinion of Probable Costs

6.1 Market Assessment Approach

The market assessment approach is performed in two parts.

1) **Non-Potable Market Approach:** Non-potable demands are based on annual meter data provided by the City for dedicated irrigation, commercial and industrial uses. Peak demands are based on monthly meter data and estimated peaking factors. Irrigation demands peak in the summers months while commercial and industrial demands are relatively constant throughout the year. Thus, the ability to meet non-potable demands is assessed based on the available supply in the summer months when irrigation demands are at their peak.

2) **Potable Market Approach:** Potable demand estimates are not based on meter data, but rather the capacity of a suitable environmental buffer and/or future potable water demands.

   - Indirect potable demand for groundwater recharge is based on the available capacity of identified aquifers to receive recycled water while meeting regulatory requirements for retention (response) time.
   - Indirect potable demand for surface water augmentation is based on the available capacity of a local reservoir to receive recycled water while meeting regulatory requirements for retention time.
   - Direct potable demand for recycled water is based on future potable demands in Santa Cruz's service area.

   Indoor potable demands are assumed to be relatively constant throughout the year and the available supply of advanced treated water in the summer months, when wastewater production is the lowest, would limit the size of a DPR project for the City.

Although there are currently no regulatory requirements and/or criteria for the beneficial use of recycled water for streamflow augmentation in California, for the purpose of this study, streamflow augmentation is categorized with the other types of potable reuse because it would provide additional water system supply and reliability by increasing streamflow downstream to compensate for increased diversions upstream to meet potable demands. Both surface water augmentation and streamflow augmentation would be limited during the winter months when rainfall and naturally occurring runoff utilize the available capacity in the reservoir and the stream.

6.2 Non-Potable Reuse Market Assessment

This section describes the approach used to identify potential non-potable recycled water customers in the city's service area and to estimate their demands.

6.2.1 Non-Potable Meter Data

Potential recycled water demands for the City, except for UCSC, were estimated using existing meter data provided by the City. The meter data excludes domestic residential data since domestic residential use is primarily for potable purposes and conversion of domestic irrigation to recycled water is typically not cost-effective. Home Owner Association (HOA) accounts, where irrigation of common areas is typically managed by an on-site supervisor, fall under domestic irrigation accounts and are likewise excluded to be conservative.

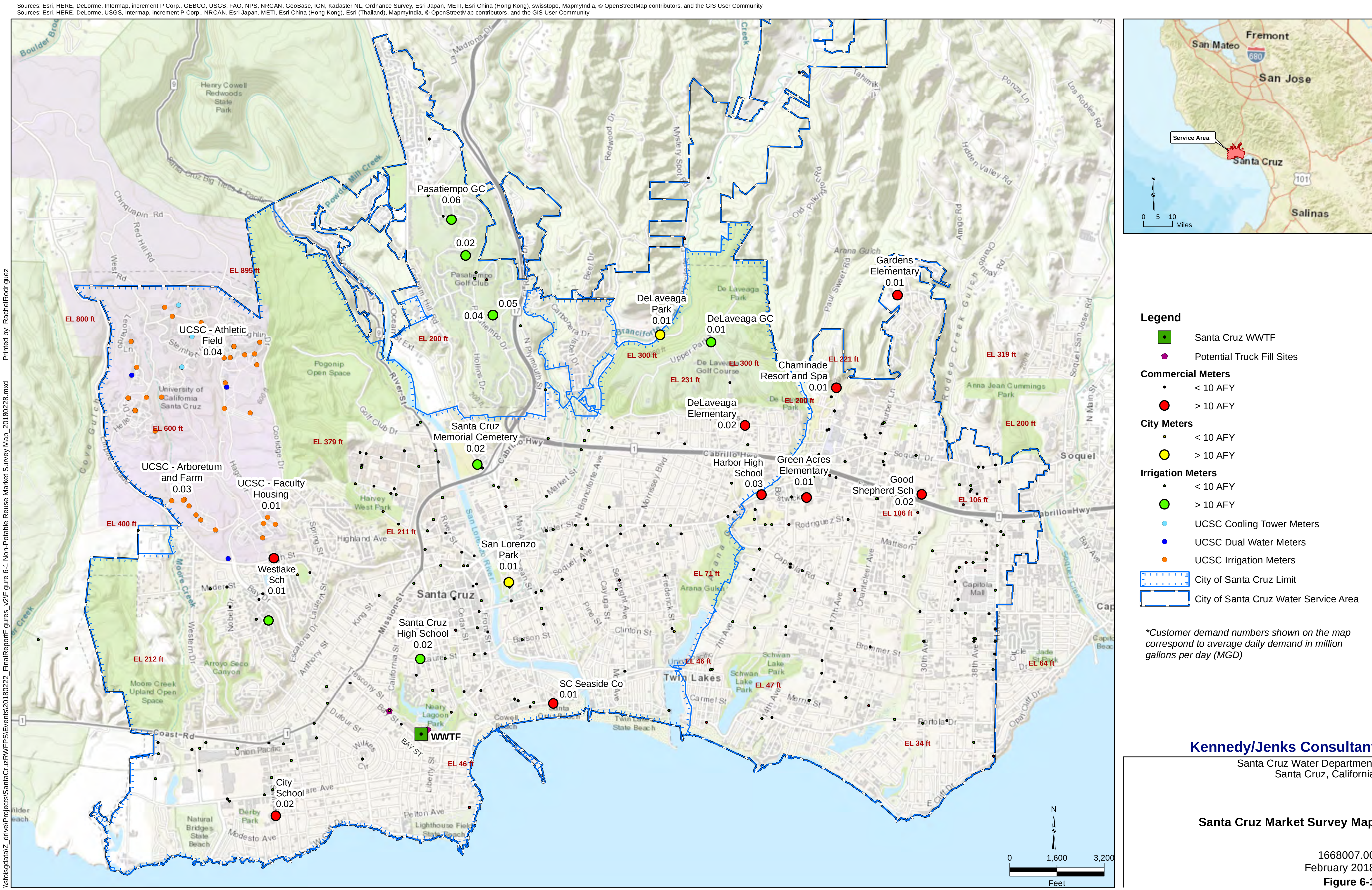
Based on discussions with the City, 2013-meter data was selected because 2013 represents the highest demand before drought conservation measures were implemented in 2014 and 2015. This represents a conservative approach for evaluating whether there is sufficient effluent to meet potential recycled water demand. Projected future demands in the City are not expected to increase significantly due to conservation, water efficiency programs, available space for new developments and other factors. The 2013 demand is comparable to the projected 2035 demand for the City identified in the 2015 UWMP (SCWD 2016) and thus provides a reasonable estimation of future non-potable demands as well. A more detailed discussion is included in Appendix B.

The City's non-domestic meters are classified into 4 major account categories: (1) Irrigation, (2) Commercial, (3) City Owned and (4) UCSC which are collectively called non-domestic meters. A description of sub-categories and account types for each account category is provided in a summary table in Appendix B.

6.2.2 Non-Potable Market Survey

A market survey map for the study area is shown on Figure 6-1. Meters are colored based on account categories and relative demand is illustrated by dot size; where demands less than 10 AFY (0.009 mgd) are shown as small dots and demands greater than 10 AFY are shown by larger dots. The market survey map only shows the location of existing meters with the potential to be served by non-potable recycled water.

The geographic distribution of the City's meters with the potential to use non-potable recycled water, shown on 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 and associated infrastructure is evaluated in Section 8 – Project Alternatives Analysis.



Note: Service laterals to individual meters are not shown

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6.2.3 Non-Potable Demand Evaluation

The following sections describe how meter data for each non-domestic account category was evaluated for the non-potable market assessment to identify large potential users and quantify potential demands for recycled water.

(1) Irrigation Accounts

Irrigation accounts represent customers who have dedicated irrigation meters. Most dedicated landscape irrigation systems could be converted to receive recycled water by following the guidelines in CCR Title 17. Schools, parks, cemeteries, golf courses, Caltrans medians and homeowner associations represent some of these irrigation accounts. Schools, cemeteries and golf courses represent the largest of these users. Residential users with separate dedicated irrigation accounts typically have smaller demands and are more complex and costly to convert to recycled water, thus these meters are not typically pursued for recycled water programs.

Based on discussions with the Study Partners, the following irrigation accounts would not be served.

- **Pasatiempo Golf Course** – Pasatiempo Golf Course is within the City's service area and has an annual irrigation demand of about 0.2 mgd. Pasatiempo Golf Course has signed an agreement with City of Scotts Valley to receive their secondary effluent directly from the Scotts Valley outfall, which it will treat with filters on-site to produce tertiary water to irrigate the golf course. Hence, Pasatiempo is not considered to be a potential recycled water customer for the City, although the use of recycled water will provide a regional benefit of a potable water offset.
- **North Coast –** There are a number of irrigation accounts on the north coast that are supplied raw or potable/treated water from the City, or that pump local groundwater for use. The largest North Coast user currently uses an average of 0.03 mgd raw water from the City's North Coast sources. The City has previously looked at delivering recycled water to North Coast users, assuming a potential demand of 1.1 mgd (1,200 AFY), in exchange for raw water (groundwater) conveyed back to the City. This type of alternative would require 5 miles of new pipeline to deliver recycled water to the north coast and up to 6 miles of new conveyance and distribution upgrades to deliver groundwater back to the City. There are several challenges associated with this concept, including (1) significant uncertainty about the quantity, water quality and seasonable reliability of groundwater available for exchange in a multi-year drought, (2) potential opposition by growers and their degree of willingness to transition to a new water supply, (3) minimal demand occurring in the winter months, and (4) high cost due to the required length of the distribution line. Thus, supplying recycled water to North Coast users presents a high cost and high risk for the City and was eliminated from further consideration.
- **Residential Users with Separate/Dedicated Irrigation** - As previously noted, conversion of individual residential landscapes can be complex and costly given the small amount of

potable offset that would be gained. The training required for onsite supervision and reporting requirements are further reasons to remove these accounts from further consideration.

There are over 500 irrigation accounts in the City, with a combined total demand of approximately 0.7 mgd (750 AFY), without the excluded meters cited above. More than 60% of the potential recycled water demand comes from 8 accounts. A list of large meters by account type is provided in Appendix B and the larger potential recycled water users are called out on the market survey map (Figure 6-1).

(2) Commercial Accounts

Commercial account holders include hotels, restaurants, industrial, schools, parks, jails, hospitals and retail outlets. Commercial account meters serve (i) irrigation purposes only (e.g. park, hotel, school landscape irrigation), (ii) domestic purposes (e.g. medical facilities, hotels, park drinking fountains, swimming pools) only or (iii) are mixed use meters that serve a combination of irrigation and domestic purposes (e.g. landscape irrigation and drinking fountains and/or indoor potable use).

The City's billing system was used in this analysis to identify how water is used at each meter. Inputs from the City help to track meter use and meter type. Customers verify these inputs. The following assumptions were applied to estimate potential recycled water demand for these account sub-categories.

- For **irrigation** only users, it is assumed that all demand can potentially be met by recycled water.
- It is assumed that **domestic** demand cannot be served by recycled water due to the incompatibility of water quality versus type of use.
    - A number of major commercial account holders have been thus been screened out. These include Santa Cruz County main jail, Dignity Health Medical Facility, Santa Cruz Seaside Company and Fairfield Inn and Suites.
    - In addition, the City of Santa Cruz has a seasonal economy with increased domestic demand in the summer. Hence, for mixed use meters, the demand evaluation estimating the portion of potential recycled water demand took seasonal use patterns into account.
- For **mixed use** meters:
    - Landscape irrigation demands were estimated based on the percent irrigable land and average annual uses. A recent SCWD Water Conservation mixed use account study, Residential and Commercial Water Use Baseline Study (SCWD 2013), was used to identify mixed use meter accounts with significant landscape irrigation demand. In some instances, this resulted in the estimated recycled water demand being higher than the meter demand.

- For mixed use meters that were not identified in the City's study, it was conservatively assumed that average winter (Dec to Mar) demand represents the monthly baseline potable water demand. Potential irrigation demand was estimated as the difference between total annual demand and the estimated potable water demand.
- As a result, about 0.25 mgd of potential recycled water demand from mixed use meters was identified. This represents about 120% of the actual mixed use metered data - the difference is attributed to the higher estimated irrigation demand from the SCWD 2013 study.
- A separate irrigation meter would likely be required so that the domestic demand served by these mixed-use meters can continue to be served by potable water, while the irrigation demand identified would be served by recycled water.

There are almost 1,900 commercial accounts with a total demand of approximately 1.7 mgd (1,900 AFY). More than 60% of the potential recycled water demand comes from 9 accounts. A list of large meters by account type is provided in Appendix B and the larger potential recycled water users are called out on the market survey map (Figure 6-1).

(3) City Owned Accounts

City owned account holders include parks, golf courses and bulk water stations. City owned account meters serve (i) irrigation purposes only (e.g. parks landscape irrigation), (ii) domestic purposes (e.g. park drinking fountains, swimming pools) only or (iii) are mixed use meters that serve a combination of irrigation and domestic purposes (e.g. landscape irrigation and drinking fountains and/or indoor potable use).

The following assumptions were applied to estimate potential recycled water demand for these sub-account categories.

- For **irrigation** only users, it is assumed that all demand can potentially be met by recycled water.
- It is assumed that **domestic** demand cannot be served by recycled water due to the incompatibility of water quality versus type of use.
- For **mixed use** meters, the same approach is used as described for commercial accounts.
- There are also 4 **bulk water stations** within the City's service area that serve industrial uses (e.g. construction contractors and paving companies) and have the potential to receive recycled water. 2013-meter demand was used to estimate the potential recycled water demand for Delaware, Portola and Sylvania Bulk Water Stations. 2015-meter demand was used to estimate the potential recycled water demand for Research Park Bulk Water Station instead since that station was completed after 2013. The total potential recycled water demand from these 4 bulk water stations is about 0.01 mgd (9.8 AFY).

There are more than 200 city owned accounts in the City, with a combined total demand of approximately 0.2 mgd (190 AFY). More than 50% of the potential recycled water demand comes from 2 accounts. A list of large meters by account type is provided in Appendix B and the larger potential recycled water users are called out on the market survey map (Figure 6-1).

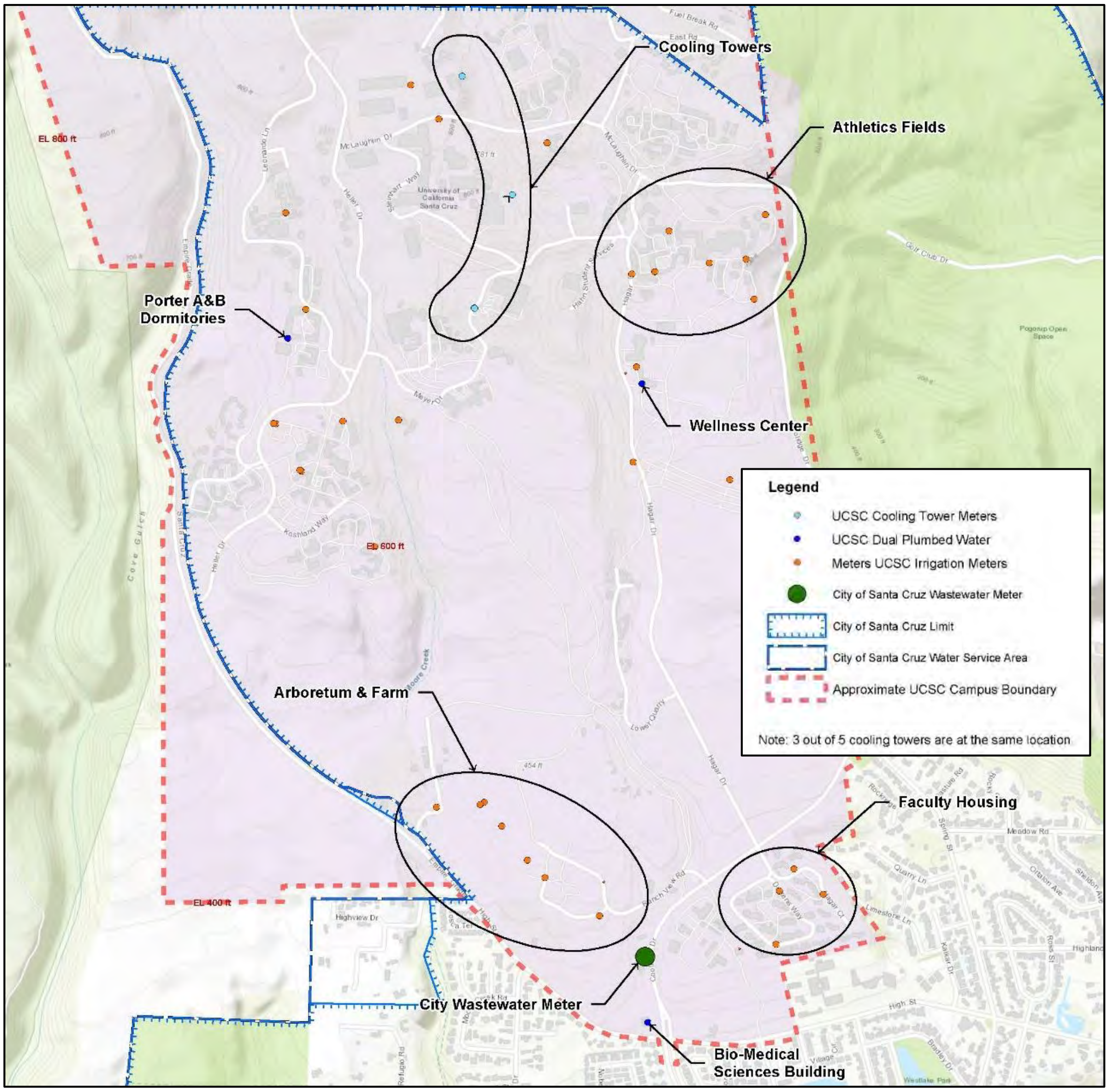
(4) University of California Santa Cruz (UCSC) Accounts

The City's 8 water meters for UCSC were not used for the demand analysis because more detailed sub-meter information was provided by UCSC. Metered demand provided by UCSC, for 2013, can generally be classified under 4 categories: Irrigation, demand at existing dual plumbed buildings for toilet flushing, cooling tower, and housing (indoor use). Housing meters are not evaluated because of incompatible use.

- **Irrigation**
  - It is assumed that all irrigation demand can potentially be met by recycled water.
  - Irrigation demand is primarily from the Arboretum and the UCSC Farm and Garden in the lower part of campus, the East Field (upper campus), the Family Student Housing Field, and the Lower West Field. These locations account for more than 70% of the estimated irrigation demand that can potentially be met by recycled water.
  - Other irrigation demands near these major irrigation uses have also been identified as they can be served along the way. These include faculty housing at Cardiff Terrace and Hagar Meadow/Court and Stevenson College grounds.
- **Existing dual plumbed buildings**
  - There are 3 existing dual plumbed buildings: Porter A&B dormitories, the bio-medical sciences building and the Wellness Center. The dual plumbed facilities are primarily plumbed for non-potable water use for toilet flushing.
  - As there are no dedicated dual plumbed meters available at this time (because the use of recycled water is still under evaluation by UCSC), the potential recycled water demand was estimated based on the volume of water used per flush, and seasonal occupancy rates.
- **Cooling Towers**
  - The 5 cooling towers are located on the north side of campus and have been identified as potential recycled water users.

Forty-seven UCSC sub-meter accounts with potential recycled water demand of 0.14 mgd were identified. More than 75% of the potential recycled water demand comes from 5 irrigation sub-meters. A list of sub-meters accounts is provided in Appendix B. The aggregated potential recycled water use at UCSC is called out on the market survey map (Figure 6-1). The locations of areas with potential recycled water uses at UCSC are shown in the close-up UCSC map (Figure 6-2).

Figure 6-2: Potential RW Demand Users on UCSC



6.2.4 Potential Future Demands

As described in Section 6.2.1, the 2013-meter demand used for the non-potable use market assessment was deemed to represent the most accurate accounting of potential existing demand for recycled water now and in the future based on projected demands identified in the 2015 UWMP (SCWD 2016). Currently there are no significant future developments that are planned to be dual-plumbed to receive recycled water within the City service area. City staff did however note that future opportunities for industrial or commercial development may bring additional non-potable demands. While locations are unknown, potential locations include the Soquel Avenue and Ocean Street corridors and other industrial/commercial land uses.

Section 5.3.2 discussed general customer based water quality objectives for recycled water. Tertiary recycled water would be suitable for most non-potable uses identified in the market assessment (mostly landscape irrigation with some indoor or cooling tower uses at UCSC). Future high tech or industrial customers may desire a higher quality water to meet specific water quality objectives. This could be achieved through chemical additions or installation of small package filtration systems to manage water quality at the point of use. If advanced treatment is implemented in the City, there may be an opportunity to offer higher quality recycled water to all users in the City. Although it is recognized that the demand for advanced treated recycled water could be greater than tertiary recycled water due to the higher water quality, for the purpose of this report, it is assumed that the potential demand for recycled water would be the same assuming all regulatory requirements are met.

It should also be noted that industrial and indoor demands for recycled water tend to occur during the daytime, opposite of the evening hours when irrigation would occur. Thus, there would likely be available capacity and flows to meet future customers of these types within a planned irrigation dominated non-potable system.

Since at the time of this RWFPS, no potential future customers have been identified, a future demand has not been estimated. To provide flexibility for the future, the City requested that non-potable pipeline alignments developed as part of the alternatives analysis in Section 8 consider routes along prime corridors such as Soquel Avenue and Ocean Street to accommodate future developments.

6.2.5 Summary of Potential Non-Potable Reuse Demand

A summary of the total demand associated with all non-domestic accounts is provided in Table 6-1. Appendix B provides additional detail for different account types in each category.

Table 6-1: Summary of All Metered Non-Domestic Accounts

Category	All Non-Domestic Meters			Large Meters Only	
	Annual Average (mgd)	Annual Average (AFY)	Total # of Meters (#)	Annual Average (Meters with Demand >10 AFY) (AFY)	Total # of Meters (Demand >10 AFY) (#)
Irrigation[1]	0.51	566	502	213	4
Commercial	1.69	1,897	1,934	484	25
City Owned	0.17	189	217	56	4
UCSC[2]	0.14	155	47	80	5
TOTAL	2.51	2,807	2,700	**834**	**38**

[1] Excluding Pasatiempo and North Coast users.
[2] All non-domestic meter data provided by the City of Santa Cruz; Large meters and potential recycled water users identified were based on sub-meter information provided by UCSC.

As noted in the prior sections, not all of the non-domestic demand can be met by recycled water for various reasons including mixed use metering. Table 6-2 shows the demand and number of meters that would be able to receive recycled water based on the considerations discussed in Section 6.2.3.

Table 6-2 also identifies the large non-potable demands, which represent key customers identified in the market survey map (Figure 6-1).

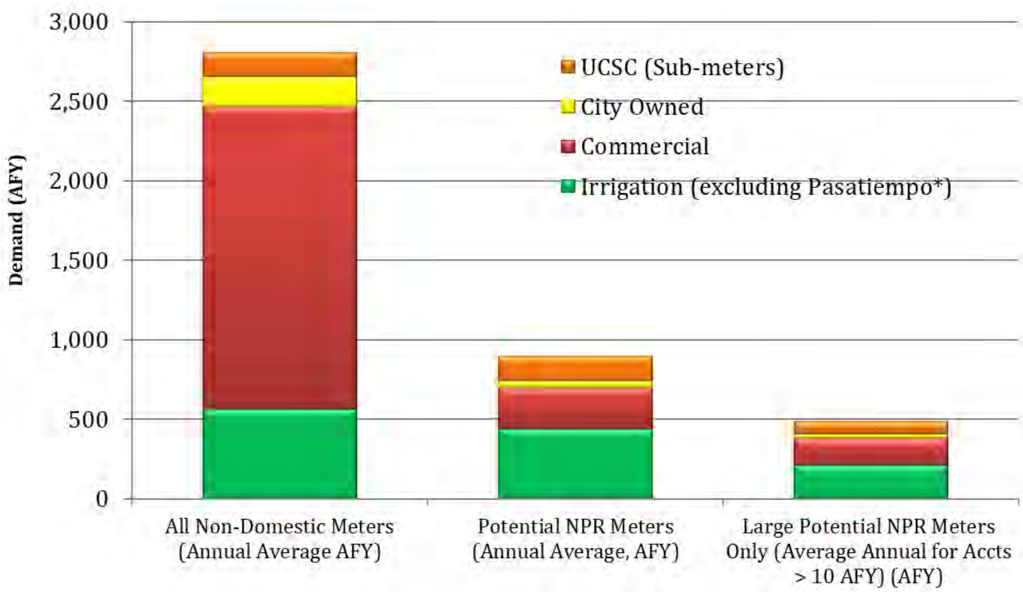
Table 6-2: Summary of Potential Non-Potable Recycled Water Demand

Category	Potential NPR Meters			Large Potential NPR Meters Only	
	Annual Average (mgd)	Annual Average (AFY)	Total # of Meters (#)	Annual Average (Meters with Demand >10 AFY) (AFY)	Total # of Meters (Demand >10 AFY) (#)
Irrigation	0.39	439	234	213	4
Commercial	0.23	257	26	166	9
City Owned	0.04	47	21	26	2
UCSC	0.14	155	47	80	5
TOTAL	0.80	899	328	**485**	**20**

Figure 6-3 provides a graphical comparison of the total non-domestic demand from all the meter data provided by the City and the identified potential non-potable reuse demand, corresponding to the data in Table 6-2.

The total amount of potential recycled water demand comprises about 0.80 mgd (900 AFY), which is about a third of the City's non-domestic residential demand, or about 13% of the City's total domestic and non-domestic demand. Of this 0.80 mgd (900 AFY), more than 50% of the potential recycled water demand, is from 20 larger users with individual demands greater than 0.009 mgd (10 AFY).

Figure 6-3: Summary of Non-Potable Demand Evaluation



* Pasatiempo Golf Course is not included here because there is already a recycled water project in progress to use secondary effluent from the Scotts Valley outfall to meet irrigation demands

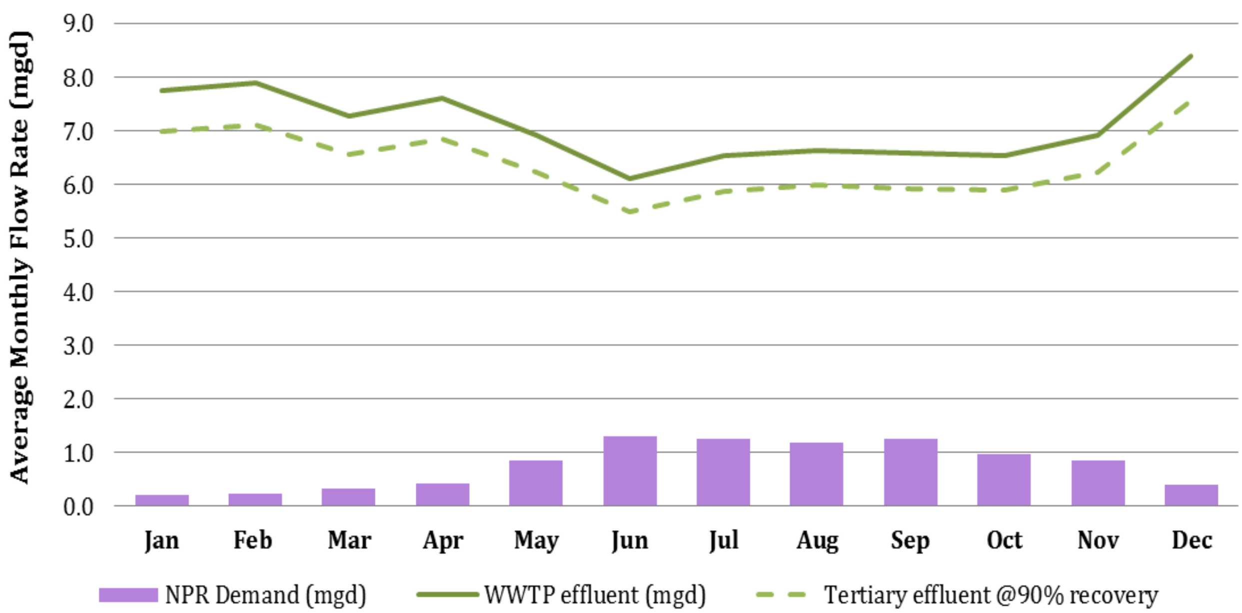
Peak month factors were estimated based on the 2013-meter data and 2013 UCSC sub-meter data for each account type. It was assumed that peak day demand is the same as peak month demand. For irrigation demands, an 8-hour irrigation window from 10 pm to 6 am on a daily basis is assumed to obtain the peak hour demand. A description of account types and their respective peaking factors is provided in Appendix B.

6.2.6 Non-Potable Supply and Demand Evaluation

Figure 6-4 shows the average monthly wastewater supply available, expressed in mgd, at Santa Cruz WWTF in 2015 and the average monthly tertiary effluent supply available, also expressed in mgd, assuming 90% of influent wastewater is available at the tertiary treatment system. Monthly wastewater flows generally increase during the winter wet weather season, from December to March, and are at their lowest during summer months.

The average monthly potential NPR demand, expressed in mgd, that was estimated via the market assessment is also shown. NPR demands, most of which are demands for irrigation, are highest during summer months. June represents the month with the highest NPR demand (1.4 mgd) and lowest wastewater available (6.1 mgd) and hence tertiary effluent available (5.5 mgd). Nevertheless, wastewater availability is not a limitation as there is more than 4 times as much tertiary effluent available, compared to NPR demand.

Figure 6-4: Recycled Water Supply and Potential Non-Potable Reuse Demand



6.3 Potable Reuse Market Assessment

The potable reuse concepts investigated within the Santa Cruz Region for this study include groundwater replenishment, surface water augmentation, streamflow 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, to fill the Santa Cruz Region water supply deficiencies. Some of the potential benefits and challenges associated with potable reuse in the Santa Cruz Region are summarized below:

Potential Benefits of Potable Reuse in the Santa Cruz Region:

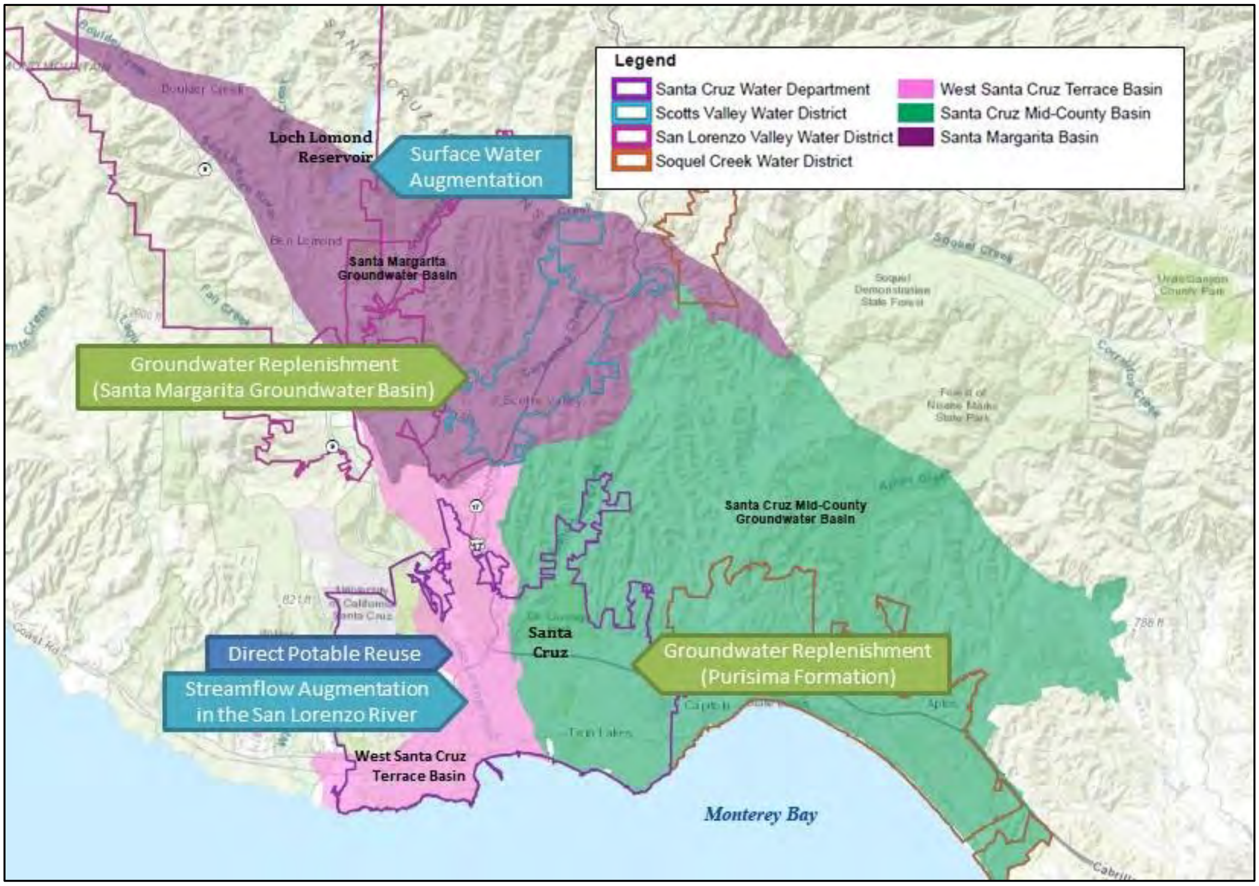
- Develop a local, drought-resistant and sustainable water supply
- Use of available recycled water flows in the winter and off-peak irrigation months
- Recharge groundwater basin(s) (via groundwater recharge)
- Maintain lake levels (via surface water augmentation)
- Supplement in-stream flows to maintain habitat and fisheries, particularly in the summer
- Provide an integrated approach to resolving multiple issues related to regional water supplies, which could bring together a number of stakeholders in the Santa Cruz Region

Potential Challenges of Potable Reuse in the Santa Cruz Region:

- Higher costs associated with advanced treatment
- 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 (between regional partners)
- Regulatory uncertainty related to SWA and DPR requirements

Section 5.3 introduced potable reuse concepts and their treatment requirements. Figure 6-5 illustrates the general locations for the potable reuse concepts being explored for the RWFPS. The following sections describe how these potable reuse concepts could be implemented in the Santa Cruz Region. The infrastructure requirements and concepts for specific potable reuse alternatives are presented in Section 8.

Figure 6-5: Potable Reuse Market Survey Map



6.3.1 Groundwater Replenishment Market Assessment

A **Groundwater Replenishment Reuse Project (GRRP)** incorporates recycled water into a groundwater aquifer, where it mixes and assimilates with native groundwater, thus providing an environmental buffer prior to extraction (and sometimes additional treatment) and use as a source of domestic water supply. Potential sites for groundwater replenishment in the Santa Cruz region include the Santa Cruz Mid-County and/or the Santa Margarita Groundwater Basins.

The two forms of GRR included in the final State regulations are surface spreading and subsurface injection. Through the Regional RWFPS, the City of Santa Cruz has determined that space limitations and hydrogeologic conditions constrain any GRR project to subsurface injection. The focus of this section, therefore, is on regulations related to direct injection projects.

The GRRP concept being evaluated is direct injection of advanced treated recycled water (or advanced treated water) into the groundwater basin via injection wells. Once in the subsurface, the advanced treated water will comingle with local groundwater and be stored in the local aquifer. Groundwater would then be extracted via existing or new production wells to meet drinking water needs. For direct injection, the GRRP Regulations mandate a minimum retention time in the groundwater basin of 2 months between the point of injection and extraction, though no existing regulated GRRP facilities currently operate with a retention time under 6 months. For this study, it was assumed that a travel time of 6-months would be achieved within the aquifer. Additional consideration of any GRRP concept would require a detailed analysis of groundwater travel times in a follow-up study.

The direct injection of recycled water does not require a source of diluent water, thus the demand of a GRRP is limited by the amount of recycled water available and/or the capacity of the groundwater aquifer to receive recycled water while meeting the minimum travel time requirements. A detailed assessment of the groundwater aquifer can be found in Appendix C, TM #2a and #2b. A supply and demand evaluation for a GRRP is provided in Section 6.4. The associated conveyance facilities for GRR alternatives are presented in Section 8.

6.3.2 Surface Water Augmentation Market Assessment

A recycled water reservoir augmentation project, also referred to as **Surface Water Augmentation (SWA)** project, involves the use of advanced treated recycled water for the purpose of augmenting a reservoir that is designated as a source of domestic water supply. Loch Lomond Reservoir is a surface water impoundment used for drinking water for the City of Santa Cruz and the only candidate for a SWA project.

Loch Lomond Reservoir is a man-made impoundment located ten miles north of Santa Cruz in the Santa Cruz Mountains near Ben Lomond (Figure 6-5). When full, the reservoir has a surface area of approximately 180 acres, is nearly 3 miles long, 0.25 miles wide and has a depth of approximately 150 feet. The reservoir is majority owned by the City of Santa Cruz and used as a source of water supply and for public recreation (e.g. fishing, boating and hiking), though swimming is not allowed. The north-south trending reservoir is formed by an approximately 190-foot-tall dam on Newell Creek, which is the principal tributary to the reservoir. The dam provides for the storage of up to approximately 8,600 AF (2,810 MF) of water in Loch Lomond Reservoir.

Water stored in Loch Lomond Reservoir is conveyed in a pipeline to GHWTP. The City of Santa Cruz can also divert water from the San Lorenzo River in Felton and pump it to the reservoir (typically during the months of February and March). Additional details of reservoir characteristics and operational considerations for a SWA alternative are discussed in Section 8.

The SWA concept would convey advanced treated recycled water to Loch Lomond Reservoir, where it would be combined with surface water in the reservoir. After storage, Loch Lomond Reservoir water would be transported to the City's GHWTP for treatment and conveyance to drinking water users through the existing potable water distribution system.

The size of a SWA project would depend on the amount of secondary effluent available for reuse, the dilution ratio in the reservoir and the retention time in the reservoir (as discussed in Section 5.4.2). As shown on Figure 6-4, monthly wastewater flows generally increase during the winter wet weather season, from December to March, and are at their lowest during summer months. Hence, the size of a SWA project would be limited to secondary effluent available in the summer. Another scenario exists that would draw down the reservoir in the summer (potentially for in lieu and ASR projects). A larger SWA project may facilitate this by allowing refill during the winter. Dilution would need to be considered; this scenario was not considered at this time. The total volume available for SWA and the associated conveyance facilities is presented in Section 8.

6.3.3 Streamflow Augmentation Market Assessment

The discharge of treated wastewater to a surface stream is common practice, as regulated through waste discharge requirements or NDPES permits, for the discharge of treated municipal wastewater. However, an agency seeking to pursue streamflow augmentation with recycled water for the purpose of increasing potable water supplies will likely face many obstacles related to water quality, ecological risks and perceived public acceptance (Plumlee et. al 2012).

For the purpose of this RWFPS, streamflow augmentation is categorized with the other types of potable reuse because it would provide additional water system supply and reliability by increasing streamflow downstream to compensate for increased diversions upstream to meet potable demands. The streamflow augmentation concept for the City would involve adding advanced treated recycled water to the San Lorenzo River downstream of the City's San Lorenzo River Diversion to meet downstream environmental needs. The City would then be able to reliably divert raw water from the San Lorenzo River at the San Lorenzo River Diversion to send to the GHWTP to meet potable demands. Additional details of water quality issues in the San Lorenzo River and potential regulatory and operational considerations are further discussed in Appendix E Streamflow Augmentation.

The size of a streamflow augmentation project would depend on the amount of secondary effluent available for reuse and the need for increased diversions to meet potable water demands. In addition, the San Lorenzo River's Nitrogen Total Maximum Daily Load (TMDL) of 1.5 mg/L nitrate (as nitrate) and other water quality objectives may limit the volume of water that may be allowed due to nitrate loads in the advanced treated recycled water. The total volume available for streamflow augmentation and the associated conveyance facilities is presented in Section 8.

6.3.4 Direct Potable Reuse Market Assessment

Direct Potable Reuse (DPR) is the purposeful introduction of advanced treated 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. For this RWFPS, recycled water supply directly into the potable water supply distribution system (i.e. flange-to-flange or pipe-to-pipe) is not being studied.

Unlike indirect potable reuse projects, there is no environmental buffer that limits the capacity of a DPR project. Thus, the DPR concept could potentially utilize all secondary effluent available for reuse. The DPR concept would treat all available effluent generated at the SCWWTF to the highest level of advanced treatment prior to blending with other raw water supplies entering the GHWTP for additional treatment and conveyance to drinking water users through the existing potable water distribution system.

It is important to note that existing criteria and regulations for DPR do not currently exist, nor is there an established timeframe for promulgating DPR regulations at this time. The City should track direct potable reuse developments in California and revisit the feasibility of DPR in the future. The total volume available for DPR and the associated conveyance facilities is presented in Section 8.

6.4 Potable Reuse Supply and Demand Evaluation

One factor which limits the capacity of all types of potable reuse is the available wastewater supply and seasonality of wastewater flows. As shown on Figure 6-4, monthly wastewater flows generally increase during the winter wet weather season, from December to March, and are at their lowest during summer months. Although an AWTF could be sized to treat the peak winter flow, there are two drawbacks: a very large treatment facility would be required (to treat up to the maximum daily winter flow of 29 mgd), and facilities would need to be taken off-line for many months when flows are lower (i.e., average daily summer production of 6 mgd). Based on discussions with the City, a potable reuse project would be limited to secondary effluent available in the summer months, such that an AWTF could be operated at a relatively constant flow year-round. This would serve to keep treatment costs down and simplify operations. Future analysis may reconsider the use of additional flows.

A GRRP would further be limited by groundwater capacity and travel times from injection to extraction to meet the GRR Regulations. A SWA project would be limited by reservoir conditions and operations and the ability to meet anticipated SWA Regulations. A streamflow augmentation project may be limited by discharge requirements to meet TMDLs and other water quality objectives in the Basin Plan. The applicable variables and the limiting constraints will depend on the type of potable reuse and the alternatives developed as part of Section 8.

Table 6-3 summarizes the major limitations for each type of potable reuse. Section 8 evaluates the available flow for each alternative based on competing demands for recycled water.

Table 6-3: Potable Reuse Limitations

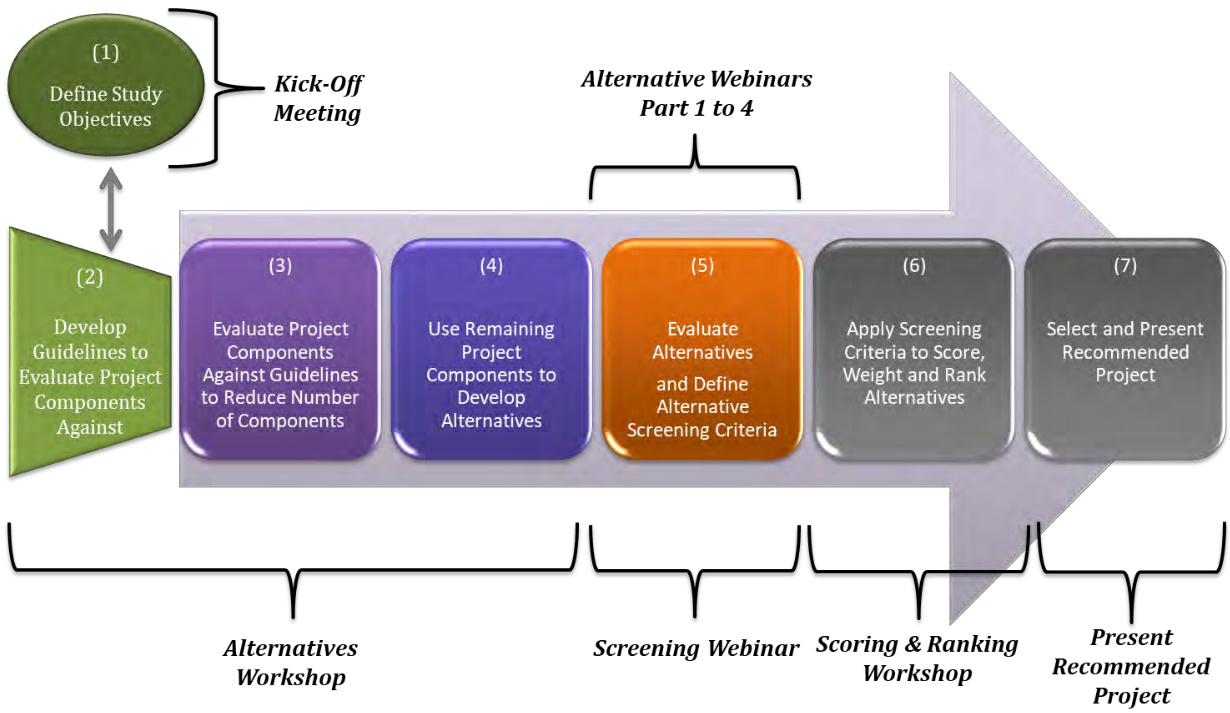
Potable Reuse	Use limited by
Groundwater Recharge	• Summer wastewater generation • GRR Regulations • Groundwater Basin Capacity • Travel time from injection to extraction
Surface Water Augmentation	• Summer wastewater generation • SWA Regulations • Operation of Loch Lomond Reservoir
Streamflow Augmentation	• Summer wastewater generation • TMDL for Nitrate • Basin Plan requirements for Temperature and Dissolved Oxygen
Direct Potable Reuse	• Summer wastewater generation • GHWTP Treatment Capacity • Coast Pump Station Capacity • Pending DPR Regulations

All potable reuse options would produce a brine, or concentrate, from the RO system that would be discharged through the City's outfall and would need to meet discharge requirements.

Section 7: Development of Project Alternatives

This section describes the approach used to develop alternatives based on a long list of project components, the guidelines applied to identify alternatives for further evaluation and the screening approach to evaluate the alternatives. The alternatives development and evaluation approach is shown in Figure 7-1.

Figure 7-1: Alternatives Development and Evaluation Approach



Meetings, workshops, webinars and presentations, described below, were attended by Study Partners (SCWD and SCPWD) as well as local and regional stakeholders (SqCWD, SVWD, SCCSD and EHS).

- The process started with a **Kick-off Meeting** to define study objectives, present the scope, schedule and budget, and initiate a data request. The **Study Objectives** (Section 1.3) were approved by the large group of stakeholders.
- During the **Alternatives Workshop** guidelines were developed and applied to evaluate project components, which resulted in identification of components that advance for further evaluation and other components for removal from further consideration. The **Guidelines to Evaluate Project Components** aligned with the Study Objectives and were the metrics used to better understand the extent to which the project components would meet the **Study Objectives.** The application of the guidelines resulted in identification of project components to develop alternatives for further evaluation. Workshop participants worked collaboratively to define a preliminary list of alternatives for further development. The

evaluation of project components and the project alternatives selected for further consideration are described in this section.

- A **Screening Webinar** was then held to define screening criteria and present the approach for scoring and weighting the alternatives. **Alternative Screening Criteria** (introduced in Section 8) also aligned with the **Study Objectives** and were the metric used to score a project based on the more detailed quantitative results and qualitative findings from the alternatives evaluation.
- The consultant team and financial project partners provided criteria weighting factors to reflect the relative importance of each criteria and the weighting themes to provide a unique point of view. In particular, the consultant team provides a point of view informed by multiple projects for a variety of owners, the SCWD represents a water supply focused perspective and the SCPWD prioritizes maximizing beneficial reuse and engineering/operational considerations. The regional partners, SVWD, SqCWD and SC County Teams, were invited to provide their point of view, but as non-financial partners in this study they chose not to submit weighting factors. Weighting outcomes are presented in Section 8.5.
- The consultant team worked collaboratively with the project partners to further develop the alternatives. Preliminary maps, facilities, costs and other considerations were presented at four **Alternative Webinars** to obtain inputs and clarify assumptions used. The alternatives are described in greater detail in Section 8.
- These webinars culminated in a **Scoring and Ranking Workshop,** where the preliminary scoring and ranking of the alternatives was presented. The scoring and ranking was based on the weighted screening criteria provided by project partners, and preliminary scoring by the City and consultant team. The consultant team scored the project in close coordination with the SCWD and SCPWD to reflect professional judgment and City experience. The outcome of the workshop included identification of a set of preferred near-term and long-term projects, herein referred to as the recommended project. The outcome of the alternative evaluation and identification of the recommended project is discussed in detail in Section 8.
- The consultant team further refined the recommended project based on input from the project partners and developed preliminary implementation, operational and construction financing plans to describe the next steps to be taken by the City. The **Recommended Project** was presented to stakeholders via a final meeting to confirm facilities, estimated costs and considerations for implementation, operations and financing. The recommended project is described in Section 9 and the construction financing plan is discussed in Section 10.

7.1 Evaluation of Project Components

7.1.1 Guidelines to Evaluate Project Components

The study objectives that were developed by the project partners (see Section 1.3) were refined to formulate a set of basic guidelines, described in Table 7-1 for evaluation of project components. Each study objective is tied to at least one guideline, with some objectives tied to multiple guidelines. The guidelines were developed after recognizing that the objectives were more qualitative than quantitative. The guidelines were used to compare the relative benefits of each project component and encompass a range of issues that could affect the feasibility of a recycled water project.

Table 7-1: Basic Guidelines for Evaluation of Project Components

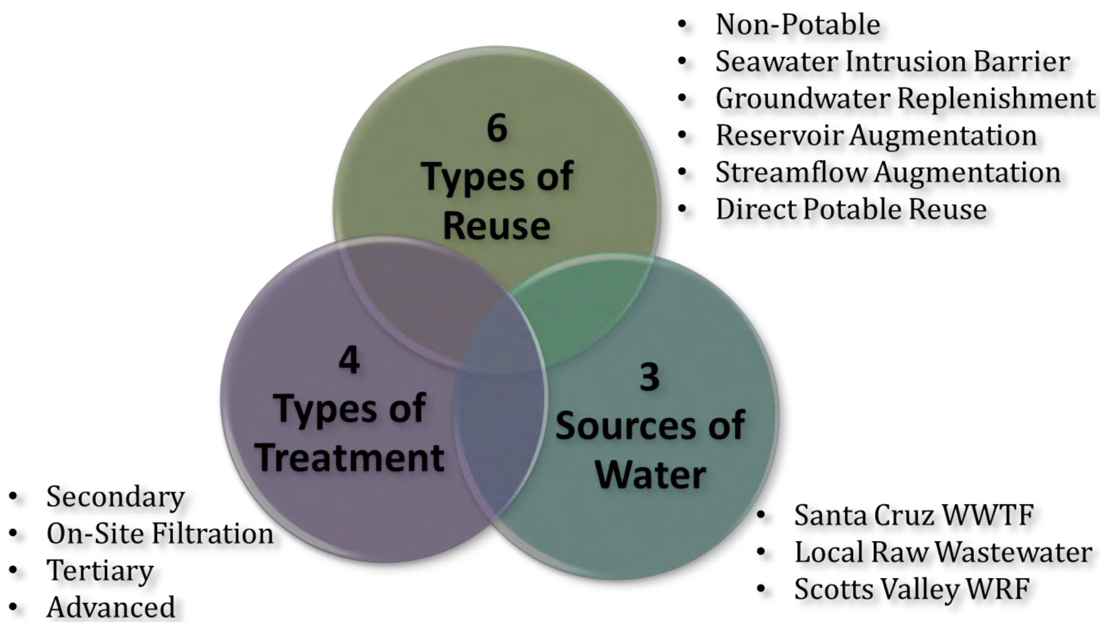
Basic Guideline	Description for Evaluation of Project Component	Primary Alignment with Study Objective[1]
Reuse of Santa Cruz WWTF Effluent	Project uses Santa Cruz WWTF effluent or wastewater destined for Santa Cruz WWTF	Assess beneficial reuse of wastewater from a resource recovery perspective
Offset or Increase Potable Supplies	Project offsets or increases Santa Cruz potable supplies to meet or reduce the Santa Cruz water supply gap	Meet or reduce the water supply gap as identified by the WSAC
Right Treatment for Right Use	Non-Potable reuse that is at least tertiary level of treatment; Potable reuse and streamflow augmentation require advanced treatment; Preference is to avoid over-treatment for a given use	Evaluate local and regional recycled water projects
Consolidate Treatment Facilities	Tertiary treatment is located at or near Santa Cruz WWTF; AWTF located at or near the Santa Cruz WWTF or GHWTP.	Identify potential impacts to Santa Cruz WWTF operations
Sufficient Flows and Demands for MBR	Sewer mining would only be considered at sites with flows > 2 MGD; MBR would only be considered for demands > 1 MGD	Identify potential impacts to Santa Cruz WWTF operations
Minimize Impacts to WW collection and treatment	WWTF impacts to water quantity, water quality, facilities and O&M activities should be minimized	Identify potential impacts to Santa Cruz WWTF operations
GRRP Identified by preliminary siting study	A preliminary siting study will identify potential City and Regional GRRP location(s), characteristics and limitations	Meet schedule and intent of WSAC Outcome Element #3
AWTF Capacity Limited by Siting	Potable reuse and streamflow augmentation project capacity will be bookended by available space for treatment facilities	Identify a phased approach to reuse in Santa Cruz
Preliminary Agreements Imminent	Projects could involve outside agencies/users and/or have (at least) a preliminary agreement (letter of willingness to pursue) for anticipated use (farmers, UCSC, industry)	Meet State Water Resource Control Board (SWRCB) grant requirements
Approved/Practiced Reuse	Recycled water use is currently approved under existing regulatory conditions or implemented in the USA	Initiate plan for continued recycled water outreach and education

[1] Many of the basic guidelines address more than one Study Objectives.

7.1.2 Long List of Potential Project Components

For the purpose of this study, project components are defined as a unique combination of three building blocks: (1) Types of reuse, (2) Sources of water and (3) Types of treatment, as illustrated in Figure 7-2 and further described in this section.

Figure 7-2: Types of Project Components



(1) **Types of Reuse**: The recycled water use options considered span the range of non-potable to direct potable reuse.

- ✓ Non-potable reuse is the most common, with well-developed regulations which includes irrigation, industrial and commercial uses.
- ✓ Potable reuse options, including seawater intrusion barrier, groundwater replenishment, streamflow augmentation, reservoir augmentation, and direct potable reuse, are less common with increasingly stringent regulatory requirements. Groundwater replenishment is the only type of potable reuse that has established regulations at this time; though surface water augmentation criteria should be developed shortly.

(2) **Sources of Water:** Utilizing secondary effluent from the Santa Cruz WWTF and tertiary effluent from the Scotts Valley WRF were considered for centralized options, where recycled water would be produced and distributed to users from a central location. Raw wastewater from a local sewer system would serve as a source for a decentralized facility, where recycled water would be produced closer to the place of use.

(3) **Types of Treatment:** four general levels of recycled water treatment were considered. The treatment processes required for each level of treatment and details on their potential uses are described in greater detail in Section 5.3.

- ✓ Secondary Treatment represents the existing level of treatment at Santa Cruz WWTF and Scotts Valley WRF, which meets the NPDES discharge permit requirements for each plant.
- ✓ Tertiary Treatment would require upgrades to the existing facilities at or near the Santa Cruz WWTF (e.g. adding media filtration or membranes). Excess flows from the Scotts Valley WRF could also be utilized as source water for a regional alternative.
- ✓ For decentralized or on-site treatment, a membrane bioreactor (MBR) facility would treat raw wastewater from a local sewer to tertiary levels using a combined biological treatment and membrane filtration.
- ✓ Advanced Treatment would add multiple advanced unit treatment processes (e.g. MF/RO and UV/AOP), beyond secondary or tertiary treatment, to produce advanced treated recycled water through a multi-barrier treatment framework that incorporates resiliency, redundancy and robustness. An AWTF could be coupled with a MBR for a decentralized advanced treatment option.

Twenty-four project components, shown in Table 7-2, were developed using a unique combination of these three building blocks. The project components were screened based on the guidelines listed in Table 7-1. As shown in the legend in Table 7-2, a white circle indicates that the component meets the guideline, a half black circle signifies that the component somewhat meets the guideline and a black circle denotes that the component does not meet the guideline. Thus, components with mostly white circles and half black circles are deemed more feasible than those with black circles.

Components with at least one guideline scored with one black circle are deemed infeasible and are removed from further consideration. Section 7.2 describes the rational for projects removed from further consideration. Although these project components were not deemed to be attractive as a standalone project, they could be part of a future project or a combined alternative.

Section 7.3 describes project components selected for further development and Section 7.4 lists the alternatives that moved forward for feasibility evaluation.

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Table 7-2: Long List of Potential Project Components

#	Type of Reuse	Source of Water	Type of Treatment	Description	Reuse of Santa Cruz WWTF Effluent	Offset or Increase Potable Supplies	Right Treatment for Right Use	Consolidate Treatment Facilities	Sufficient Flows and Demands for MBR	Minimize Impacts to WW collection and treatment	GRRP Identified by prelim. siting study	AWTF Capacity Limited by Siting	Preliminary Agreements Imminent	Approved/Practiced Reuse
					Basic Guidelines for Evaluation of Project Components									
1	Non-Potable Reuse	Santa Cruz WWTF	Secondary	Limited use in Santa Cruz (in-plant, restricted areas, truck filling)	○	●	◖	○		○			○	○
2			Tertiary	Unrestricted use in Santa Cruz (irrigation, commercial, industrial, truck filling) including UC Santa Cruz	○	○	○	○		○			○	○
3				North Coast Agricultural Irrigation	○	●	○	○		○			◖	○
4			Advanced Water Treatment (AWT)	Unrestricted use in Santa Cruz (irrigation, commercial, industrial, truck filling) including UC Santa Cruz	○	○	●	○		○			○	○
5				North Coast Agricultural Irrigation	○	●	●	○		○			◖	○
6				Customers along pipeline alignments to potable reuse (IPR, DPR, streamflow augmentation)	○	○	◖	○		○			○	○
7		Local Raw Wastewater	MBR (Tertiary)	Anchor customers in Santa Cruz (Unrestricted use)	○	○	○	◖	●	◖			●	○
8				UC Santa Cruz	○	○	○	◖	◖	◖			○	○
9				North Coast Agricultural Irrigation	○	●	○	◖	●	●			●	○
10		Scotts Valley WRF	Secondary	Pasatiempo Golf Course	●	○	●	◖		○			○	○
11	Seawater Intrusion Barrier	Santa Cruz WWTF	AWT	Identified groundwater basin subject to seawater intrusion	○	●	○	○		○	◖	○	○	○
12		Local Raw Wastewater	MBR + AWT	Identified groundwater basin subject to seawater intrusion	○	●	○	◖	●	○	◖		○	○
13	Groundwater Replenishment	Santa Cruz WWTF	AWT	Suitable sites for groundwater replenishment in Santa Cruz service area	○	○	○	○		○	○	○	○	○
14				SqCWD groundwater replenishment sites in Aptos/Purisima Formation (per GRRP Feasibility Study)	○	●	○	○		◖		○	○	○
15				Suitable sites for groundwater replenishment in Santa Margarita GW Basin	○	◖	○	○		○	◖	○	○	○
16		Local Raw Wastewater	MBR + AWT	Suitable sites for groundwater replenishment in Santa Cruz service area	○	○	○	◖	◖	◖	○	○	○	○
17				SqCWD groundwater replenishment sites in Aptos/Purisima Formation (per GRRP Feasibility Study)	○	●	○	◖	○	◖		○	○	○
18		Scotts Valley WRF	AWT	Suitable sites for groundwater replenishment in Santa Cruz service area	●	○	○	○		○	○	○	○	○
19				Suitable sites for groundwater replenishment in Santa Margarita GW Basin	●	●	○	○		○	●	○	○	○
20	Reservoir Augmentation	Santa Cruz WWTF	AWT	Blending and storage in Loch Lomond Reservoir	○	○	○	○		○		○	○	◖
21	Streamflow Augmentation	Santa Cruz WWTF	Tertiary	Discharge to the San Lorenzo River	○	○	●	○		○			○	◖
22			AWT	Discharge to the San Lorenzo River	○	○	○	○		○		○	○	◖
23	Direct Potable Reuse	Santa Cruz WWTF	AWT	Raw Water Blending at Graham Hill WTP (via Coast Pump Station)	○	○	○	○		○		○	○	◖
24				Potable Water Blending Downstream of Graham Hill WTP (Pipe-to-Pipe)	○	○	○	○		○		○	○	●

LEGEND			
○	Meets Guideline	#	Component #
◖	Somewhat Meets Guideline	(dark purple shading)	Components that consistently meet guidelines
●	Does Not Meet Guideline	(light purple shading)	Components that meet most guidelines to some degree
(blank)	Not applicable (blank)	(no shading)	Components to be removed from further consideration

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7.2 Project Components Removed from Further Consideration

Based on the screening results, 15 project components were removed from further consideration, which are described in this section. These components were not used to develop standalone project alternatives; however, some were considered as part of a future project or a combined alternative.

NON-POTABLE REUSE – Seven out of the ten project components with non-potable reuse were removed from further consideration.

- **Component #1 - Limited non-potable reuse in Santa Cruz (using secondary treated effluent from the Santa Cruz WWTF)** was removed primarily because there are relatively few urban uses that can utilize secondary effluent under Title 22 regulations (see Appendix A.2). The use of secondary effluent would likely require additional on-site treatment at each place of use and qualified operators on-site. Therefore, the use of secondary treated effluent would provide minimal benefit to water supply.
- **Component #3* - North Coast Agricultural Irrigation (using tertiary treated water from the Santa Cruz WWTF)** was removed due to uncertainty about the quantity, water quality and seasonal reliability of groundwater available for exchange in a multi-year drought. There may be permitting challenges with State Parks, the major landowner, to obtain approval for groundwater pumping for the water exchange. In addition, there is potential opposition by local growers that may pose a challenge to confirm their willingness to use recycled water. These factors result in this being a high cost and high-risk component for the City, with minimal incentive to support the recycled water rates needed for revenue generation. *A future recycled water project could reconsider including demands presented in this component.
- **Component #4 - Unrestricted non-potable reuse in Santa Cruz (using advanced treated Santa Cruz WWTF effluent)** was removed because of the significant higher cost and energy that would be required to treat recycled water beyond its regulatory requirements.
- **Component #5 - North Coast Agricultural Irrigation (using advanced treated Santa Cruz WWTF effluent)** was removed because of the same reasons given for Components #3 and #4 above.
- **Component #7* – Anchor customers in Santa Cruz (localized use of raw wastewater with MBR to produce tertiary effluent)** was removed because of the lack of large "anchor" customers in Santa Cruz to justify the higher costs and operational requirements associated with a decentralized facility. The largest and second largest customers within Santa Cruz's service area are DeLaveaga Golf course and Harbor High School with demands of 0.12 mgd and 0.03 mgd respectively. (Pasatiempo Golf Course is not included here because there is already a recycled water project in progress to use secondary effluent from the Scotts Valley outfall to meet irrigation demands) Hence, there is a lack of customers with sufficient demand within Santa Cruz that would make constructing and operating an MBR cost effective. In addition, commitments and more complex operating agreements would be needed for an MBR facility. The public may oppose construction of a facility that treats raw wastewater. Decentralized facilities can provide reliable water quality; however, there is some loss of economy of scale associated with operating more than one facility due to duplication of some treatment facilities,

greater area required for treatment site development, and more complex operational practices. *A future recycled water project for UCSC could consider locating an MBR facility on-campus to meet irrigation and dual-plumbed demands (see Component #8 in Section 7.3).

- **Component #9 - North Coast Agricultural Irrigation (localized use of raw wastewater with MBR to produce tertiary effluent)** was removed because of the same reasons given for Component #3 above. In addition, there is lack of raw wastewater near the North Coast users which makes an off-site MBR component infeasible.
- **Component #10 – Pasatiempo Golf Course (using secondary effluent from the Scott Valley outfall)** was removed from consideration in this study because this project is already in progress. The golf course is currently testing on-site cartridge filters to treat extracted water from the outfall for golf course irrigation. Pasatiempo Golf Course is not considered to be a potential user of Santa Cruz WWTF effluent because their demands will be fully met by flows in the Scotts Valley outfall pipeline. Since this component would not beneficially reuse Santa Cruz WWTF effluent, it was removed from consideration.

SEAWATER INTRUSION BARRIER – Both project components involving a seawater intrusion barrier, without the intent to extract the recharged groundwater, were removed from further consideration.

- **Component #11 – Injection into identified groundwater basins (using advanced treated Santa Cruz WWTF effluent)** was removed from further consideration since the seawater intrusion threat to the City's groundwater is currently low and there would be limited water supply benefit associated with this component. Injection of recycled water solely to create a seawater intrusion barrier would provide a very costly "insurance" against the low potential future loss of the Beltz coastal wells. Similar to Component #3, the City could study this component as a potential opportunity to achieve zero discharge as part of another study. For this RWFPS, a groundwater replenishment project with recycled water would have the added benefit of reducing the potential for seawater intrusion.
- **Component #12 - Injection into identified groundwater basins (localized use of raw wastewater with MBR and advanced treatment)** was removed because of the same reasons given for Component #11. In addition, the component also poses additional constraints due to limited available supply from the DA Porath pump station and siting challenges for treatment facilities at this location.

GROUNDWATER REPLENISHMENT – Five out of the eight components for indirect potable reuse via groundwater recharge were removed from further consideration.

- **Component #14* – Injection into SqCWD GRRP sites in Aptos/Purisima Formation (using advanced treated Santa Cruz WWTF effluent)** was removed because injection directly into Aptos/Purisima formation does not augment potable water supplies within the City of Santa Cruz's water service area. In addition, complex institutional arrangements and significant new infrastructure would be needed for water transfers to increase potable supplies for the City. While this component has been removed, the potential for Santa Cruz to utilize a portion of the flow from a SqCWD conveyance system to serve non-potable uses or recharge groundwater in

Santa Cruz remains as part of Component #6, which will advance to the next stage of alternative development. *Ongoing discussions and developments via the MGA could potentially present a future opportunity to pursue reuse in the Aptos/Purisima formation as part of a regional GRRP.

- **Component #17* – Injection into SqCWD GRRP sites in Aptos/Purisima Formation (localized use of raw wastewater with MBR and advanced treatment)** was removed because of the same reasons given for Component #14 above. In addition, the component also poses additional constraints due to limited available supply from the DA Porath pump station and siting challenges for treatment facilities at this location. *Ongoing discussions and developments via the MGA could potentially present a future opportunity to pursue reuse in the Aptos/Purisima formation as part of a regional GRRP.
- **Component #18 – Injection into Suitable GRRP sites to be defined in Preliminary Siting Study (using advanced treated Scotts Valley WRF effluent)** was removed from further consideration because it does not reuse Santa Cruz's WWTF effluent. In addition, minimal flow is available at the City of Scotts Valley outfall due to the existing demands of the SVWD's recycled water program, the planned use of secondary effluent in the Scotts Valley outfall for Pasatiempo Golf Course irrigation and the proposed GRRP currently being explored by SVWD.
- **Component #19* – Injection into Santa Margarita Groundwater Basin (using advanced treated Scotts Valley WRF effluent)** was also removed from further consideration because of the same reasons given for Component #18. In addition, SVWD is currently studying this project as part of a separate RWFPS. There is, however, a possibility to utilize Scotts Valley WRF effluent in combination with Santa Cruz WWTF for a regional project. Thus, this option would not be studied as a stand-alone component as part of this RWFPS, but could be included in a regional alternative. *A future regional recycled water project could reconsider including demands presented in this component as part of a regional GRRP.

STREAMFLOW AUGMENTATION – One of the two components for streamflow discharge was removed from further consideration.

- **Component #21 – Discharge to San Lorenzo River (using tertiary treated water from the Santa Cruz WWTF)** was removed because of potential environmental and habitat concerns related to water quality. Specifically, the TMDL for nitrogen (as described in Section 6.3.3) would be a limiting factor with discharging tertiary treated water. In addition, the proximity of the discharge location to raw water diversion, regulatory and permitting challenges, and environmental and habitat issues in the San Lorenzo River as well as the Lagoon would likely require a higher level of treatment (see Appendix E, TM #5 for more information). Therefore, this component was removed from further consideration. SFA with ATRW was considered.

DIRECT POTABLE REUSE – One of the two components for direct potable reuse was removed from further consideration.

- **Component #24 – Pipe-to-Pipe Direct Potable Reuse (using advanced treated Santa Cruz WWTF effluent)** was removed from further consideration because the planned introduction of recycled water directly into the treated water distribution system lacks the additional treatment and response time that would be provided by blending upstream of a drinking water treatment plant. No project of this type has currently been permitted in the US and the current regulatory climate is focused on the development of criteria for potable reuse through raw water augmentation first, thus a regulatory pathway for pipe-to-pipe DPR could be more than a decade away. In addition, it is anticipated that there would be significant public acceptance issues for this type of project.

7.3 Project Components Selected for Further Evaluation

Based on the screening results, nine project components were selected for further analysis, which are described in this section. Section 7.4 describes the alternatives that were developed using these components.

NON-POTABLE REUSE

- **Component #2 – Unrestricted non-potable reuse in Santa Cruz (using tertiary treated water from the Santa Cruz WWTF)** to serve irrigation, commercial, industrial and truck-filling uses was selected for further consideration.
- **Component #6 – Unrestricted non-potable reuse in Santa Cruz for customers along pipeline alignments for the potable reuse alternatives (using advanced treated Santa Cruz WWTF effluent).** This component may be analyzed as part of indirect potable reuse (groundwater replenishment, reservoir augmentation), direct potable reuse and streamflow augmentation alternatives. However, the viability of serving customers along this alignment may depend on the amount of flow available during the summer months, customer demand and costs.
- **Component #8 – Unrestricted non-potable reuse at UCSC (localized use of raw wastewater with MBR to produce tertiary effluent).** This component offers a localized source of recycled water that would capture wastewater before it is conveyed down to Santa Cruz WWTF for treatment, thereby eliminating the need to convey and pump treated recycled water back up to potential campus uses. The analyses for UCSC explores the potential for decentralized treatment to serve UCSC demands. The analysis focuses on UCSC because of the localized production of wastewater coupled with potential end use demands as well as consistency with UCSC's Water Action Plan (UCSC 2013).

GROUNDWATER REPLENISHMENT

- **Component #13 – Injection into Suitable Santa Cruz GRRP site(s) (using advanced treated Santa Cruz WWTF effluent).** Potential sites for groundwater recharge and extraction within the Santa Cruz service area will be identified and studied. This component could be part of a stand-alone City lead GRRP or a partnership with the SqCWD GRRP to allow sharing of facilities for regional benefits.
- **Component #15 – Injection into Santa Margarita Groundwater Basin (using advanced treated Santa Cruz WWTF effluent).** This component remains as part of a regional project where the injected advanced treated water would be extracted from existing or new production wells in the Santa Margarita Basin and conveyed back to the City to augment potable supplies within the City's service area. As noted for Component #19 in the prior section, there is a

possibility to utilize Scotts Valley WRF effluent in combination with Santa Cruz WWTF for a regional project. This component would require institutional arrangements and significant new infrastructure.

- **Component #16 – Injection into Suitable Santa Cruz GRRP site(s) (localized use of raw wastewater with MBR and advanced treatment).** Similar to component #13, potential sites for groundwater recharge and extraction within the Santa Cruz service area will be studied. This component would only be part of a stand-alone City led GRRP due to the limited available supply at the DA Porath Pump Station.

RESERVOIR AUGMENTATION

- **Component #20 – Reservoir Augmentation (using advanced treated Santa Cruz WWTF effluent)** into Loch Lomond Reservoir for the purpose of augmenting a reservoir that is designated as a source of domestic water supply was selected for further analysis.

STREAMFLOW AUGMENTATION

- **Component #22 –Streamflow Augmentation (using advanced treated Santa Cruz WWTF effluent)** via discharge of advanced treated water into the San Lorenzo River was selected for further consideration. Initial discussions identified the preferred location as being downstream of the City's San Lorenzo River Diversion to meet downstream environmental needs, while allowing the City to reliably divert water (within water rights) from the San Lorenzo River at the San Lorenzo River Diversion site to send to the GHWTP to meet potable demands. Discharge above the San Lorenzo River Diversion would be considered potable reuse through raw water augmentation and was not included in this study.

DIRECT POTABLE REUSE

- **Component #23 – Direct Potable Reuse with Raw Water Blending at GHWTP (using advanced treated Santa Cruz WWTF effluent)**. This component involves the purposeful introduction of advanced treated recycled water into the City's drinking water supply immediately upstream of the Graham Hill WTP.

7.4 Project Alternatives Selected for Further Development

The selected project components were then used to develop eight (8) alternatives coupled with nuanced variations of these 8 alternatives resulted in a total of fifteen (15) sub-alternatives. Some project components are part of multiple alternatives. For example, components #2 and #6 unrestricted non-potable reuse in Santa Cruz could be part of a stand-alone project or in conjunction with another project. Table 7-3 provides a high-level description of each alternative.

Table 7-3: Alternatives for Further Development

Alternative	Sub Alt	Description
Alternative 1 – Centralized Non-Potable Reuse	1a	Title 22 (tertiary) upgrades to the existing disinfected reclaimed water system at the Santa Cruz WWTF (aka SCPWD Title 22 Project) to serve in-plant uses, La Barranca Park and new City truck fill stations.
	1b	Additional tertiary treatment at Santa Cruz WWTF (or off-site) to meet identified non-potable demands within the City's service area
Alternative 2 – Decentralized Non-Potable Reuse	2	Satellite treatment of local raw wastewater from the UC Santa Cruz campus to meet on-campus non-potable demands. All facilities are located on or near campus.
Alternative 3 – Santa Cruz Participation in SqCWD led Groundwater Recharge Reuse Project (GRRP)	3a	Send secondary effluent from the Santa Cruz WWTF to SqCWD for their GRRP. No reuse in the City.
	3b	Expand tertiary treatment at the Santa Cruz WWTF to deliver to SqCWD for the GRRP in SqCWD, serving non-potable reuse customers along the way.
	3c	Send additional secondary effluent from the Santa Cruz WWTF to the SqCWD AWTF and return advanced treated water for groundwater replenishment in the City's service area, serving non-potable reuse customers along the way.
	3d	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water to SqCWD for their GRRP, serving non-potable reuse customers along the way.
	3e	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water to SqCWD for their GRRP, serving non-potable reuse customers and groundwater replenishment in the City's service area along the way.
Alternative 4 – Santa Cruz GRRP	4a	AWTF at Santa Cruz WWTF (or a nearby location). Send advanced treated water for groundwater replenishment in the City's service area, serving non-potable reuse customers along the way.
	4b	Satellite treatment of local raw wastewater from Santa Cruz County Sanitation District at DA Porath Pump Station. New MBR plus AWTF to produce advanced treated water for groundwater replenishment in the City's service area, serving non-potable reuse customers along the way.
Alternative 5 – Surface Water Augmentation (SWA)	5	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water for blending and storage in Loch Lomond Reservoir, to be conveyed to the GHWTP and enter the City's potable water distribution system.
Alternative 6 – Streamflow Augmentation	6	AWTF at the Santa Cruz WWTF (or a nearby location). Send advanced treated water to augment San Lorenzo River flows (downstream of San Lorenzo River Diversion) to maintain habitat, meet future fishery requirements.
Alternative 7 – Direct Potable Reuse (DPR)	7	AWTF at the Santa Cruz WWTF (or a nearby location). Blend advanced treated water with raw water at the Coast Pump Station, for further treatment at the GHWTP prior to distribution as finished water, suitable for drinking.
Alternative 8 – Regional GRRP	8a	Regional AWTF to produce advanced treated water for groundwater replenishment in the SMGB. Utilize existing or new production wells to serve Santa Cruz, SVWD, SLVWD and SqCWD. Send secondary effluent from WWTF to AWTF in Scotts Valley.
	8b	Regional AWTF to produce advanced treated water for groundwater replenishment in the SMGB. Utilize existing or new production wells to serve Santa Cruz, SVWD and SLVWD. Send secondary effluent from the Santa Cruz WWTF to SqCWD for their GRRP.

A more detailed description, including estimated recycled water deliveries, infrastructure requirements, maps and costs, is provided in Section 8.

7.5 No Project Alternative

For the RWFPS, the no project alternative means the City would not reuse wastewater to meet non-potable or potable demands, i.e. no recycled water project would be developed. As previously discussed, the adopted recommendations from the WSAC were to pursue a strategy of water conservation and enhanced groundwater storage, with a back-up option of advanced treated recycled water or desalinated water. Thus, a no recycled water project option would indicate the need to fill the City's water supply gap via one or a combination of other WSAC elements. And the no recycled water project would maintain the status quo in terms of existing discharges to the Monterey Bay as described earlier in this report.

7.6 Nexus with Other Projects

This section provides a brief discussion of other projects and studies being conducted by the City, as well as local and regional stakeholders that may influence the water supply portfolio in the region. These include:

- **Water conservation measures** and **water supply reliability studies** that are being pursued by the City in parallel to this study, that have the potential to fill all or a portion of the worst-case gap of 1.2 bgy.
- **Regional recycled water projects** that are relevant to this RWFPS in relation to the potential opportunities for infrastructure and cost sharing.
- **Discharge compliance drivers** due to future regulatory or legislative requirements to meet increasingly stringent discharge requirements or to go to a zero-discharge strategy. A mandate for additional treatment or a ban on ocean discharge could trigger the City to revisit water recycling to achieve zero or near-zero discharge. At this time, no existing legislation exists.

The economic costs of these non-recycled water alternatives are being evaluated under parallel efforts by the City. The costs of the recycled water alternatives developed in this RWFPS will be compared to other water supply options as part of the larger water supply evaluation process under the WSAC.

7.6.1 Water Conservation Measures and Water Supply Reliability Studies

The WSAC agreed to the following water conservation measures and water supply reliability studies or non-recycled water elements to be in the Water Supply Augmentation Plan, which are being further studied:

- **Element 0: Demand Management**, with a goal to generate an additional 200 to 250 million gallons of demand reduction by 2035 from expanded water conservation as detailed below. Demand management is focused on strengthening water conservation programs.

  The City's Water Department, in partnership with Maddaus Water Management Inc., is finalizing an update to the Water Conservation Master Plan (WCMP), with a planning horizon to 2035 (Maddaus 2017). The WCMP systematically evaluates and quantifies the City's remaining long-term water conservation potential (baseline survey), determines which set of measures and implementation mechanisms represent the best approach to achieve future water savings, and creates a road map to achieve maximum practical water use efficiency. The WCMP observes that additional incremental water savings from the Recommended Program (deliberated by the WSAC) will amount to 220 MG in 2035. The estimated annual demand will decline over time to about 3.2 bgy in 2035 versus about 3.4 bgy previously estimated. The WCMP estimates that 100 MG more water will be saved as a result of changes in the fixture plumbing codes prompted by the emergency conservation regulations put into place in 2015. Several measures, such as efficient clothes washing and toilets are areas where there is potential for long-term reduction in per capita water use in the residential sector. The WSAC Final Report included several additional measures which were added to the program, which shifted the focus more toward reducing peak season use to increase supply reliability. These measures target reduction in outdoor use in residences and large landscapes, enhancing base or indoor measures that lessen overall demand or that target specific uses such as visitor-serving uses.

- **Element 1: In Lieu Recharge** of regional aquifers is defined as the transfer of available winter flows during the rainy season from Santa Cruz to SqCWD and/or SVWD and SLVWD to meet their customer demands, thus allowing reduced pumping from the regional aquifers and enabling the aquifer to passively rest and recharge. A small program relying on existing infrastructure to provide potable water to SqCWD could start quickly and grow over time as additional infrastructure is developed and additional agreements are reached with SqCWD and SVWD, and any needed changes to water rights are granted by the State of California. Details for cost sharing, water right modification and timing and quantity of flows will be addressed in future studies and agreements. In lieu recharge is being evaluated and a pilot study is underway. The feasibility of in lieu recharge as a water supply reliability strategy is expected to be better understood between January 2018 and January 2019.

- **Element 2: Aquifer Storage and Recovery (ASR)** involves the injection of treated surface water from available winter flows into regional aquifers to recover a large portion of the stored water as a supplement supply for Santa Cruz. This program is proceeding through the evaluation and piloting steps detailed in a reconnaissance-level evaluation of the feasibility ASR within the City's service area (Pueblo Water Resources 2015). The main findings of this study are focused on an ASR project using excess surface water from the San Lorenzo River, with treatment at GHWTP before injection, which has the potential to be implemented on a scale sufficient to meet the yield goals for the City. The Aquifer Storage and Recovery Feasibility Study is the first of three phases to plan a potential ASR project.

The Phase I study tasks completed include existing well screening and injection capacity analysis. Geochemical interaction modeling and groundwater modeling are in progress at the time of this study, and are anticipated to be completed by late 2017. The Phase II study task will include pilot testing and Phase III will include tasks to implement the project. The total amount of time for completion of all three phases is 6 to 12 years. The hydrogeologic evaluations, conceptual-level injection well capacities and siting considerations performed as part of this RWFPS were coordinated with the ASR work as appropriate.

- **Element 3: Advanced Treated Recycled Water or Desalination** is intended to supplement or replace Elements 1 and 2 to the extent that they do not generate sufficient yield to fill the supply/demand gap in a cost effective and timely manner. The investigation of recycled water alternatives is being accomplished through this RWFPS. Desalination is considered as a back-up should the use of advanced treated recycled water not be feasible or if it cannot provide sufficient yield to meet the water supply gap (WSAC 2015). A Seawater Desalination Project Technical Memorandum is being developed to describe the environmental and/or regulatory changes that have occurred over the last few years and the impacts these would have to the project. Previous assumptions about the costs of the project and alternatives are also being updated. This Technical Memorandum will provide additional detail about the tasks involved with pursuing desalination of seawater as a reliable water supply strategy.

7.6.2 Regional Recycled Water Projects

7.6.2.1 SqCWD GRRP

SqCWD completed their Groundwater Replenishment Feasibility Study in 2016 (Carollo, 2016). The study recommended the following three alternatives that involve groundwater recharge via injection at the Cabrillo College and Monterey Street wells:

- SqCWD GRRP Alternative 1 - Advanced treatment of secondary effluent at Santa Cruz WWTF that will be conveyed to SqCWD for injection,
- SqCWD GRRP Alternative 3 - A satellite MBR and advanced treatment facility located at SqCWD that would make use of localized wastewater from Soquel and Capitola pump stations to produce advanced treated water for injection, and
- SqCWD GRRP Alternative 4 - Conveyance of secondary effluent from the Santa Cruz WWTF to SqCWD, with an advanced treatment facility sited at SqCWD for treatment and injection.

The City's RWFPS builds upon SqCWD GRRP Alternatives 1 and 4 to identify opportunities for sharing facilities and resources between the City and SqCWD to meet their respective water supply needs (Alternative 3 in this RWFPS). In addition, all of the alternatives in this RWFPS assume that the City would provide sufficient effluent to SqCWD to support the 1.3 mgd of groundwater recharge identified in their GRRP.

7.6.2.2 SVWD GRRP

The SVWD also recently completed a recycled water planning study, the Santa Margarita Groundwater Basin Recycled Water Groundwater Replenishment Program – Facilities Planning Report (FPR) (Kennedy/Jenks 2016a). The recommended project includes groundwater replenishment in the Lompico aquifer via two existing wells repurposed for injection and a new injection well drilled at the Scotts Valley – El Pueblo site. The source water would be from the Scotts Valley WRF and the advanced treatment facility would be located at the Scotts Valley El Pueblo site.

The findings from the FPR were used to inform the development of a Regional GRRP (Alternative 8 for this study), with the aim of developing a regional solution that shares facilities and resources to meet each stakeholder's water supply needs. The hydrogeologic evaluations for the Santa Margarita Basin, performed as part of this RWFPS, were coordinated with modeling work performed for SVWD. Conceptual-level injection well capacities and siting considerations were also developed based on input from SVWD and the FPR team.

7.6.3 Discharge Compliance Drivers

7.6.3.1 Pollution Control Projects

The City is currently able to comply with their existing waste discharge requirements, thus a possible allocation of costs between recycling and pollution control is not identified as part of this study.

7.6.3.2 Ocean Ban for Zero Discharge

Senate Bill 163 (SB163) was introduced by Senator Robert Hertzberg in 2015 to impose a mandate requiring each wastewater treatment facility that discharges through an ocean outfall to achieve 100 percent reuse of the facility's actual annual flow by 2036. This bill was withdrawn in June 2016, but could potentially be reintroduced again in the future. If an ocean ban on discharge were to be reintroduced, there would likely be substantial opposition from both wastewater and recycled water municipal agencies as well as professional organizations. The California Association of Sanitation Agencies, Bay Area Clean Water Agencies and WateReuse California opposed the bill on the basis of numerous technical and institutional challenges associated with water recycling.

In the case of the Santa Cruz WWTF, water recycling would likely be only one component to achieve zero discharge because the high wastewater flows coupled with the low demand in winter means that there would be a surplus of wastewater that would need to be dealt with during the rainy season. Even if potable reuse were able to utilize a large portion of the winter flows, the brine generated from the advanced treatment process would need to be disposed of through the outfall. Hence, zero discharge is not considered one of the main key drivers for developing the recycled water alternatives in this RWFPS.

Section 8: Project Alternatives Analysis

This section presents an alternatives evaluation of the eight (8) alternatives considered for the RWFPS, as introduced in Section 7.3:

- Alternative 1: Centralized Non-Potable Reuse
- Alternative 2: Decentralized Non-Potable Reuse
- Alternative 3: SqCWD Led Groundwater Replenishment Reuse Project (GRRP)
- Alternative 4: Santa Cruz Led GRRP
- Alternative 5: Surface Water Augmentation
- Alternative 6: Streamflow Augmentation
- Alternative 7: Direct Potable Reuse
- Alternative 8: Regional GRRP

As previously discussed, the adopted recommendations from the WSAC were to pursue a strategy of water conservation and enhanced groundwater storage, with a back-up option of advanced treated recycled water or desalinated water. The objectives of the resulting project or portfolio of projects are to meet a worst-case gap of 3,700 AFY (or 1.2 bgy) during an extended drought. Thus, the investigation of recycled water alternatives in this RWFPS is conducted within the context of the ability of a recycled water project to provide a new water supply to meet City demands. The alternative evaluation for the RWFPS was therefore conducted at a high-level, with a focus on providing an apples-to-apples comparison of the infrastructure required for beneficial reuse to meet the City's current water needs.

A guiding principle from the WSAC Report that has been integrated in the strategy noted above is to promote regional collaboration to improve water supplies (City of Santa Cruz 2015). In terms of the regional projects (i.e. Alternative 3 and 8), the City recognizes that additional information, agreements and time would be needed to more fully understand opportunities, benefits and limitations to making the region more inter-connected and resilient in the long-term. Due to the historical variability in rainfall and the need to replenish groundwater basins, the regional partners have an interest and need to work together to optimize regional use of resources and infrastructure to meet regional needs. However, the current water systems for the City of Santa Cruz, SqCWD and SVWD are not matched in size or in some cases not connected, which poses challenges to conveying flow across service area boundaries. This RWFPS provides valuable information that can be used to support future conversations to explore regional water supply projects.

The alternatives evaluation approach consists of a conceptual-level engineering analysis to evaluate each project and to score and rank projects based on screening criteria defined by project participants. The following sections provide the basis of the conceptual-level engineering analysis, a description of each alternative project, the screening approach and the outcomes of the scoring and ranking evaluation used to identify a preferred list of prioritized projects.

8.1 Conceptual-Level Engineering Analysis

A conceptual-level engineering analysis was performed to evaluate each alternative project and identify major infrastructure to treat and convey recycled water for each type of use. All pipeline alignments and facility locations are assumed to be preliminary, and would be further evaluated and refined in future studies as part of environmental review and design process. Costs are provided at a conceptual-level, based on unit costs and recent project experience, to reflect facility requirements and operational activities to produce and deliver recycled water. A summary of key assumptions is provided in this section.

8.1.1 Design Criteria

Pipeline, pump station, treatment facility and storage tank design criteria and assumptions are based on the criteria described below and listed in Table 8-1.

- **Pipelines:** New pipelines would be located to convey recycled water between the treatment facility and place of use, in some cases connecting to new or existing pipelines or storage facilities. New pipelines were sized using velocity and head loss criteria to meet peak hourly demands. A hydraulic model was not developed for the alternatives evaluation; however, the results of prior hydraulic models were used where applicable.
- **Pump Stations:** New pump stations were included in projects, where needed, to deliver recycled water to higher elevations or to boost pressures to higher pressure zones. Distribution pump stations were sized to meet customer design peak hourly demands and pressure service requirements. Pump station total dynamic head (TDH) was estimated based on the change in elevation plus frictional headloss (calculated using the Hazen-Williams equation) and accounting for other minor losses. The number of duty and standby pumps depends on the alternative evaluated. The calculated motor horsepower for the pump station was rounded to the nearest compatible motor size for determining the cost of pump stations.
- **Treatment Facilities:** New treatment processes and/or facilities were required for all alternatives to meet recycled water treatment requirements based on the type of use. Treatment facilities were sized to meet peak day demands. The following section provides additional treatment facility considerations.
- **Storage Tanks:** Product water storage tanks were included for NPR alternatives to address diurnal fluctuations in demand and DPR alternatives to serve as an engineered storage buffer and for pumping purposes to connect to coast pump station. Product water storage capacities are based on 1-day effective diurnal product water storage, an includes provision for dead space and rounding contingency. Either steel ground tanks or prestressed concrete tanks were assumed, depending on the location. There is no need for blending recycled water with potable water during peak irrigation months since there is more than sufficient available effluent to meet potential irrigation demands. However, it is assumed that each recycled water storage tank would have a potable water back-up in the case of a loss of recycled water production. it is assumed that existing customers will have the

infrastructure to switch to the potable water supply system if recycled water is not available

Table 8-1: Pipeline, Pump Station and Treatment Facility Design Criteria

Description	Value
Pipeline Design Criteria	
Minimum Pipeline Diameter	6 inches (with exceptions for short segments of pipeline near treatment facilities)
Maximum Pipeline Velocity	6 feet/second
Pipeline Material	High-pressure PVC
Minimum Distribution Pressure	35 psi
Pump Station Design Assumptions	
Pump Efficiency	80%
Motor Efficiency	90%
Pipeline Roughness (C Factor)	130
Minor Pipeline Losses	5% of calculated frictional headloss
Injection Schedule	24 hours a day, year-round
Irrigation Schedule	8 hours at night[1]
Non-Irrigation Schedule	12 hours in the day, year-round
Treatment Facility Design Assumptions	
Tertiary Treatment Recovery Rate	100%
MBR Recovery Rate	90%
MF Recovery Rate	90%
RO Recovery Rate	85%
Storage Tank Design Assumptions	
NPR product water storage capacity	Estimated at 1 day of storage (to address diurnal fluctuations in demand)
DPR product water storage capacity	Assumed to be 1 MG (to serve as an engineered storage buffer)

[1] The primary irrigation season is from May through November, though some irrigation occurs during the winter and shoulder months depending on the year-type. Figure 6-4 illustrates the distribution of irrigation demands throughout the year.

8.1.2 Treatment Facility Considerations

Each alternative would require treatment to produce recycled water suitable for its proposed use. The treatment criteria for each type of beneficial reuse are discussed in Section 5 with additional detail provided in TM #1a Evaluation of Treatment Requirements (Appendix A). Treatment facility considerations for each alternative are further described in TM #1b Treatment Facility Evaluation, also included in Appendix A. The treatment processes assumed for each alternative project are summarized below:

- **Centralized Non-Potable Reuse:** Secondary effluent would undergo tertiary filtration with either granular media filtration (GMF) or membrane filtration (MF), followed by disinfection to meet Title 22 requirements for unrestricted use.
- **Decentralized Non-Potable Reuse:** Primary influent (i.e. local raw wastewater) would be treated by a membrane bioreactor (MBR), followed by disinfection to meet Title 22 requirements for unrestricted use.
- **Groundwater Replenishment Reuse (GRR):** Would undergo full advanced treatment, which assumes an Advanced Water Treatment Facility (AWTF) that would employ MF, reverse osmosis (RO), ultraviolet (UV) light with an advanced oxidation process (AOP), post treatment and free chlorine disinfection to meet Title 22 requirements for a GRRP. This AWTF would be needed for secondary or tertiary influent. If receiving primary influent, the AWTF would include MBR, RO, UV/AOP, post treatment, and free chlorine disinfection.
- **Surface Water Augmentation (SWA)**: An AWTF for SWA would employ the same treatment train as described for a GRRP. In addition, biological nutrient removal (BNR) prior to an AWTF would likely be required to produce a high clarity, well oxygenated water that is low in nutrients and organics with dechlorination prior to discharge into a surface water reservoir. Costs and layout requirements associated with nutrient removal would require additional study and were not included in this RWFPS.
- **Streamflow Augmentation:** due to the lack of existing regulatory requirements or established criteria for streamflow augmentation it is assumed that the AWTF would be comparable to the treatment train assumed for SWA, including the need for nutrient removal prior to advanced treatment.
- **Direct Potable Reuse:** Due to the uncertainty of the treatment requirements for DPR, the AWTF proposed would consist of ozone, biologically activated carbon (BAC), MF, RO, UV/AOP, post treatment and free chlorine disinfection. This multi-barrier approach is conservative and has been shown to provide superior public health protection (Pecson et al. 2017). As was the case for SWA and streamflow augmentation, it is assumed that nutrient removal would precede the AWTF.

Options for siting future treatment facilities include:

(1) at the Santa Cruz WWTF,
(2) at external locations near the WWTF, and
(3) at satellite locations.

Conservative assumptions are included in TM #1b for the potential facility layout requirements (i.e. estimated footprint). There may be options to conserve space through design of a two-level facility; however detailed facility layouts have not been provided given this uncertainty related to treatment facility locations. Conservative layout assumptions were used and efforts were not made to minimize facility footprints or fit them into unknown specific site constraints. This approach was selected to provide the most direct comparison of the various project options being explored. The City would need to conduct a more comprehensive siting analysis following this study to provide a more detailed assessment of costs, environmental, social, engineering and operational considerations to identify a preferred facility site.

TM #1b provides high-level estimates for capital costs, and yearly operations and maintenance (O&M) costs for each alternative project based on real and estimated costs from several existing or developing water reuse facilities throughout California. TM #1b also details other assumptions associated with treatment facility operations including chemical and energy requirements, typical staffing needs and equipment replacement assumptions. All costs and assumptions are integrated into the economic evaluation of each alternative project and detailed in the cost sheets provided in Appendix F. As noted above, costs for BNR or other types of nutrient removal processes are not included as part of this assessment.

8.1.3 Engineers Opinion of Probable Costs

The engineer's opinion of probable cost is based on a conceptual level estimate of the capital and operating costs for each alternative considered for the RWFPS. Planning-level opinions of capital, O&M, and lifecycle costs are developed to facilitate an economic comparison of the projects within each alternative.

Capital, annual and life cycle 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, summarized herein.

- **Capital Cost:** Unit capital costs and recent project experience were used to estimate facility costs for treatment, pipelines, pump stations, storage tanks, site retrofits and groundwater wells. Additional facility costs for site development, yard piping, electrical, and instrumentation and controls are assigned as a percent of facility costs. Sales taxes, mobilization costs, contractor overhead and profit costs and an estimate contingency were applied to all alternatives. An annual inflation rate was applied to represent anticipated escalation to the mid-point of construction, based on an estimated construction schedule, which differs by alternative.
- **O&M Cost:** The estimated O&M costs include energy cost, labor costs, chemical costs and maintenance costs with a contingency applied to all O&M costs.
- **Life Cycle Unit Cost:** Costs are then converted to annualized lifecycle costs using basic assumptions about discount rates (estimated at 4%) and the life expectancy of project components (30-years for treatment and pump stations and 50-years for all other components). Total annualized costs are divided by the recycled water delivered over the life of the project to obtain a uniformly derived unit cost of water in dollars per acre-foot ($/AF), dollars per million gallons ($/MG) and dollars per one-hundred cubic feet ($/CCF).

Appendix F includes additional information about cost assumptions and provides a detailed opinion of probable cost for each alternative.

8.1.4 Planning Period

The planning period is defined as the period over which a water development project is evaluated for cost-effectiveness. This period is not necessarily the same as the useful lives of the facilities under consideration. The planning period begins with the system's initial operations and is defined to be 30 years for the WRFP.

8.2 Description of Recycled Water Alternatives

This section describes each project alternative including the source water, project size, beneficial uses, treatment facility and other infrastructure. A facility map and capital, O&M and life cycle costs are provided for each project alternative. The cost of delivering secondary effluent for the SqCWD GRRP is not included for any alternatives. A comparison of costs for all project alternatives is provided in the last section.

8.2.1 Alternative 1 – Centralized Non-Potable Reuse

Alternative 1 includes two City led projects, where recycled water is centrally treated and beneficially reused within the SCWD service area for non-potable reuse.

Alternative 1A – Santa Cruz Public Works Department Title 22 Upgrade Project

This alternative would upgrade and enhance the robustness of the current reclaimed water system located at the Santa Cruz WWTF. The alternative would increase the production of recycled water to meet in-plant uses as well as Title 22 requirements for non-potable reuse off-site. Key components of Alternative 1A are summarized below and illustrated in Figure 8-1.

- **Description:** Title 22 upgrades to the existing disinfected reclaimed water system at the Santa Cruz WWTF
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** ~0.25 mgd (282 AFY) tertiary RW demand
- **Uses:** Non-potable in-plant uses, truck filling, and irrigation at La Barranca Park
- **Treatment Facilities:** Chlorine disinfection using Chlorine Contact Basin #2, Interconnecting Piping, Chemical dosing System, Control System, Other Miscellaneous Components (Trussell 2015).
- **Other Infrastructure:** ~1,200 LF of 6-inch-diameter pipeline to La Barranca Park and truck filling station; recycled water pump station at Santa Cruz WWTF (1 duty, 0 standby, 10 gpm, 70 ft TDH)

A summary of loaded capital costs, by facility component, as well as life cycle unit costs is summarized in **Table 8-2**.

Table 8-2: Alternative 1A – Summary of Probable Costs

Facility Component	Alt 1A Title 22 Upgrade Project
Treatment	$770,000
Pipelines	$160,000
Pump Station	$100,000
Storage Tank	$0
Site Retrofit Costs	$20,000
Total Capital Cost ($mil)	**$1.1**
Annualized Unit Capital Cost ($/AF)	$200
Annual Unit O&M Cost ($/AF)	$800
Life Cycle Unit Cost ($/AF)	**$1,000**
Life Cycle Unit Cost ($/CCF)	**$2.30**
Life Cycle Unit Cost ($/MG)	**$3,100**
Average Annual Reuse in Santa Cruz (AFY)	**282**

Note: Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction.) See Appendix F for detailed project sheets.

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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend

- Santa Cruz WWTF
- Pump Station
- Chlorine Contact Tank
- Potential Truck Fill Site

Commercial Meters

- < 10 AFY
- > 10 AFY

City Meters

- < 10 AFY
- > 10 AFY

Irrigation Meters

- 0.002296 - 10.000000
- 10.000001 - 300.000000
- PWD Title 22 Project
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

**Includes water meters with 0 MGD demand*

N

0 50 100
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 1A – Santa Cruz Public Works Department (SCPWD) Title 22 Upgrade Project

1668007.00
May 2018
Figure 8-1

Printed by: RachelRodriguez

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Note: Service laterals to individual meters are not shown

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Alternative 1B – Maximize Tertiary Treatment

Using secondary effluent from the Santa Cruz WWTF, this alternative would provide additional tertiary treatment at the Santa Cruz WWTF (or an off-site location) to meet non-potable demands within SCWD's service area, based on the market assessment described in Section 6.3. Alternative 1B is broken into 4 phases:

- **Phase 1 – Near Plant:** Would convey recycled water from Santa Cruz WWTF to San Lorenzo Park
  - Approximately 16,000 LF of 6-inch-diameter pipeline
  - Recycled water pump station (2 duty, 1 standby, 950 gpm, 260 TDH)
  - One (1) 400,000 gallon storage tank
- **Phase 2 – Northern Extension:** Would convey recycled water from San Lorenzo Park to Santa Cruz Memorial Cemetery, DeLaveaga Park and Golf Course
  - Approximately 20,000 LF of 6-inch-diameter pipeline
  - Recycled water pump station (1 duty, 1 standby, 610 gpm, 240 ft TDH)
- **Phase 3 – Eastern Extension:** Would convey recycled water to Good Shepherd School
  - Approximately 31,000 LF of 6-inch-diameter pipeline
  - Recycled water pump station (1 duty, 1 standby, 640 gpm, 290 ft TDH)
  - One (1) 500,000 gallon storage tank
- **Phase 4 – UCSC Extension:** Would convey recycled water to UC Santa Cruz for non-potable on-campus uses including irrigation, agriculture, cooling towers, dual-plumbed facilities.
  - Approximately 34,000 LF of 6-inch-diameter pipeline
  - Recycled water pump station at or near Santa Cruz WWTF (1 duty, 1 standby, 240 gpm, 550 ft TDH) and recycled water pump station at UCSC (1 duty, 1 standby, 540 gpm, 550 ft TDH)
  - One (1) 150,000 gallon storage tank
  - On campus facilities would include approximately 25,000 LF of distribution pipelines, a 150,000-gallon storage tank, a pump station and customer retrofits.

Key components of Alternative 1B are summarized in Table 8-3 and illustrated in Figure 8-2.

- **Description:** New tertiary treatment at Santa Cruz WWTF (or off-site) to meet identified non-potable demands within SCWD's service area
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** ~0.75 mgd (825 AFY) tertiary Recycled Water demand
- **Uses**: In-plant uses, irrigation, bulk water stations and existing dual-plumbed buildings. Approximately 101 customer sites in City service area, including UCSC (with 47 sub-sites) but not including Pasatiempo Golf Course.
- **Treatment Facilities:** Tertiary treatment via GMF, chlorine disinfection using Chlorine Contact Basins, interconnecting piping, chemical dosing system, Control System, other miscellaneous components.
- **Other Infrastructure:** Conveyance and distribution pipelines, pump stations and storage (details for each phase given above).

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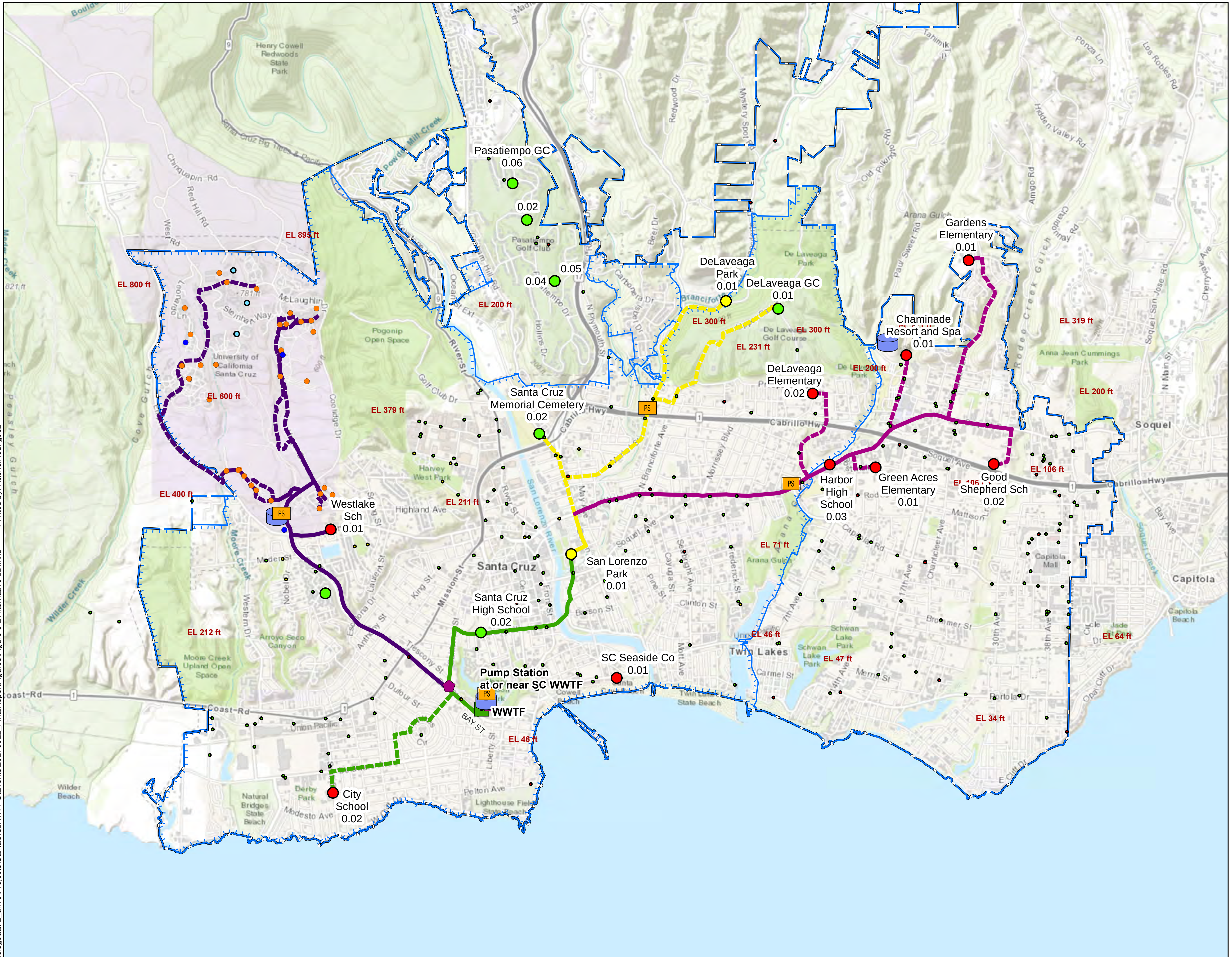

Legend

- Santa Cruz WWTF
- Pump Station
- Storage Tank
- Potential Truck Fill Site

Commercial Meters
- < 10 AFY
- > 10 AFY

City Meters
- < 10 AFY
- > 10 AFY

Irrigation Meters
- < 10 AFY
- > 10 AFY

UCSC Meters
- Cooling Towers
- UCSC Dual
- UCSC Irrigation

- Phase I
- Phase II
- Phase III
- Phase IV
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*
**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Agency
Santa Cruz, California

Alternative 1B – Maximize Tertiary Treatment

1668007.00
May 2018
Figure 8-2

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\\sfoisgdata\Z_drive\Projects\SantaCruzRWFPS\Events\20170921_FinalReportFigures\Figure 8-2 Alternative 1B.mxd

Note: Service laterals to individual meters are not shown

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A summary of loaded capital costs, by phase, as well as annual unit life cycle costs is summarized below.

Table 8-3: Alternative 1B – Summary of Probable Costs

Facility Component	Alt 1B Centralized NPR All Phases	Phase 1 – Near Plant	Phase 2 – Northern Extension	Phase 3 – Eastern Extension	Phase 4 – UCSC Extension
Treatment	$7,970,000	$1,660,000	$2,230,000	$1,840,000	$2,240,000
Pipelines	$15,100,000	$3,210,000	$2,870,000	$4,450,000	$4,570,000
Pump Station	$5,430,000	$1,070,000	$930,000	$1,070,000	$2,360,000
Storage Tank	$2,590,000	$980,000	$0	$1,110,000	$500,000
Site Retrofit Costs	$3,360,000	$340,000	$370,000	$900,000	$1,750,000
Total Capital Cost ($mil)	**$34**	**$7.3**	**$6.4**	**$9.4**	**$11.4**
Annualized Unit Capital Cost ($/AF)	$2,100	$1,100	$1,900	$3,200	$3,300
Annual Unit O&M Cost ($/AF)	$1,300	$1,000	$1,200	$1,500	$1,500
Life Cycle Unit Cost ($/AF)	**$3,400**	**$2,100**	**$3,100**	**$4,700**	**$4,800**
Life Cycle Unit Cost ($/CCF)	$7.80	$4.80	$7.10	$10.80	$11.00
Life Cycle Unit Cost ($/MG)	$10,400	$6,400	$9,500	$14,400	$14,700
Ave Annual Reuse in Santa Cruz (AFY)	**840**	**341**	**176**	**146**	**177**

It is noted that for all subsequent alternatives, it is assumed that this SCPWD Title 22 Upgrade Project would have been implemented and hence, the associated facilities and costs are not included.

8.2.2 Alternative 2 – Decentralized Non-Potable Reuse

Alternative 2 is a joint effort between the City and UCSC which would treat local raw wastewater from the campus sewer collection system at a decentralized location, i.e. satellite treatment facility, for beneficial reuse to meet on-campus non-potable demands. This alternative would include a MBR to produce Title 22 tertiary disinfected recycled water for non-potable on-campus uses in five major demand areas; (1) Athletic Fields, (2) Arboretum and Farm, (3) Faculty Housing, (4) West Demand Cluster and (5) Cooling Towers. A pump station and conveyance and distribution pipelines would also be needed.

For this alternative, all facilities would be located on-campus or close to the base of campus including the MBR, which would be located to capture the east and west branch sewer flow. Additional study is needed to confirm the available sewer flows seasonally and diurnally to meet demands and identify treatment criteria. The preferred location of the satellite treatment facility, pump station and pipeline alignments would be identified in a future investigation.

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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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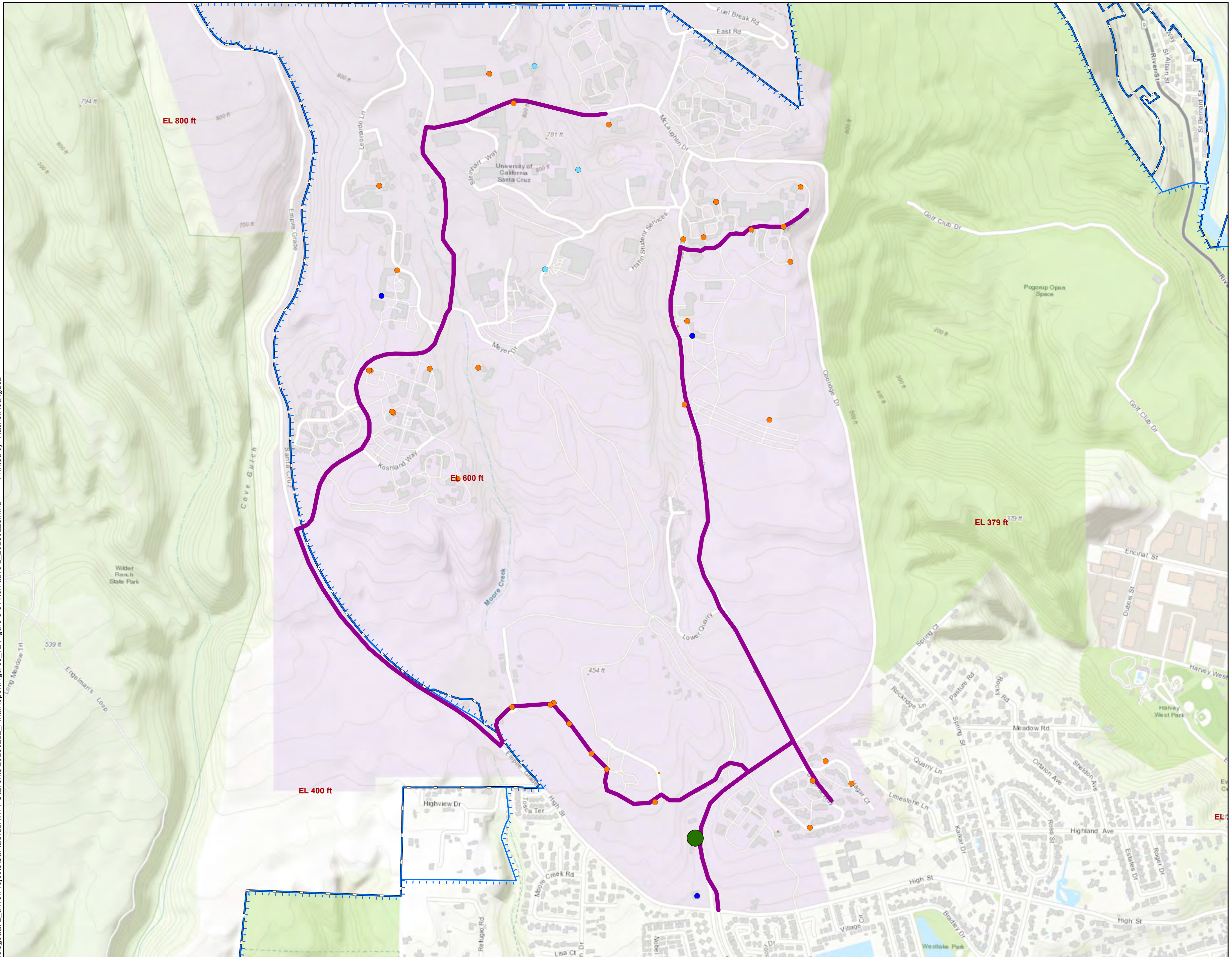

Legend

- UCSC Cooling Tower Meters
- UCSC Dual Water Meters
- UCSC Irrigation Meters
- City of Santa Cruz Wastewater Meter
- Tertiary Effluent Pipeline
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

Note: 3 out of 4 cooling rowers are at the same location*

N

0 500 1,000

Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 2 – Decentralized Non-Potable Reuse at UC Santa Cruz

1668007.00
February 2018
Figure 8-3

Note: Service laterals to individual meters are not shown

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Key components of Alternative 2 are summarized below and illustrated in Figure 8-3.

- **Description:** Satellite treatment at or near UCSC to meet on-campus non-potable demands
- **Source:** UCSC wastewater collection system
- **Project Size:** 0.14 mgd (155 AFY) tertiary recycled water demand
- **Uses:** Irrigation and existing dual-plumbed buildings at ~5 clusters of customer sites (with 47 sub-sites)
- **Treatment Facilities:** Tertiary treatment using a MBR with UV disinfection for tertiary treatment
- **Other Infrastructure:** ~24,600 LF of 6-inch-diameter conveyance and distribution pipelines; recycled water pump station (1 duty, 1 standby, 540 gpm, 550 ft TDH); 150,000-gallon storage tank.

A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized below.

Table 8-4: Alternative 2 – Summary of Probable Costs

Facility Component	Alt 2 Decentralized NPR
Treatment	$21,230,000
Pipelines	$3,290,000
Pump Station	$1,460,000
Storage Tank	$490,000
Site Retrofit Costs	$1,590,000
Total Capital Cost ($mil)	**$28.1**
Annualized Unit Capital Cost ($/AF)	$10,100
Annual Unit O&M Cost ($/AF)	$1,900
Life Cycle Unit Cost ($/AF)	**$12,000**
Life Cycle Unit Cost ($/CCF)	**$27.50**
Life Cycle Unit Cost ($/MG)	**$36,800**
Average Annual Reuse in Santa Cruz (AFY)	**155**

Note: Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction.) See Appendix F for detailed project sheets.

8.2.3 Alternative 3 – Santa Cruz Participation in SqCWD led GRRP

Alternative 3 consists of five projects that would involve the City's participation in a GRR project with SqCWD to meet regional demands and share facilities. Alternative 3 builds off the recommended projects developed as part of SqCWD's Groundwater Replenishment Feasibility Study (Carollo 2016) which assumes that 1.3 mgd of groundwater recharge would occur in the Purisima Formation in SqCWD's service area. Demands and uses in Santa Cruz vary by project and would include non-potable reuse for irrigation and/or potable reuse for groundwater replenishment via direct injection.

Three projects are based on an AWTF located in the SqCWD service area (Alts 3A, 3B and 3C) and two projects are based on an AWTF located at or near the Santa Cruz WWTF (Alts 3D and 3E). The

Alternative 3 projects are described in the following sections with a summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized at the end of this section in Table 8-5.

Alternative 3A – SqCWD GRRP (Baseline)

Alternative 3A would send secondary effluent from the Santa Cruz WWTF to SqCWD for injection in the Purisima Formation in SqCWD's service area. There would be no use of secondary recycled water in SCWD's service area primarily because there are relatively few urban uses that can utilize secondary effluent under Title 22 regulations and no suitable sites were identified to operate an on-site treatment facility.

This alternative provides the costs for the Pure Water Soquel, Groundwater Replenishment Seawater Intrusion Prevention Project (herein referred to as Pure Water Soquel) without reuse within SCWD's service area and is the baseline to compare the cost of varying levels of the City's participation (Alternatives 3B through 3E). Pure Water Soquel is a groundwater replenishment project using advanced water purification methods to supplement the natural recharge of the Santa Cruz Mid-County Groundwater Basin in SqCWD's service area, reduce the degree of overdraft conditions, and protect it against seawater intrusion, and promote beneficial reuse by reducing discharge of treated wastewater to the Monterey Bay National Marine Sanctuary. Pure Water Soquel would provide sufficient treatment capacity to offset impacts to the basin attributable to SqCWD pumping. It also includes the potential use of the advanced treated water for landscape irrigation application and redistribution of groundwater pumping from District extraction wells (ESA 2017)[10]. The SqCWD Board selected this project as the preferred supplemental water supply and directed staff to further evaluate. The City and SqCWD have entered into a Memorandum of Understanding (MOU), included in Appendix H, to memorialize preliminary terms related to Pure Water Soquel.

Key components of Alternative 3A are summarized below and illustrated in Figure 8-4.

- **Description:** Send secondary effluent from Santa Cruz WWTF to SqCWD for treatment and injection in the Purisima Formation in SqCWD's service area.
- **Source Water:** Santa Cruz WWTF secondary effluent.
- **Project Size:** 1.7 mgd (1,900 AFY) secondary effluent conveyed to SqCWD to produce 1.3 mgd (1,450 AFY) advanced treated recycled water for GRR in SqCWD.
- **Uses**: Groundwater recharge in the Purisima Formation in SqCWD's service area.
- **Treatment Facilities:** AWTF at SqCWD employing full advanced treatment with MF, RO and UV/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.

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10 http://www.soquelcreekwater.org/planning-our-water-future/purewatersoquel

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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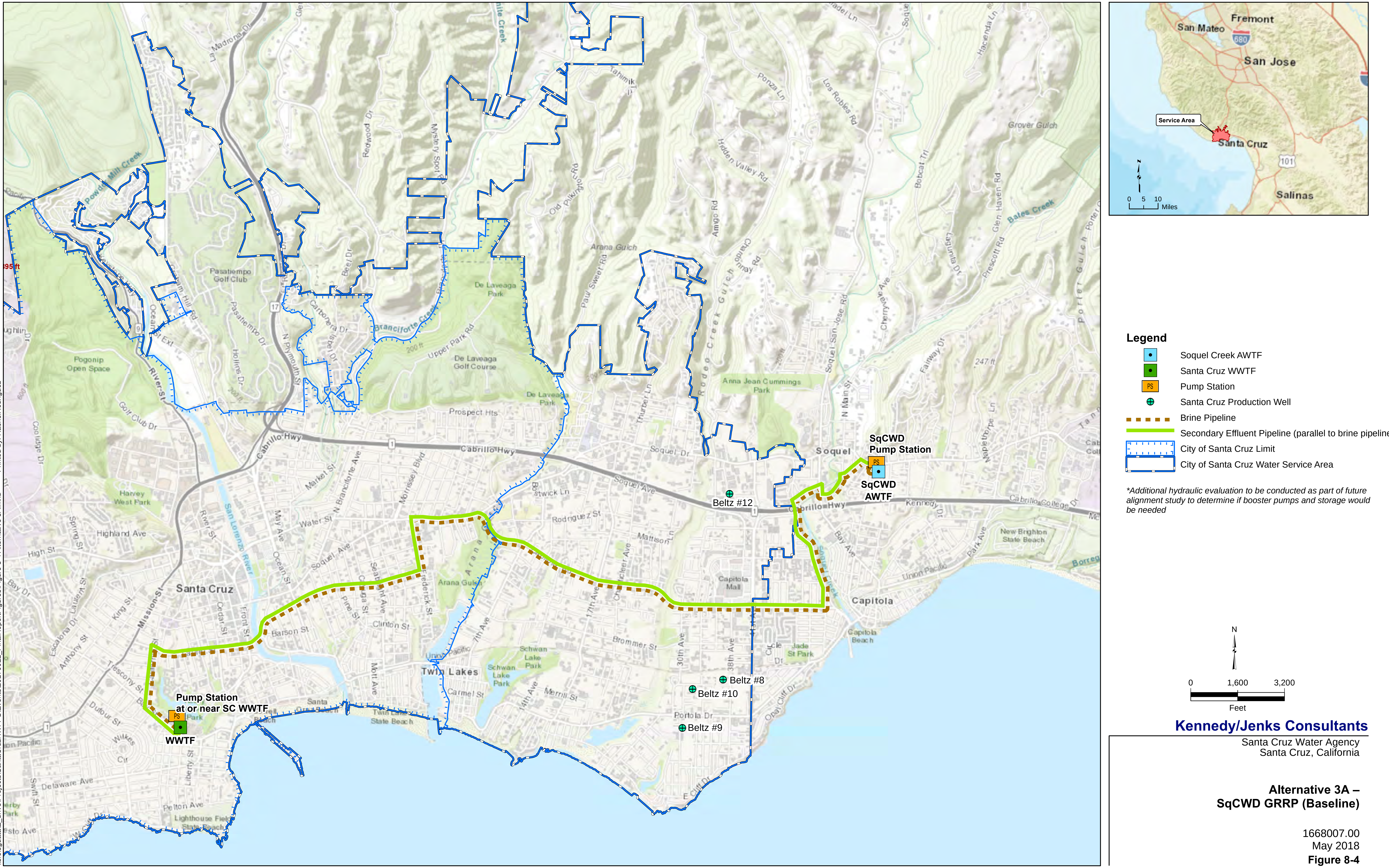

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Kennedy/Jenks Consultants

Santa Cruz Water Agency
Santa Cruz, California

Alternative 3A – SqCWD GRRP (Baseline)

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May 2018
Figure 8-4

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- **Other Infrastructure:**
    - Secondary effluent pump station at Santa Cruz WWTF (2 duty, 1 standby, 1,180 gpm, 460 ft TDH per pump) and brine pump station at SqCWD AWTF (2 duty, 1 standby, 280 gpm, 810 ft TDH).
    - 38,600 LF of 14-inch-diameter effluent pipeline from Santa Cruz WWTF to SqCWD AWTF and 38,600 LF of 6-inch diameter brine pipeline from SqCWD AWTF to connect with the existing ocean outfall at Santa Cruz WWTF.
    - Pipelines for the conveyance of advanced treated water, recharge and monitoring wells.

Since no recycled water would be beneficially reused in the SCWD service area; costs for facilities associated with this alternative are not included in the annual unit life cycle cost analysis as they are assumed to be borne entirely by SqCWD.

Alternative 3B – SqCWD GRRP with Tertiary NPR in Santa Cruz

Alterantive 3B would send tertiary effluent from the Santa Cruz WWTF to SqCWD for treatment and injection in the Purisima Formation in SqCWD's service area. Non-potable demands in SCWD's service area could be served along the way.

Key components of Alternative 3B are summarized below and illustrated in Figure 8-5.

- **Description:** Send tertiary effluent from Santa Cruz WWTF to SqCWD for treatment and injection in the Purisima Formation in SqCWD's service area and meet identified non-potable demands within the SCWD's service area
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 1.7 mgd (1,900 AFY) tertiary recycled water conveyed to SqCWD to produce 1.3 mgd (1,450 AFY) advanced treated recycled water for GRR in SqCWD, 0.25 mgd (282 AFY) Santa Cruz WWTF in-plant use, 0.23 mgd (263 AFY) and 0.005 mgd (5 AFY) to meet NPR demand within SCWD's service area and SqCWD's service area respectively.
- **Uses**: Irrigation at approximately 34 customer sites in City along the pipeline alignment to SqCWD.
- **Treatment Facilities:** Tertiary treatment at Santa Cruz WWTF via GMF, chlorine disinfection using Chlorine Contact Basins, interconnecting piping, chemical dosing System, Control System, other miscellaneous components. AWTF at SqCWD (see Alternative 3A). Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
    - Tertiary effluent pump station at Santa Cruz WWTF (2 duty, 1 standby, 880 gpm, 400 ft TDH) and brine pump station at SqCWD AWTF (2 duty, 1 standby, 280 gpm, 550 ft TDH).
    - 38,600 LF of 16-inch-diameter and 8,400 of 6-inch diameter tertiary effluent pipelines from Santa Cruz WWTF to SqCWD AWTF serving NPR demands along the way, and 38,600 LF of 8-inch diameter brine pipeline from SqCWD AWTF to connect with the existing ocean outfall at Santa Cruz WWTF.

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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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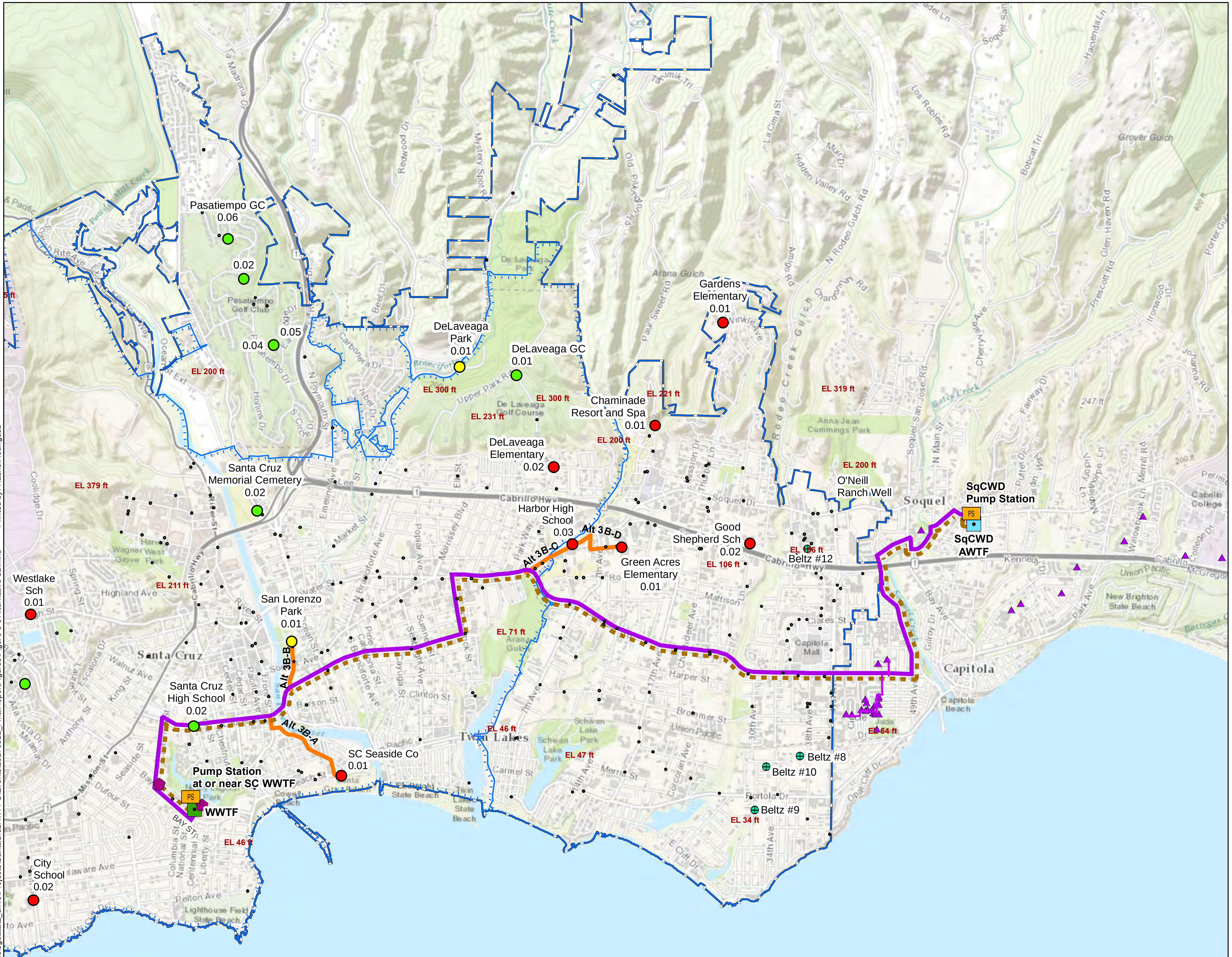

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Legend

- Soquel Creek AWTF
- Santa Cruz WWTF
- PS Pump Station
- Potential Truck Fill Site
- Santa Cruz Production Well
- SqCWD NPR Sites

Commercial Meters

- < 10 AFY
- > 10 AFY

City Meters

- < 10 AFY
- > 10 AFY

Irrigation Meters

- < 10 AFY
- > 10 AFY

- Tertiary Effluent (parallel to brine pipeline)
- Brine Pipeline
- NPR Distribution Pipeline (segment name)
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N

0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 3B – SqCWD GRRP with Tertiary NPR in Santa Cruz

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September 2017
Figure 8-5

Note: Service laterals to individual meters are not shown

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Alternative 3C - SqCWD GRRP with GRR and NPR in Santa Cruz

Alternative 3C would send additional secondary effluent from the Santa Cruz WWTF to SqCWD for injection in the Purisima Formation in SqCWD's service area and provide additional infrastructure for the delivery of excess advanced treated water from the AWTF back to the City for injection in the Beltz Wellfield area in the SCWD's service area. Non-potable demands in Santa Cruz's service area would be served by the advanced treated water pipeline along the way.

The City's GRRP concept would involve direct injection of advanced treated water into the Beltz Wellfield area of the Purisima Formation via injection wells to achieve a minimum travel time of 6-months between the point of injection and the point of extraction. TM #2a - Beltz Wellfield Area Injection Well Capacity and Siting Study (included in Appendix C) describes subsurface geologic and hydrogeological conditions and existing production well characteristics in the Beltz Wellfield area, with a focus on opportunities for groundwater recharge in the vicinity of Beltz Wells #8, #9, #10 and #12. An evaluation of injection well capacity was performed using the Beltz Screening Model, a 3-D steady state groundwater flow model developed for this study, to assess the feasibility of using recycled water for groundwater replenishment through injection wells and the ability of existing production wells to extract the recharged water and meet Title 22 GRR Regulations (previously described in TM #1a and Section 5.4.2).

The modeling effort in TM #2a arrived at the following conclusions:

- Assuming injection rates of 0.5 MGD per well; two injection wells could be sited and operated at the North Beltz Wellfield (Beltz #12) and achieve a groundwater retention period of 4 to 5 years until any injected water would be extracted by the downgradient well.
- Assuming injection rates of 0.5 MGD per well; two injection wells could be sited and operated at the South Beltz Wellfield (Beltz #8, #9 and #10) and achieve a groundwater retention period of 4 to 5 years until any injected water would be extracted by the downgradient well.

Thus, the estimated GRR capacity for the Beltz Wellfield area is assumed to be 2.0 mgd. Though potential injection well sites are identified in TM #2a, further modeling and siting evaluation is recommended should a GRR Project be pursued in this area to determine if additional benefit is realized by additional wells.

Key components of Alternative 3C are summarized below and illustrated in Figure 8-6.

- **Description:** Send additional secondary effluent from the Santa Cruz WWTF to SqCWD AWTF and deliver advanced treated water back to the City for groundwater recharge and NPR.
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 4.33 mgd (4,850 AFY) of secondary effluent to SqCWD to produce 1.3 mgd (1,450 AFY) of advanced treated recycled water for GRR in SqCWD and 2.0 mgd (2,250 AFY) of advanced treated recycled water for GRR at the Beltz Wellfield, 0.01 mgd (11 AFY) and 0.005 mgd (5 AFY) to meet NPR demand within SCWD's and SqCWD's service area respectively.

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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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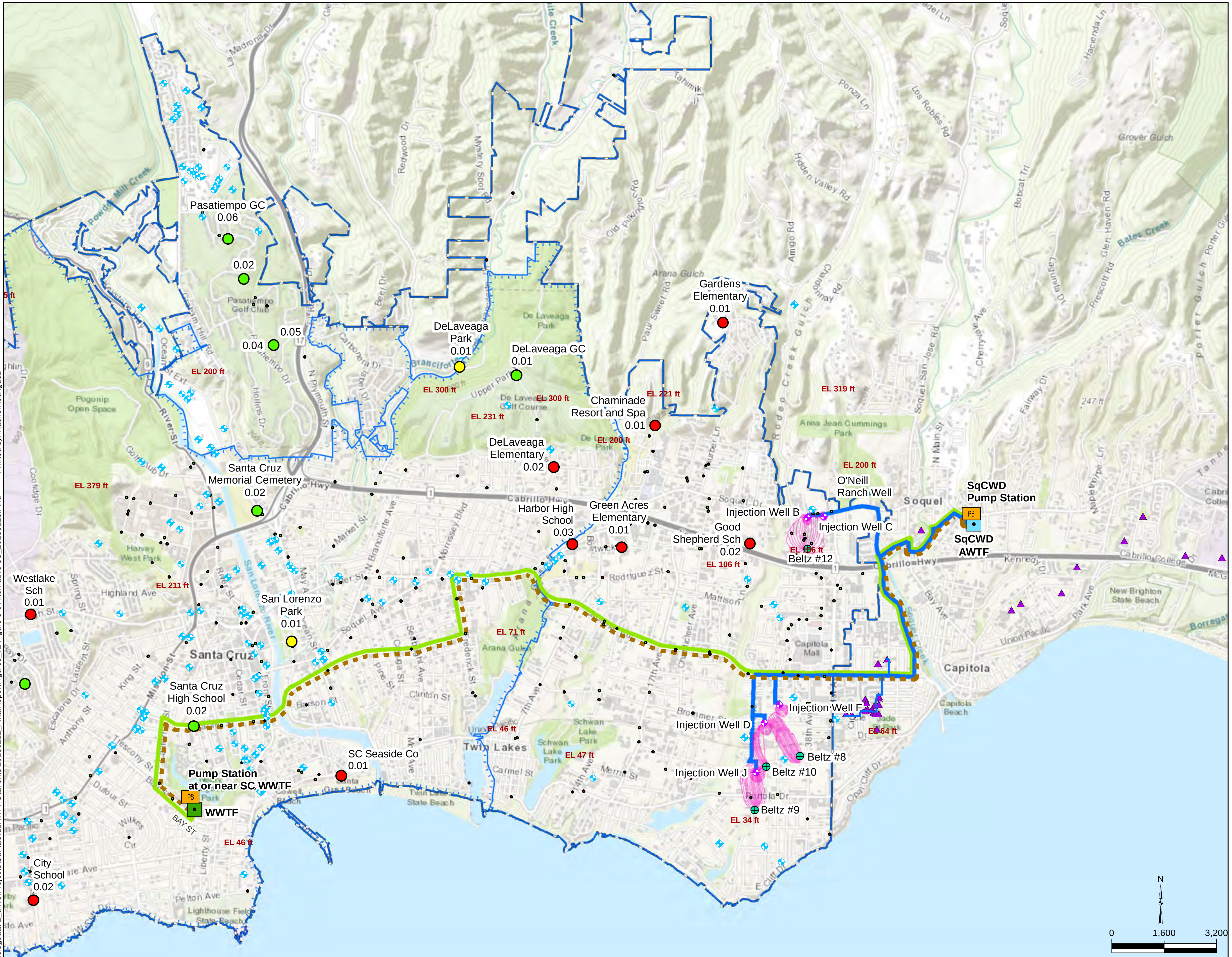

Legend

- Soquel Creek AWTF
- Santa Cruz WWTF
- Pump Station
- Soquel Creek Production Well
- Santa Cruz Production Well
- Santa Cruz Injection Well
- Santa Cruz Private Well
- SqCWD NPR Sites

Commercial Meters
- < 10 AFY
- > 10 AFY

City Meters
- < 10 AFY
- > 10 AFY

Irrigation Meters
- < 10 AFY
- > 10 AFY

- Particle Flow Lines
- AWT Pipeline
- Secondary Effluent Pipeline (parallel to brine pipeline)
- Brine Pipeline
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 3C

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February 2018
Figure 8-6

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Note: Service laterals to individual meters are not shown

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- **Uses**: Irrigation at approximately 8 customer sites in City along the pipeline alignment from the AWTF to the City's GRR injection sites. Groundwater replenishment at Beltz Wellfield.
- **Treatment Facilities:** AWTF at SqCWD (see Alternative 3A). Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:** Pump station at Santa Cruz WWTF, a conveyance pipeline to AWTF at SqCWD, advanced treated water pipeline from the AWTF to the Beltz Wellfield GRR injection sites, GW injection and monitoring wells, brine discharge via pipeline from the AWTF to connect with the existing ocean outfall.
    - Secondary effluent pump station at Santa Cruz WWTF (1 duty, 1 standby, 2,720 gpm, 580 ft TDH), brine pump station at SqCWD AWTF (1 duty, 1 standby, 710 gpm, 290 ft TDH), and 1 advanced treated water pump station at SqCWD AWTF (1 duty, 1 standby, 400 gpm, 100 ft TDH).
    - 38,600 LF of 20-inch-diameter effluent pipeline from Santa Cruz WWTF to SqCWD AWTF and 38,600 LF of 8-inch diameter brine pipeline from SqCWD AWTF to connect with the existing ocean outfall at Santa Cruz WWTF.
    - 5 injection wells (including 1 back-up well) and 5 monitoring wells and associated buildings.

A summary of loaded costs, by facility component, and annual unit life cycle costs is summarized in Table 8-5.

Alternative 3D - SqCWD GRRP with AWTF and NPR in Santa Cruz

Alternative 3D would send advanced treated water from the Santa Cruz WWTF to SqCWD for injection in the Purisima Formation in SqCWD's service area. Non-potable demands in Santa Cruz's service area could be served by the advanced treated water pipeline along the way.

Key components of Alternative 3D are summarized below and illustrated in Figure 8-7.

- **Description:** Send advanced treated water from an AWTF at the Santa Cruz WWTF to SqCWD for injection in the Purisima Formation in SqCWD's service area and meet identified non-potable demands within the City's service area.
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 1.3 mgd (1,450 AFY) of advanced treated recycled water conveyed to SqCWD for GRR. 0.07 mgd (82 AFY) and 0.005 mgd (5 AFY) to meet NPR demand within SCWD's and SqCWD's service area respectively.
- **Uses**: Irrigation at approximately 34 customer sites in City along the pipeline alignment to SqCWD.
- **Treatment Facilities:** AWTF at or near the Santa Cruz WWTF. Full advanced treatment that would include similar facilities as described in Alternative 3A. Brine discharge via connection to existing ocean outfall.

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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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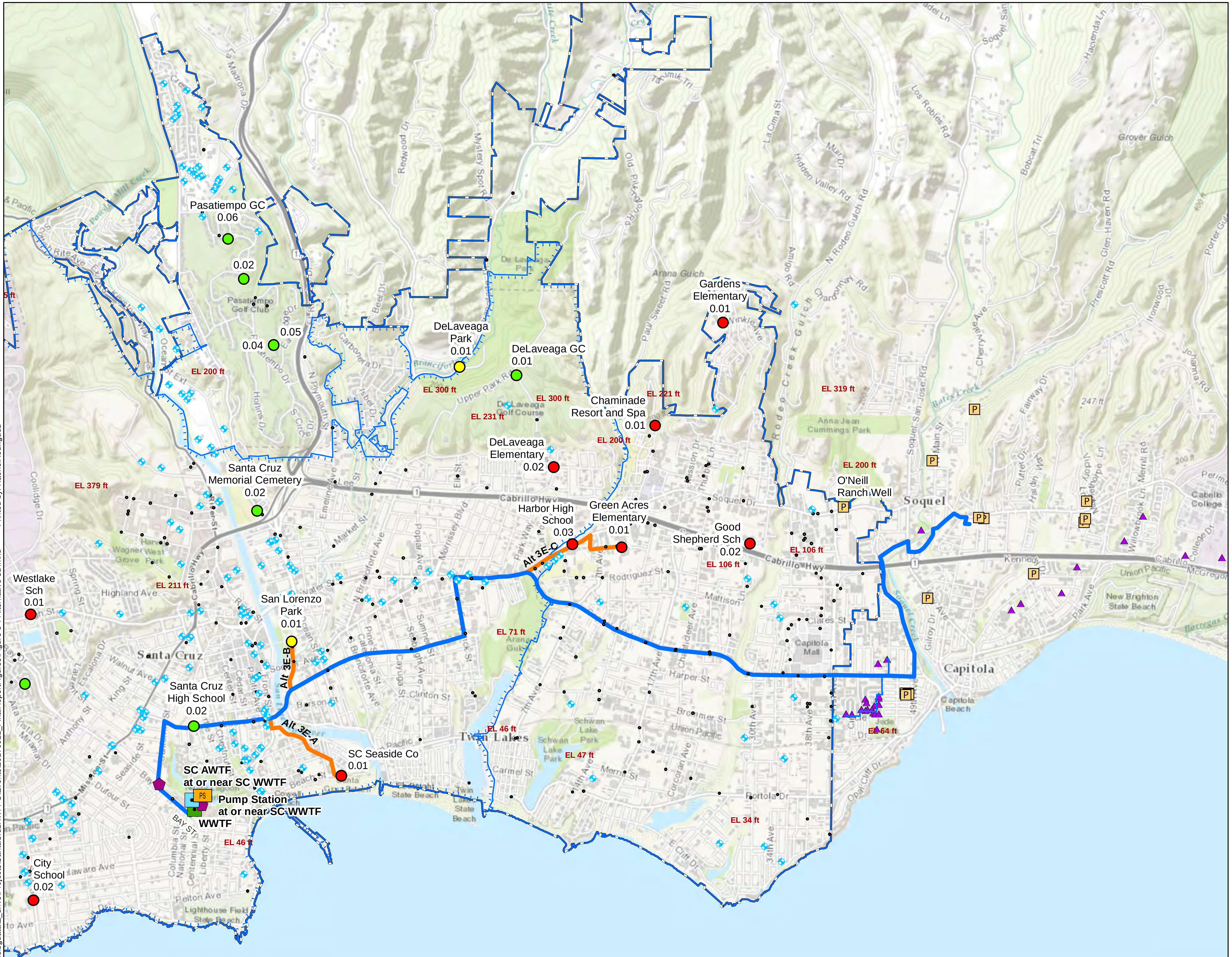

Legend

- Santa Cruz AWTF
- Santa Cruz WWTF
- Pump Station
- Soquel Creek Production Well
- Potential Truck Fill Site
- Santa Cruz Private Well
- SqCWD NPR Sites

Commercial Meters
- < 10 AFY
- > 10 AFY

City Meters
- < 10 AFY
- > 10 AFY

Irrigation Meters
- < 10 AFY
- > 10 AFY

- AWT Pipeline
- NPR Distribution Pipeline (segment name)
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N
0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 3D – SqCWD GRRP with AWTF and NPR in Santa Cruz

1668007.00
September 2017
Figure 8-7

Note: Service laterals to individual meters are not shown

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- **Other Infrastructure:**
  - Advanced treated water pump station at Santa Cruz WWTF (1 duty, 1 standby, 7,790 gpm, 490 ft TDH),
  - 8,400 LF of 6-inch-diameter and 38,600 LF of 14-inch-diameter advanced treated water pipeline from AWTF at or near Santa Cruz WWTF to SqCWD.

A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-5.

Alternative 3E - SqCWD GRRP with AWTF, GRR and NPR in Santa Cruz

Alternative 3E would send advanced treated water from the Santa Cruz WWTF to SqCWD for injection in the Purisima Formation in SqCWD's service area as well as for injection in the Beltz Wellfield area in the SCWD's service area. Similar to Alternative 3C, groundwater recharge in the City would occur at the Beltz Wellfield area based on the findings of TM #2a - Beltz Wellfield Area Injection Well Capacity and Siting Study (included in Appendix C). Non-potable demands in Santa Cruz's service area would be served by the advanced treated water pipeline along the way.

Key components of Alternative 3E are summarized below and illustrated in Figure 8-8.

- **Description:** Send advanced treated water from an AWTF at the Santa Cruz WWTF to SqCWD for injection in the Purisima Formation in SqCWD's service area and also deliver advanced treated water to the City for groundwater recharge and NPR
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 1.3 mgd (1,450 AFY) of advanced treated recycled water conveyed to SqCWD for GRR and 2.0 mgd (2,250 AFY) of advanced treated recycled water for GRR at the Beltz Wellfield. 0.11 mgd (120 AFY) and 0.005 mgd (5 AFY) to meet NPR demand within SCWD's and SqCWD's service area respectively.
- **Uses**: Irrigation at approximately 39 customer sites in City along the pipeline alignment from the AWTF to the City's GRR injection sites. Groundwater replenishment at Beltz Wellfield.
- **Treatment Facilities:** AWTF at or near the Santa Cruz WWTF. Full advanced treatment would include similar facilities as described in Alternative 3A. Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
  - Advanced treated water pump station at Santa Cruz WWTF (1 duty, 1 standby, 2,400gpm, 450 ft TDH),
  - 5,600 LF of 6-inch-diameter, 10,100 LF of 8-inch-diameter, 13,000 LF of 12-inch-diameter and 26,400 LF of 16-inch-diameter advanced treated water pipeline from AWTF at or near Santa Cruz WWTF to SqCWD and Beltz wellfield injection wells,
  - 5 injection wells (including 1 back-up well) and 5 monitoring wells and associated buildings.

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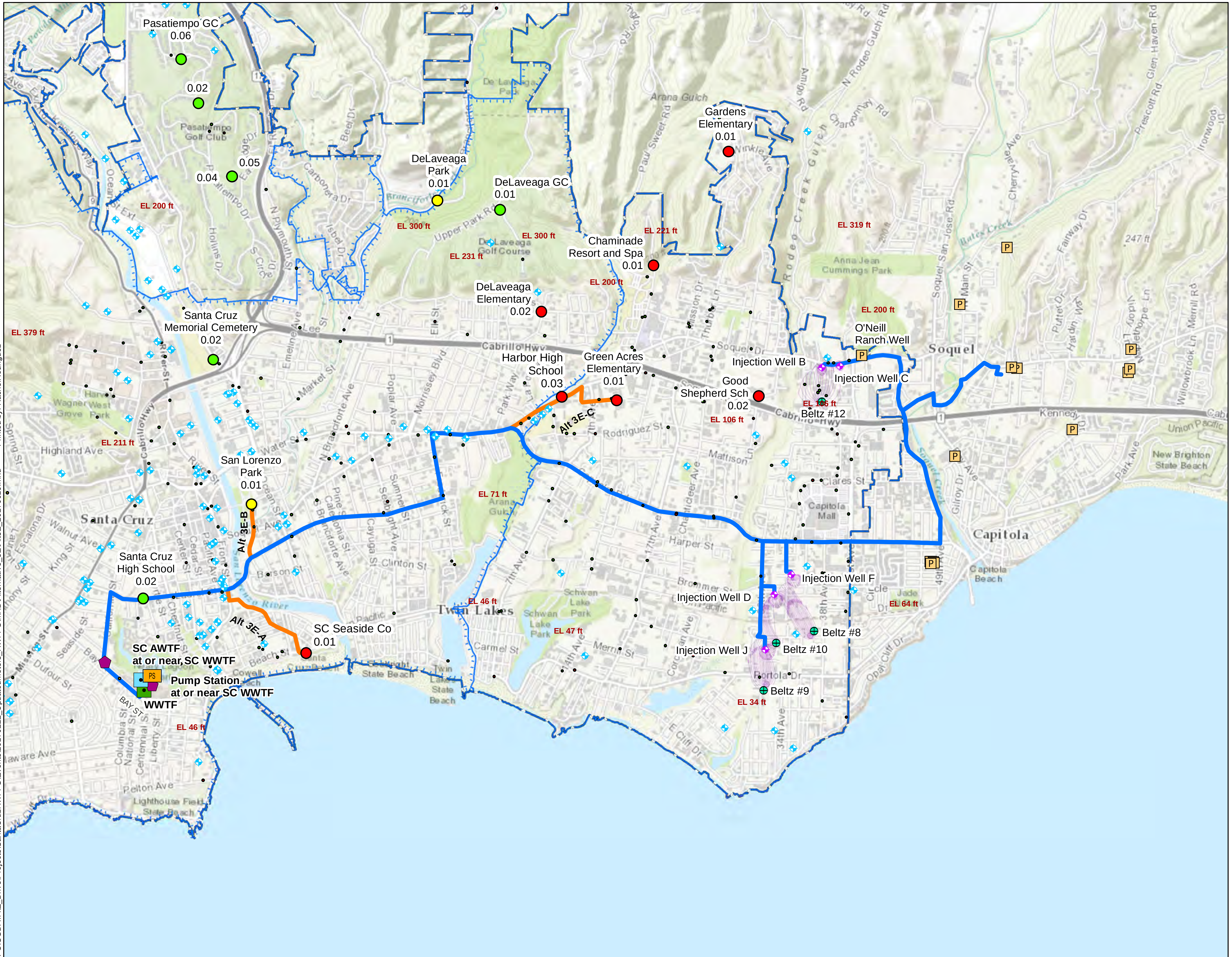
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



Legend

- Santa Cruz AWTF
- Santa Cruz WWTF
- Soquel Creek Production Well
- Potential Truck Fill Site
- Santa Cruz Production Well
- Santa Cruz Injection Well
- Santa Cruz Private Well

Commercial Meters
- < 10 AFY
- > 10 AFY

City Meters
- < 10 AFY
- > 10 AFY

Irrigation Meters
- < 10 AFY
- > 10 AFY

- Particle Flow Lines
- AWT Pipeline
- NPR Distribution Pipeline (segment name)
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N

0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 3E – SqCWD GRRP with AWTF, GRR and NPR in Santa Cruz

1668007.00
September 2017
Figure 8-8

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Note: Service laterals to individual meters are not shown

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Summary of Alternative 3

This type of regional project would require coordination between multiple agencies to establish agreements related to ownership, operation and implementation of large infrastructure facilities. Regional projects also offer opportunities for cost-sharing and pursuit of funding as a region. The level of treatment required for a GRRP via direct injection would have challenges associated with operating and maintaining an AWTF and meeting GRR monitoring requirements. Energy requirements would also be higher compared to tertiary treatment. Public acceptance of a groundwater recharge project with advanced treated recycled water is uncertain at this time. Future studies would be needed to confirm siting of facilities and to further explore GRR in the City's service area.

A summary of loaded capital costs, by facility component, as well as life cycle unit costs is shown in Table 8-5. For Alternatives 3B through 3E, the costs shown reflect the proportional facility cost and O&M costs associated with reuse in the City. In other words, the associated facilities and costs necessary for the treatment and delivery of flows for the SqCWD GRRP are not included. The detailed cost sheets in Appendix F indicate the capital costs associated with SqCWD's portion of treatment, pipelines and pumping in parenthesis and in red text. Details on alternative cost sharing options are described in Appendix F4. Current water rates and fees for the City and SqCWD are included for reference in Appendix H.3. Each agency would assess the impact of cost allocations, associated with participation in a regional project, on customer rates and the overall rate structure as part of future studies.

Table 8-5: Alternative 3 – Summary of Probable Costs

Facility Component	Alt 3A Baseline[1]	Alt 3B Tertiary NPR[2]	Alt 3C AWT NPR + GRR	Alt 3D AWT NPR	Alt 3E AWT NPR + GRR
Treatment	No City Costs	$13,750,000	$38,620,000	$3,000,000	$41,790,000
Pipelines	No City Costs	$5,520,000	$17,140,000	$2,880,000	$14,270,000
Pump Station	No City Costs	$300,000	$3,860,000	$250,000	$2,630,000
Site Retrofit Costs	not incl.	$820,000	$200,000	$800,000	$950,000
Wells	not incl.	not incl.	$9,030,000	not incl.	$9,030,000
Total Capital Cost ($mil)	**n/a**	**$20.4**	**$69.8**	**$6.9**	**$68.7**
Annualized Unit Capital Cost ($/AF)	n/a	$2,000	$1,600	$4,100	$1,600
Annual Unit O&M Cost ($/AF)	n/a	$600	$17500	$4,900	$1,300
Life Cycle Unit Cost ($/AF)	**n/a**	**$2,600**	**$3,300**	**$9,000**	**$2,900**
Life Cycle Unit Cost ($/CCF)	**n/a**	**$6.00**	**$7.60**	**$20.70**	**$6.70**
Life Cycle Unit Cost ($/MG)	**n/a**	**$8,000**	**$10,100**	**$27,600**	**$8,900**
Average Annual Reuse in Santa Cruz[3] (AFY)	0	550	2,248	88	2,368

Note: Costs shown represent the City's proportional share based on flow. Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction). See Appendix F for detailed project sheets

[1] Alt 3A provides 0 AF of recycled water use in the City, therefore the facility and unit cost for the City are not calculated

[2] Alt 3B includes tertiary treatment costs for flows to serve City NPR and SqCWD deliveries.

[3] Includes in-plant use, NPR in SCWD service area and groundwater recharge (for Alts 3C and 3E only)

8.2.4 Alternative 4 – Santa Cruz GRRP

Alternative 4 comprises two projects that involve the advanced treatment of recycled water at a centralized and decentralized location for injection into the Beltz Wellfield area in the City's service area. Facilities for a SqCWD GRRP are not included in this alternative. Demands in Santa Cruz would include groundwater replenishment via direct injection and serving non-potable, irrigation, users along the way.

Similar to Alternatives 3C and 3E, groundwater recharge in the City would occur within the Beltz Wellfield area. Based on the findings of TM #2a - Beltz Wellfield Area Injection Well Capacity and Siting Study (included in Appendix C), a 2.0 mgd (2,240 AFY) GRRP in the Beltz Wellfield area would include three new injection well sites and two existing production wells. These wells would be able to meet Title 22 GRR Regulations (previously described in TM #1a and Section 5.4.2). Though potential injection well sites are identified in TM #2a, further modeling and siting evaluation is recommended should a GRR Project be pursued in this area.

The Alternative 4 projects are described in the following sections with a summary of costs provided at the end.

Alternative 4A – Santa Cruz Centralized GRRP

Alternative 4A would send advanced treated water from the Santa Cruz WWTF, or a nearby location, for injection in the Beltz Wellfield area in the SCWD's service area. Non-potable demands in Santa Cruz's service area would be served by the advanced treated water pipeline along the way.

Key components of Alternative 4A are summarized below and illustrated in Figure 8-9.

- **Description:** Independent GRRP in Santa Cruz with a centralized AWTF at or near the Santa Cruz WWTF, to send advanced treated water for injection in the Beltz Wellfield area in the City's service area and also deliver advanced treated water for NPR along the way.
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 2.0 mgd (2,240 AFY) advanced treated water for GRR at the Beltz Wellfield. 0.11 mgd (120 AFY) to meet NPR demand in SCWD's service area.
- **Uses**: Irrigation at approximately 35 customer sites in City along the pipeline alignment from the AWTF to the City's GRR injection sites. Groundwater replenishment at Beltz Wellfield.
- **Treatment Facilities:** AWTF at or near Santa Cruz WWTF employing full advanced treatment with MF, RO and UV/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
  - Advanced treated water pump station at Santa Cruz WWTF (1 duty, 1 standby, 1,460 gpm, 310 ft TDH),
  - 7,300 LF of 6-inch-diameter, 9,600 LF of 10-inch-diameter, and 26,000 LF of 12-inch-diameter advanced treated water pipeline from AWTF at or near Santa Cruz WWTF to Beltz wellfield injection wells,
  - 5 injection wells (including 1 back-up well) and 5 monitoring wells and associated buildings.

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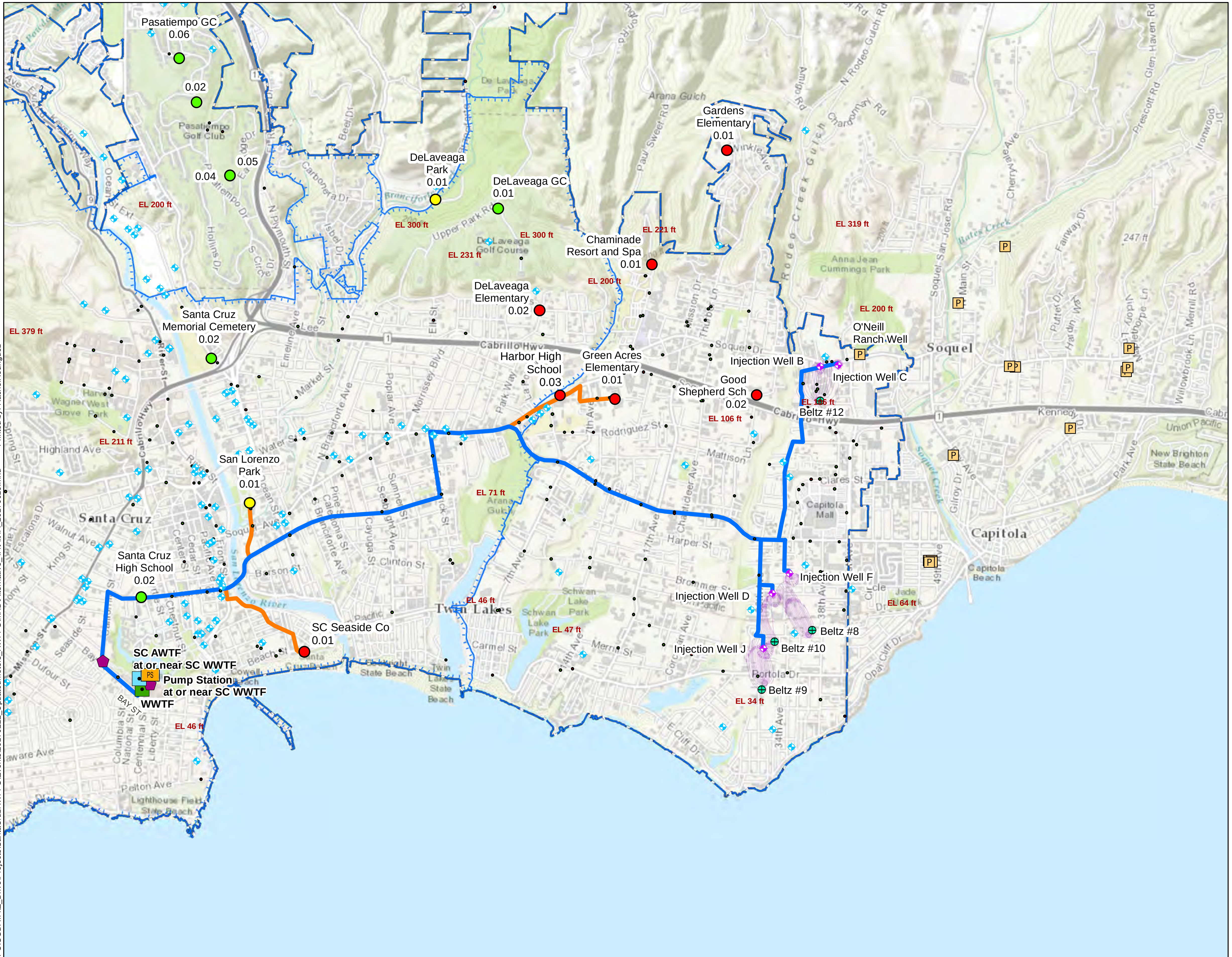

Legend

- Santa Cruz AWTF
- Santa Cruz WWTF
- Pump Station
- Soquel Creek Production Well
- Potential Truck Fill Site
- Santa Cruz Production Well
- Santa Cruz Injection Well
- Santa Cruz Private Well

Commercial Meters
- < 10 AFY
- > 10 AFY

City Meters
- < 10 AFY
- > 10 AFY

Irrigation Meters
- < 10 AFY
- > 10 AFY

- Particle Flow Lines
- AWT Transmission Pipeline
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N
0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 4A –
Santa Cruz Centralized GRRP

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September 2017
Figure 8-9

Note: Service laterals to individual meters are not shown

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A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-6.

Alternative 4B – Santa Cruz Decentralized GRRP

Alternative 4B would send advanced treated wastewater from the Santa Cruz County wastewater collection system at a decentralized, satellite treatment facility located at the DA Porath Pump Station, and send advanced treated water for injection in the Beltz Wellfield area in the SCWD's service area. Non-potable demands in Santa Cruz's service area would be served by the advanced treated water pipeline along the way.

Similar to Alternatives 3C, 3E and 4A, groundwater recharge in the City would occur at the Beltz Wellfield area based on the findings of TM #2a - Beltz Wellfield Area Injection Well Capacity and Siting Study (included in Appendix C).

Key components of Alternative 4B are summarized below and illustrated in 8-10.

- **Description:** Independent GRRP in Santa Cruz with a satellite treatment facility at the DA Porath Pump Station, to send advanced treated water for injection in the Beltz Wellfield area in City's service area and also deliver advanced treated water for NPR along the way.
- **Source Water:** Santa Cruz County wastewater collection system effluent collected at DA Porath Pump Station
- **Project Size:** 2.0 mgd (2,240 AFY) advanced treated water for GRR at the Beltz Wellfield. 0.0002 mgd (0.24 AFY) to meet NPR demand within SCWD's service area.
- **Uses**: Irrigation at approximately 2 customer sites in City along the pipeline alignment from the AWTF to the City's GRR injection sites. Groundwater replenishment at Beltz Wellfield.
- **Treatment Facilities:** A MBR for tertiary treatment, and an AWTF with RO and UV/Peroxide for advanced oxidation. Since the MBR integrates an MF or UF membrane, the AWTF would not include a duplicate MF in the treatment train. It is assumed that reject water from the RO would be discharged to the existing sewer system.
- **Other Infrastructure:**
    - Advanced treated water pump station at DA Porath AWTF (1 duty, 1 standby, 1,390gpm, 180 ft TDH),
    - 3,500 LF of 6-inch-diameter and 11,400 LF of 8-inch-diameter advanced treated water pipeline from MBR/AWTF at DA Porath to Beltz Wellfield injection wells,
    - 5 injection wells (including 1 back-up well) and 5 monitoring wells and associated buildings.

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Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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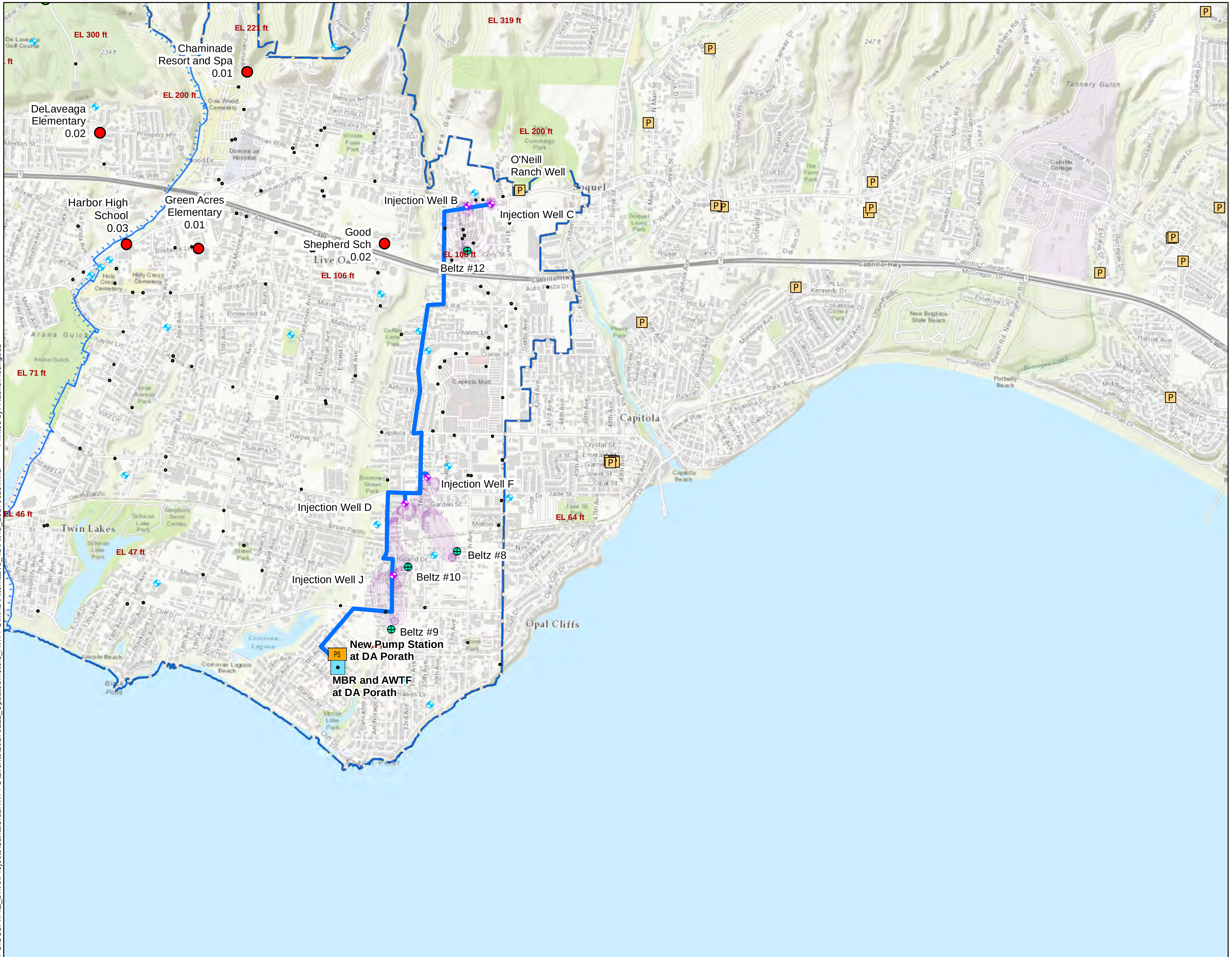

Legend

- MBR and AWTF at DA Porath
- New Pump Station
- Soquel Creek Production Well
- Santa Cruz Production Well
- Santa Cruz Injection Well
- Santa Cruz Private Well

Commercial Meters
- < 10 AFY
- > 10 AFY

City Meters
- < 10 AFY
- > 10 AFY

Irrigation Meters
- < 10 AFY
- > 10 AFY

- Particle Flow Lines
- AWT Pipeline
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N

0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 4B –
Santa Cruz Decentralized GRRP

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September 2017
Figure 8-10

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Note: Service laterals to individual meters are not shown

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A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-6.

Summary of Alternative 4 Costs

A City led GRRP would maximize the beneficial reuse of wastewater year-round and would require coordination with fewer agencies to implement the project. Like other IPR projects, operating and maintaining an AWTF and meeting GRR monitoring requirements is more complex with greater energy requirements compared to tertiary treatment. Public acceptance of groundwater recharge with advanced treated recycled water is uncertain at this time. Future studies would be needed to confirm siting of facilities and to further explore GRR in the City's service area.

Table 8-6: Alternative 4 – Summary of Probable Costs

Facility Component	Alt 4A Centralized GRR	Alt 4B Decentralized GRR
Treatment	$44,970,000	$84,150,000
Pipelines	$13,660,000	$3,780,000
Pump Station	$1,940,000	$1,600,000
Site Retrofit Costs	$850,000	$50,000
Wells	$9,030,000	$9,030,000
Total Capital Cost ($mil)	**$70.5**	**$98.6**
Annualized Unit Capital Cost ($/AF)	$1,600	$2,500
Annual Unit O&M Cost ($/AF)	$1,300	$1,500
Life Cycle Unit Cost ($/AF)	**$2,900**	**$4,000**
Life Cycle Unit Cost ($/CCF)	**$6.70**	**$9.20**
Life Cycle Unit Cost ($/MG)	**$8,900**	**$12,300**
Average Annual Reuse in Santa Cruz (AFY)	**2,389**	**2,240**

Note: Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction). See Appendix F for detailed project sheets.

8.2.5 Alternative 5 – Surface Water Augmentation (SWA) Project

Alternative 5 is a SWA Project that would convey advanced treated water from Santa Cruz WWTF and blend it with raw water in Loch Lomond Reservoir, a source of municipal drinking water supply for the City of Santa Cruz.

As discussed in Section 6.3.2, the available supply for a SWA project would depend on the amount of secondary effluent available for reuse, the dilution ratio and the retention time in the reservoir needed to meet SWA Regulations (as discussed in Section 5.4.2). Monthly wastewater flows generally increase during the winter wet weather season, from December to March, and are at their lowest during summer months (previously shown on Figure 6-4). Hence, the size of a SWA project would be limited to secondary effluent available in the summer, which also corresponds with when there is more available capacity in Loch Lomond Reservoir.

Table 8-7 describes the rationale applied to identify an available supply of 3.2 mgd of advanced treated water for potable reuse for Alternatives 5 through 7, where supply, not demand, is the limiting factor for reuse.

Table 8-7: Advanced Treated Water Supply for Potable Reuse Alternatives

Total WW Supply	Santa Cruz WWTF In-Plant Demand	SqCWD GWRR Demand	Secondary Effluent Available	Advanced Treated Water Produced
Average Daily Dry Weather Flow[1] (mgd)	Year-Round Internal Use + La Barranca Park[2] (mgd)	Year-Round Secondary Effluent (mgd)[3]	after meeting other Demands (mgd)	Based on assumed AWTF Recovery Rate[4]
6.1	0.25	1.7	4.15	**3.2**

1 Based on June 2015 flow data at the Santa Cruz WWTF
2 Assumes that the SCPWD Title 22 Project (Alternative 1A) is implemented and no additional NPR demands in Santa Cruz will be served
3 Assumes that secondary effluent is delivered for the SqCWD GRRP
4 Assumes MF/UF recovery rate of 90% and RO recovery rate of 85%

TM #3 – Surface Water Augmentation at Loch Lomond, provided in Appendix D, presents an assessment of potential SWA regulatory requirements, identifies critical regulatory feasibility issues and summarizes the suitability of Loch Lomond Reservoir for complying with the anticipated SWA requirements. This initial feasibility assessment does not identify any regulatory "fatal flaws" for the implementation of a 3.2 mgd SWA project at Loch Lomond Reservoir. The Loch Lomond SWA project would likely be able to comply with the 6-month hydraulic detention time requirement, listed in the DDW Draft criteria, under the entire range of probable reservoir operational scenarios.

The ability to augment Loch Lomond Reservoir may to be limited to when there is available capacity in the reservoir to accept advanced treated flows. Based on discussions with the City, reservoir augmentation would occur in the summer and shoulder months; representing about half the year. Thus, the project would be sized to produce 3.2 mgd of advanced treated water when the reservoir is being drawn down to meet demands, and production would scale down in the winter months during periods when the reservoir is filled by naturally occurring precipitation and runoff. As mentioned in Section 6.3.2, another scenario exists that would draw down the reservoir in the summer (potentially for in lieu and ASR projects). A larger SWA project may facilitate this by allowing refill during the winter. Dilution would need to be considered; this scenario was not considered at this time. Advanced treated water would be discharged to the reservoir via a multi-port diffuser with duckbill valves for increased mixing. The preferred discharge location would be determined by reservoir modeling studies to achieve a 10:1 dilution (i.e. such that no more than 10 percent of the water withdrawn from the reservoir would be comprised of advanced treated water that has been discharged within the prior 24 hours).

Key components of Alternative 5 are summarized below and illustrated in Figure 8-11.

- **Description:** Advanced treatment of Santa Cruz effluent for blending and storage in Loch Lomond, conveyed to and treated at the GHWTP and enter the City's potable water distribution system
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 3.2 mgd (3,585 AFY) AWTF capacity
- **Uses**: Augment Loch Lomond Reservoir (3.2 mgd max day delivery, 1,777 AFY annual RW delivered),
- **Treatment Facilities:** AWTF at or near Santa Cruz WWTF employing full advanced treatment with MF, RO and UV/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
  - Advanced treated water pump station at or near Santa Cruz WWTF (1 duty, 1 standby, 2,220gpm, 410 ft TDH),
  - 71,300 LF of 14-inch-diameter advanced treated water pipeline from AWTF at or near Santa Cruz WWTF to Loch Lomond,
  - Multi-port diffuser discharge facility at Loch Lomond

A Surface Water Augmentation project at Loch Lomond would maximize the beneficial reuse of wastewater in summer months, and potentially provide more operational flexibility for reservoir operations. Instead of preserving storage to assure sufficient water supply for the City in the dry months, in all seasons Loch Lomond could be used as a climate independent resource for the region. Though challenging, meeting the regulatory requirements for SWA are viable. Like other IPR projects, operating and maintaining an AWTF and meeting GRR monitoring requirements is more complex with greater energy requirements compared to tertiary treatment. Due to the distance and lift required to convey advanced treated water to Loch Lomond Reservoir, there would be significant additional infrastructure, pumping and energy requirements for conveyance. Public acceptance of a Surface Water Augmentation project is uncertain at this time.

Further investigation (including reservoir monitoring, reservoir modeling, and tracer studies) would be required. It is important to evaluate whether it is possible to reduce the AWTF pathogen removal requirements by 1-log by using an engineered diffuser at a discharge location that ensures that no more than 1 percent of withdrawn reservoir water is comprised of advanced treated water that has been introduced into the reservoir in the prior 24-hour period. Operational practices and releases from the reservoir during the shoulder and winter months would need to be modeled in greater detail to confirm whether there may be demand for advanced treated recycled water year-round. In addition, considerations for advanced treated water contributing to periodic biostimulation (algae blooms) that occur in Loch Lomond would need to be studied in greater detail along with a characterization of AWTF concentrations of NDMA and other constituents of concern. Coordination with RWQCB staff would be required to address the existing Basin Plan prohibition against "waste discharges" to surface reservoirs.

A summary of loaded capital costs, by facility component, as well an annual unit life cycle costs is summarized in Table 8-8.

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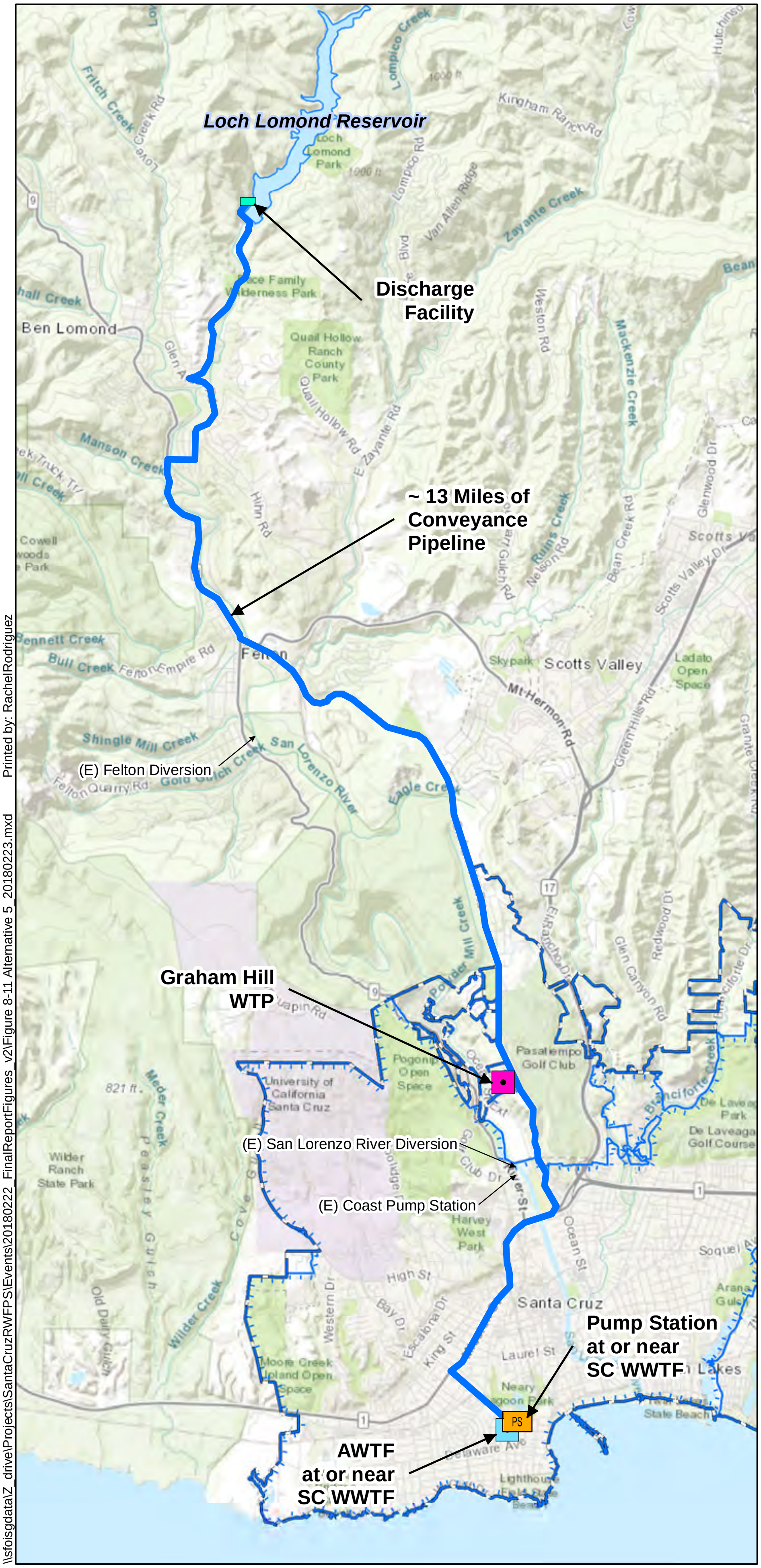


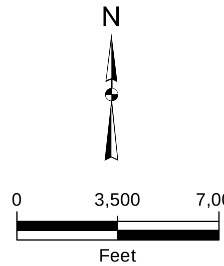
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend

- Santa Cruz AWTF
- Pump Station
- Drinking Water Treatment Plant
- Discharge Facility
- AWT Pipeline
- City of Santa Cruz Water Service Area
- City of Santa Cruz Limit

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*



Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 5 - Surface Water Augmentation

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February 2018

Figure 8-11

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Table 8-8: Alternative 5 – Summary of Probable Costs

Facility Component	Alt 5 SWA Project
Treatment	$66,150,000
Pipelines	$33,630,000
Pump Station	$4,460,000
Storage Tank	not incl.
Site Retrofit Costs	not incl.
Discharge Facility	$2,280,000
Wells	not incl.
Total Capital Cost ($mil)	**$106.5**
Annualized Unit Capital Cost ($/AF)	$3,200
Annual Unit O&M Cost ($/AF)	$2,100
Life Cycle Unit Cost ($/AF)	**$5,300**
Life Cycle Unit Cost ($/CCF)	**$12.20**
Life Cycle Unit Cost ($/MG)	**$16,300**
Average Annual Reuse in Santa Cruz (AFY)	**1,777**

Note: Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction). See Appendix F for detailed project sheets.

8.2.6 Alternative 6 – Streamflow Augmentation

Alternative 6 would augment streamflow in the San Lorenzo River with advanced treated water from Santa Cruz WWTF downstream of San Lorenzo River Diversion during the summer months. The City would then be able to reliably make diversions at the San Lorenzo River Diversion site, by using the advanced treated recycled water to meet in-stream flow requirements.

The available supply for a Streamflow Augmentation project would be similar to that of a SWA project. As described in Table 8-7, the size of the project would be limited to secondary effluent available in the summer, which also corresponds with when the City's ability to divert from the San Lorenzo River is limited by the in-stream water requirements. Similar to Alternative 5, the available supply of advanced treated water for streamflow augmentation (3.2 mgd or 3,585 AFY) assumes that secondary effluent is delivered for the SqCWD GRRP, the SCPWD Title 22 Project (Alternative 1A) is implemented and no additional NPR demands in Santa Cruz will be served. This assumption would need to be revisited with further analysis should this alternative be advanced to ensure available supply is not overstated.

Based on the Confluence Model, developed by Gary Fiske and Associates, 3.2 mgd (3,585 AFY) of streamflow augmentation below the San Lorenzo River Diversion during the summer months (assumed to be a 181 day period between May and October) would reduce a worst year peak season shortage and decrease the number of years the City would experience a water supply shortage by half, while also leaving Loch Lomond Reservoir slightly fuller at the beginning of the peak season (see Attachment A of TM #4 in Appendix E). Advanced treated water would be discharged to the San Lorenzo River via a submerged multi-port diffuser with duckbill valves to maximize rapid and complete dispersion and minimize disruption to the receiving water.

There are currently no regulatory requirements and/or criteria for the beneficial use of recycled water for streamflow augmentation in California. Thus, for the purpose of this RWFPS, streamflow augmentation was categorized with the other types of potable reuse because it would provide additional water supply and reliability by increasing streamflow downstream to compensate for increased diversions upstream to meet potable demands.

TM #4 – Streamflow Augmentation, provided in Appendix E, describes the primary issues facing the San Lorenzo River and Lagoon (nutrient loading, increasing temperatures and decreasing levels of dissolved oxygen (DO)) and presents a high-level assessment of the viability of streamflow augmentation with advanced treated recycled water. Even with an advanced treatment process similar to a SWA Project; a streamflow augmentation project would still contribute some nutrient mass loadings to the San Lorenzo River, particularly nitrate loads, which would conflict with the proposed 2020 Total Maximum Daily Load (TMDL) reduction goals to reduce nitrates in the San Lorenzo River. Thus, some form of nutrient reduction may be necessary. Effluent from the Santa Cruz WWTF is often higher in temperature and dissolved oxygen than San Lorenzo River flows, and the advanced treatment processes being considered to purify the secondary effluent prior to augmentation would further increase the temperature of the effluent. Thus, alternative temperature and oxygenation management strategies, such as cooling towers, may also be needed for compliance with Basin Plan temperature and DO limits.

A successful streamflow augmentation project would also need to address surface water quality issues in addition to the TMDL. One such issue would be the effect of recycled water on olfactory sensation by migrating salmonid fish. National Marine Fisheries Service (NMFS), Fish and Wildlife Service and other stakeholders would need to be convinced that streamflow augmentation would not adversely affect salmonid migration of other fisheries. If recycled water would be shown to not adversely affect fisheries, additional diversion upstream of the point of augmentation may be possible which may contribute to greater water supply benefits for the City.

Key components of Alternative 6 are summarized below and illustrated in Figure 8-12.

- **Description:** Augment San Lorenzo River flows to meet in stream flow requirements and maximize water supply.
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 3.2 mgd (3,585 AFY) AWTF capacity
- **Uses**: Augment the San Lorenzo River when flows are needed (3.2 mgd max day delivery, 1,777 AFY annual RW delivered),
- **Treatment Facilities:** AWTF at or near Santa Cruz WWTF employing full advanced treatment with MF, RO and UV/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
    - Advanced treated water pump station at or near Santa Cruz WWTF (1 duty, 1 standby, 2,220gpm, 50 ft TDH),

- 13,800 LF of 14-inch-diameter advanced treated water pipeline from AWTF at or near Santa Cruz WWTF to San Lorenzo River downstream of San Lorenzo River diversion,
- Multi-port diffuser discharge facility in San Lorenzo River.

A streamflow augmentation project in the San Lorenzo River would maximize beneficial reuse of wastewater in summer, augment natural stream flows, and increase the City's ability to divert water from the San Lorenzo River. Limitations include lack of regulatory criteria to support streamflow augmentation with advanced treated recycled water, uncertainty related to the ability to meet the existing or future TMDL requirements for nitrates and to meet Basin Plan requirements for temperature and dissolved oxygen. Additional fishery requirements and sensitivities of the Lagoon present further obstacles to permitting this type of project. Overall, there are many important considerations that must be better understood before streamflow augmentation with advanced treated wastewater can be considered as a water supply alternative.

Further studies would also be needed to identify the preferred location of a discharge facility and to confirm that (1) augmented flows would not contribute to flows diverted at the San Lorenzo River Diversion for potable supplies, (2) geomorphologic and hydraulic conditions would be adequate to support a discharge facility and (3) hydraulic modeling to demonstrate adequate mixing of the augmented flow to meet fishery or other environmental requirements. The need and preferred process for denitrification and cooling would also need to be confirmed via a future study.

Additional discussions with the RWQCB and the NMFS would also be necessary to understand possible criteria for regulatory agency evaluation of a project. There are other streamflow augmentation programs with recycled water to support fish habitat in San Luis Obispo, Pacifica and San Antonio, TX that may serve as examples for navigating through environmental and permitting requirements, which should be researched further should this alternative be recommended for further evaluation.

A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-9. Costs for treatment processes to reduce nutrients, temperature, and DO of the advanced treated water are not included in this study. The cost of nutrient reduction could range between $25 million to $35 million per mgd for a 3 mgd plant. The strategies for reducing temperature could include mechanical treatment through cooling towers, chillers or head exchangers or passive treatments such as heat transfer to the earth or off-stream mixing. DO reduction strategies could similarly be achieved through cooling towers and off-stream mixing, or through the use of air/oxygen addition. The costs for these treatment strategies varies widely based on the flow and regulatory requirements and were not estimated as part of this study.

Legend

- PS Pump Station
- Santa Cruz AWTF
- Drinking Water Treatment Plant
- Potential Discharge Facility
- AWT Pipeline
- City of Santa Cruz Water Service Area
- City of Santa Cruz Limit

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N

0 1,400 2,800
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 6 - Streamflow Augmentation

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Figure 8-12

\\sfoisgdata\Z_drive\Projects\SantaCruzRWFPS\Events\20180222_FinalReportFigures_v2\Figure 8-12 Alternative 6.mxd Printed by: RachelRodriguez

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Table 8-9: Alternative 6– Summary of Probable Costs

Facility Component	Alt 6 Streamflow Augmentation
Treatment	$65,620,000
Pipelines	$6,200,000
Pump Station	$880,000
Discharge Facility	$2,260,000
Total Capital Cost ($mil)	**$75.0**
Annualized Unit Capital Cost ($/AF)	$2,400
Annual Unit O&M Cost ($/AF)	$1,500
Life Cycle Unit Cost ($/AF)	**$3,900**
Life Cycle Unit Cost ($/CCF)	**$9.00**
Life Cycle Unit Cost ($/MG)	**$12,000**
Average Annual Reuse in Santa Cruz (AFY)	**1,777**

Note: Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction). See Appendix F for detailed project sheets.

8.2.7 Alternative 7 – Direct Potable Reuse (DPR)

Alternative 7 is a DPR project that would convey advanced treated water from the Santa Cruz WWTF to the Coast Pump Station, or otherwise intercept the North Coast Main, where it would be blended with other GHWTP raw water sources before treatment at the GHWTP prior to distribution with the potable water supply.

The available supply for a DPR project would be similar to that of a SWA or Streamflow Augmentation project, as described in Table 8-7. The AWTF capacity would be sized based on the secondary effluent available in the summer, less secondary effluent delivered for the SqCWD GRRP and the SCPWD Title 22 Project (Alternative 1A) demands. Unlike a SWA or Streamflow Augmentation project, DPR is not limited by reservoir capacity or in-stream flow requirements, thus the 3.2 mgd of advanced treated water production capacity would be utilized year-round. In the future, if a mandate for additional treatment of wastewater effluent or a ban on ocean discharge is enacted the City would evaluate water recycling to achieve zero or near-zero discharge. If this situation occurs, DPR could be revisited to increase the amount of beneficial reuse.

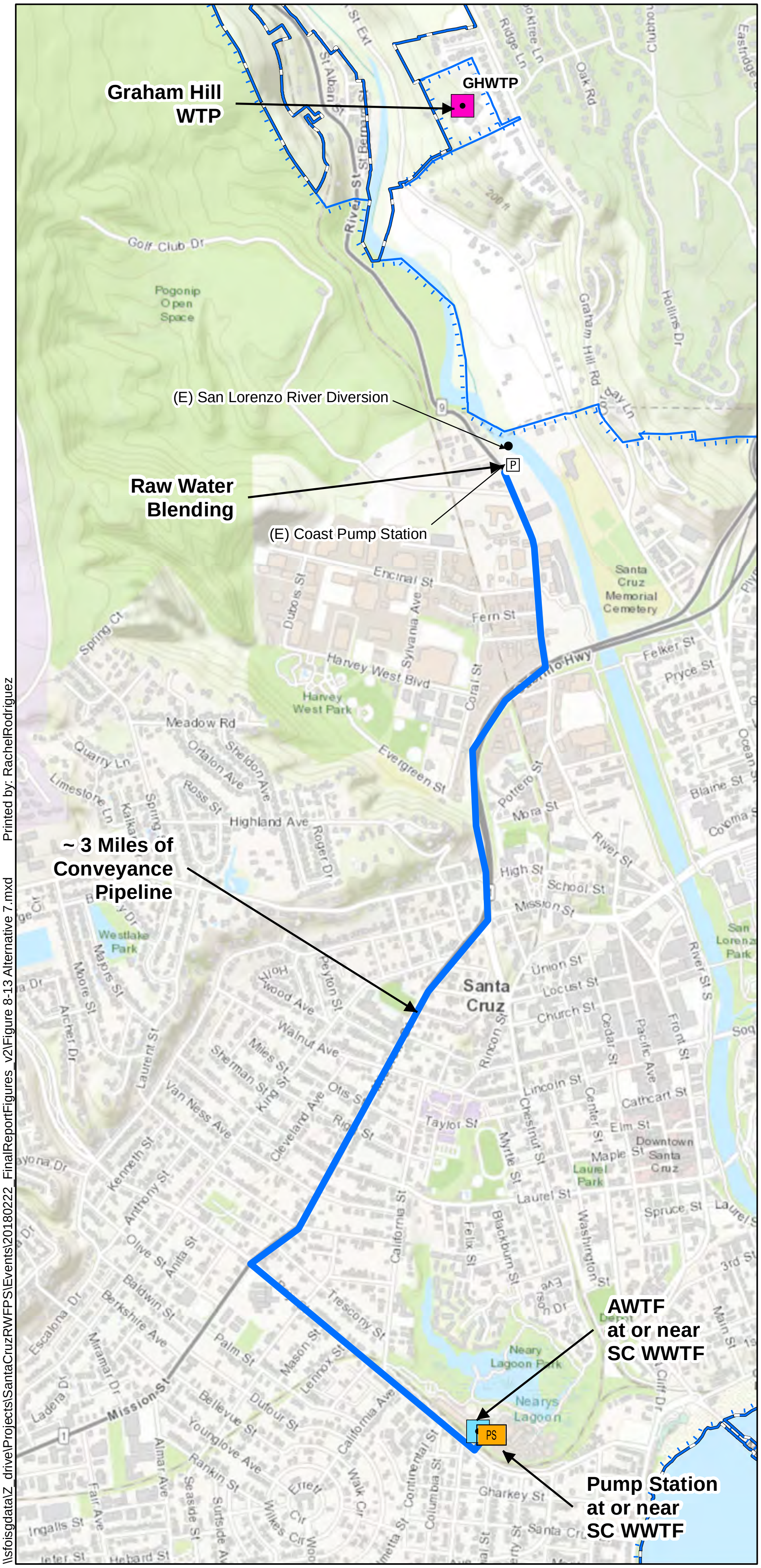
Key components of Alternative 7 are summarized below and illustrated in Figure 8-13.

- **Description:** Advanced treated water would be blended with raw water coming from City's other flowing sources for further treatment at the GHWTP prior to distribution as potable water
- **Source Water:** Santa Cruz WWTF secondary effluent
- **Project Size:** 3.2 mgd (3,585 AFY) AWTF capacity
- **Uses**: Augment potable water supplies (3.2 mgd)
- **Treatment Facilities:** AWTF at or near Santa Cruz WWTF employing full advanced treatment with MF, RO and UV/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.

- **Other Infrastructure:** Conveyance pipelines and connection to Coast Pump Station, pump station, brine discharge via connection to existing ocean outfall
    - Advanced treated water pump station at or near Santa Cruz WWTF (1 duty, 1 standby, 2,220gpm, 80 ft TDH),
    - 13,600 LF of 14-inch-diameter advanced treated water pipeline from AWTF at or near Santa Cruz WWTF to Coast pump station,
    - Three (3) 1,000,000-gallon storage tank.

A DPR project would increase water supply reliability and maximize the beneficial reuse of wastewater year-round. No DPR projects currently exist in California and existing regulations have not been developed. DPR would require robustness, reliability, a sophisticated water quality monitoring system, and engineered storage to provide a buffer, since there would not be an environmental buffer. The operational complexity of a DPR facility may also require greater levels of certification of staff. Energy requirements for treatment would be greater than tertiary treatment. Due to the proximity of the GHWTP to the Santa Cruz WWTF, the distance and lift required to convey advanced treated water to the Coast Pump Station is relatively small. Potential impacts on GHWTP source water quality upon blending would require further investigation for siting and water quality considerations, but may offer possible synergies with planned future GHWTP investments. Public acceptance of a DPR project may be a considerable challenge, but as other water agencies move forward with DPR projects it provides an opportunity for the public to become familiar with the process.

A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-10.



Legend

- PS — Pump Station
- Santa Cruz AWTF
- Drinking Water Treatment Plant
- AWT Pipeline
- City of Santa Cruz Water Service Area
- City of Santa Cruz Limit

**Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed*

**Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)*

N

0 1,400 2,800
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 7 - Direct Potable Reuse

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February 2018

Figure 8-13

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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Table 8-10: Alternative 7 – Summary of Probable Costs

Facility Component	Alt 7 DPR
Treatment	$94,240,000
Pipelines	$6,610,000
Pump Station	$1,270,000
Storage Tank	$8,450,000
Total Capital Cost ($mil)	**$110.6**
Annualized Unit Capital Cost ($/AF)	$1,700
Annual Unit O&M Cost ($/AF)	$1,300
Life Cycle Unit Cost ($/AF)	**$3,000**
Life Cycle Unit Cost ($/CCF)	**$6.90**
Life Cycle Unit Cost ($/MG)	**$9,200**
Average Annual Reuse in Santa Cruz (AFY)	**3,584**

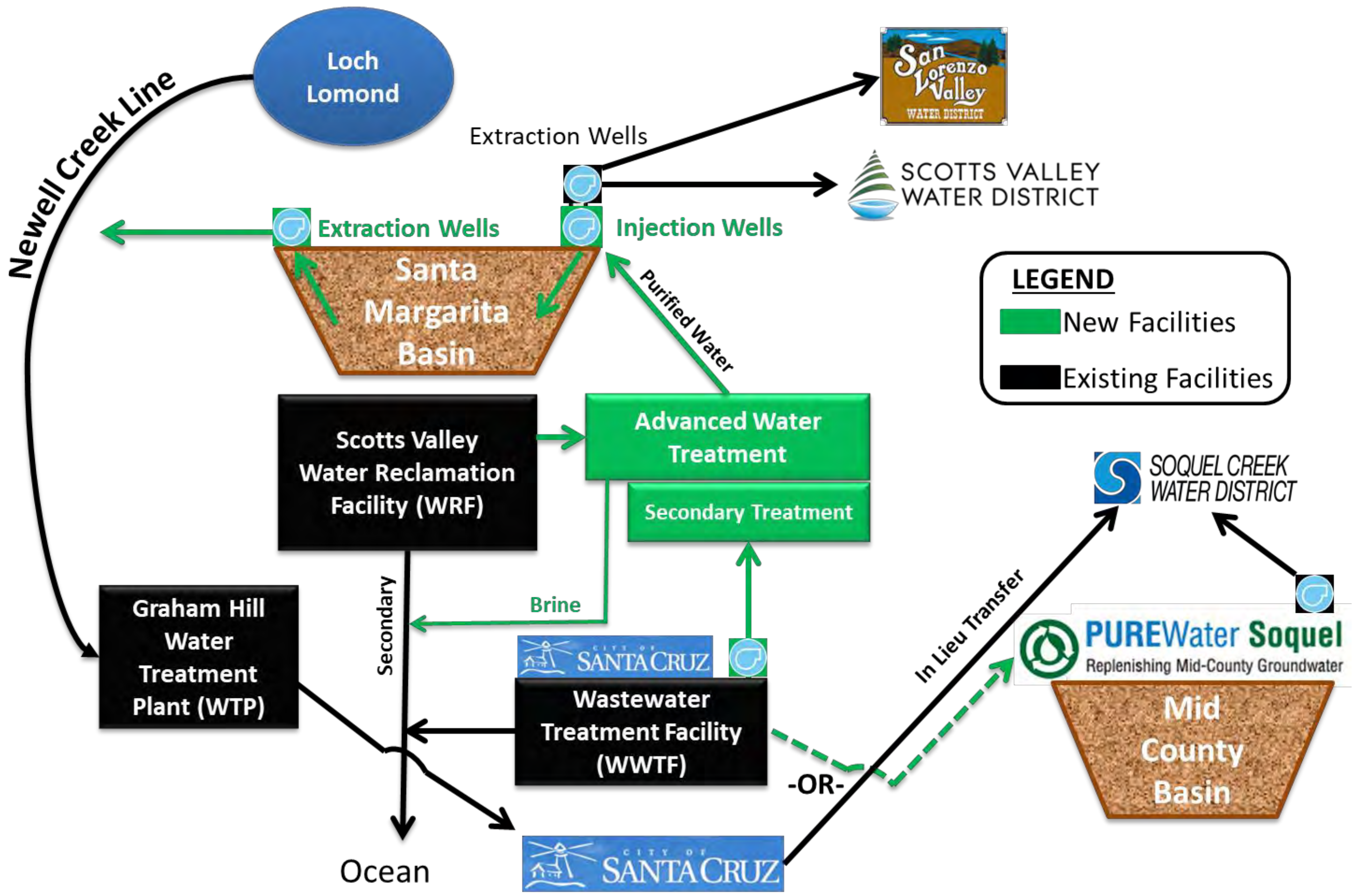
Note: Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction). See Appendix F for detailed project sheets.

8.2.8 Alternative 8 – Regional GRRP

Alternative 8 is a regional project that would involve the participation of regional stakeholders. A Regional GRR Alternative would provide advanced treated water for the City, SVWD, SLVWD and SqCWD. The recharged water would combine with the SMGB groundwater and be stored in the local aquifer. The advanced treated water and groundwater would be extracted via existing or new production wells to serve regional project partners. A portion of the water would be returned to the City via the Newell Creek Pipeline to the GHWTP. The City would deliver treated water from the GHWTP to its customers and convey treated water to Soquel Creek using the existing intertie; however, upgrades may be required to convey the full flow provided by a regional GRRP in the summer months when the available capacity is less. Alternately a seasonal schedule could be developed where more flow is delivered during the winter months when available capacity is greater.

While recharge into the Santa Margarita Basin was not initially selected as a component for further evaluation, this alternative was subsequently included to study the feasibility of a regional project for comparison with other alternatives. Figure 8-14 illustrates new and existing facilities associated with a Regional GRRP. Two Regional GRR Alternatives, Alternatives 8a and 8b, were developed and evaluated, as described in the following sections, to bracket the range of opportunities available to regional agencies utilizing the City's WWTF effluent and the SMGB. A summary of costs for Alternative 8 is provided at the end of the section.

Figure 8-14 Regional GRRP Schematic



Alternative 8A – 4-way Regional GRRP

Alternative 8A is a Regional GRRP to serve the City, Scotts Valley, Soquel Creek and San Lorenzo Valley. This project would provide in lieu water to SqCWD.

Key components of Alternative 8A are summarized below and illustrated in Figure 8-15.

- **Description:** Regional AWTF to produce advanced treated water for groundwater replenishment in the SMGB and utilize existing or new production wells to serve Santa Cruz, SVWD, SLVWD and SqCWD.
- **Source:** Santa Cruz WWTF + Scotts Valley WRF
- **Project Size:** Regional groundwater recharge of 5 mgd (5,600 AFY) including 3.2 mgd (3,585 AFY) for SCWD, 1.3 mgd (1,455 AFY) for SqCWD and 0.5 mgd (560 AFY) for SVWD.
- **Uses:** Groundwater recharge in the SMGB

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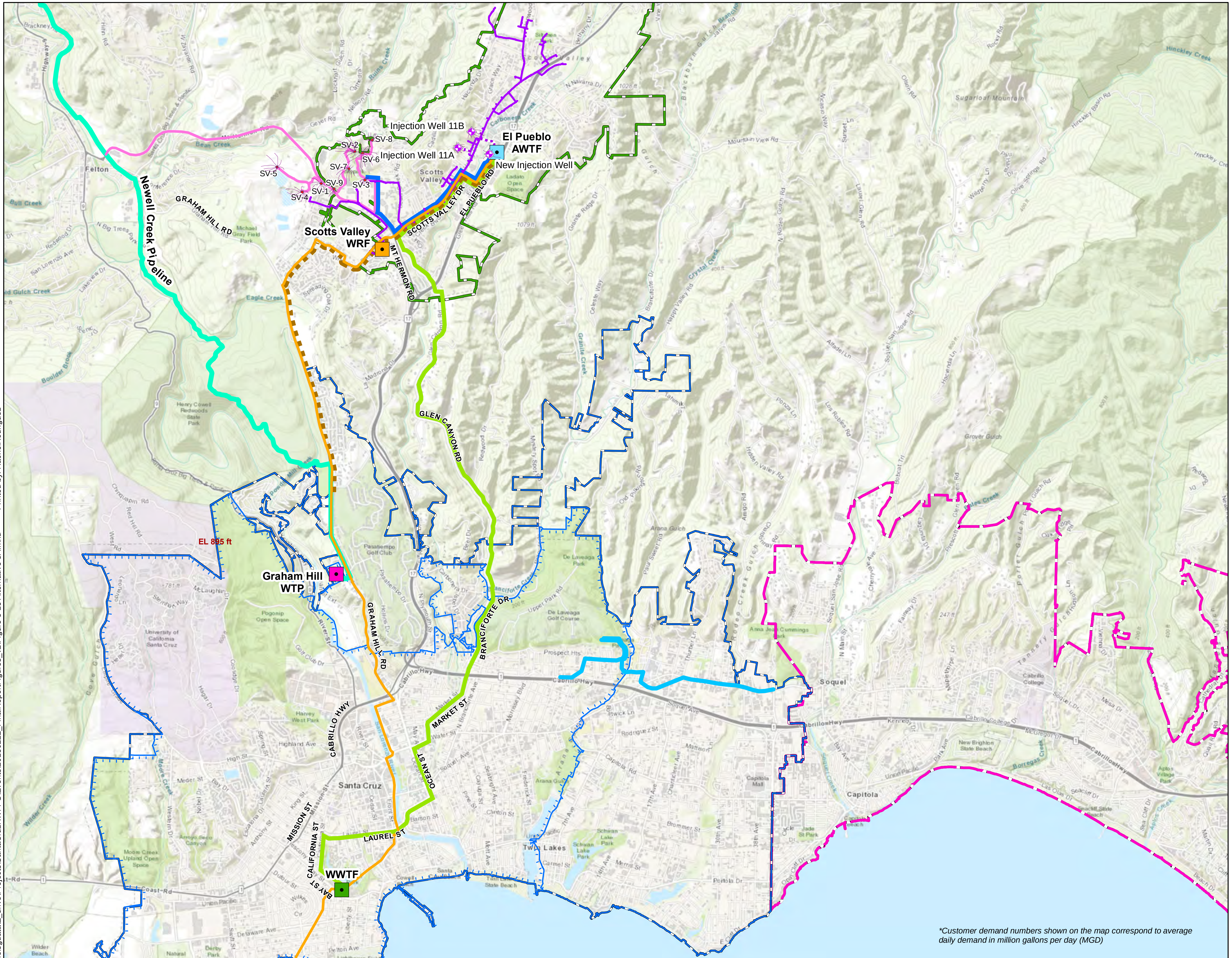
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



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\\sfoisgdata\Z_drive\Projects\SantaCruzRWFPS\Events\20180222_FinalReportFigures_v2\Figure 8-15 Alternative 8A.mxd

Legend

- El Pueblo Groundwater Injection Wells
- Santa Cruz WWTF
- Scotts Valley WRF
- El Pueblo AWTF
- Drinking Water Treatment Plant
- Regional GW Injections Wells
- Secondary Effluent Pipeline
- Newell Creek Pipeline
- Tertiary RW Pipeline
- Tertiary RW Pipeline - To Be Constructed
- Brine Pipeline
- New GW Extraction Pipeline
- Upgrade Existing Potable Intertie to SqCWD
- SVWD Outfall Pipeline
- AWT Pipeline
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area
- Scotts Valley Water District Water Service Area
- Soquel Creek Water District Water Service Area
- Particle Flow Lines

Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed

Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)

N

0 1,600 3,200

Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 8A – 4-way Regional GRRP

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February 2018

Figure 8-15

Note: Service laterals to individual meters are not shown

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- **Treatment Facilities:** The AWTF at the Scotts Valley El Pueblo Site (or other location) employing full advanced treatment with MF, RO and UV/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
  - Secondary effluent pump station at or near Santa Cruz WWTF to the El Pueblo AWTF (1 duty, 1 standby, 4,070 gpm, 890 ft TDH), Extracted groundwater pump station from Regional Injection Wells to Newell Creek Pipeline (1 duty, 1 standby, 3,130 gpm, 380 ft TDH), Brine pump station at the El Pueblo AWTF to the SVWD outfall (1 duty, 1 standby, 670 gpm, 940 ft TDH)
  - 49,300 LF of 18-inch-diameter secondary effluent pipeline from Santa Cruz WWTF to the El Pueblo AWTF, 10,100 LF of 16-inch-diameter pipeline from the El Pueblo AWTF to Regional Injection Wells, 25,700 LF of 16-inch-diameter extracted groundwater pipeline from regional extraction wells to existing Newell Creek Pipeline, 23,700 LF of 8-inch-diameter brine pipeline from the El Pueblo AWTF to the SVWD outfall
  - 11 injection wells (including 2 back-up wells), 11 monitoring wells, 5 new production wells and associated buildings,
  - Infrastructure upgrades to the existing potable water intertie with SqCWD.
  - The use of an existing potable water intertie between SVWD and SLVWD.

A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-11.

Alternative 8B – 3-way Regional GRRP

Alternative 8B is a Regional GRRP to serve the City, Scotts Valley and San Lorenzo Valley. This alternative would not include SqCWD and recognizes the potential for SqCWD to develop a project independent of the other agencies that are not as far along in their water supply project development as SqCWD.

Key components of Alternative 8B are summarized below and illustrated in Figure 8-16.

- **Description:** Regional AWTF to produce advanced treated water for groundwater replenishment in the SMGB and utilize existing or new production wells to serve Santa Cruz, SVWD and SLVWD. SqCWD would develop an independent GRRP.
- **Source:** Santa Cruz WWTF + Scotts Valley WRF
- **Project Size:** Regional groundwater recharge of 3.7 mgd (4,145 AFY) including 3.2 mgd (3,585 AFY) for SCWD and 0.5 mgd (560 AFY) for SVWD.
- **Uses:** Groundwater recharge in the SMGB
- **Treatment Facilities:** The AWTF at the El Pueblo Site employing full advanced treatment with Microfiltration (MF), Reverse Osmosis (RO) and Ultra-Violet/Peroxide for advanced oxidation. Brine discharge via connection to existing ocean outfall.
- **Other Infrastructure:**
  - Secondary effluent pump station at or near Santa Cruz WWTF to El Pueblo AWTF (1 duty, 1 standby, 2,910 gpm, 940 ft TDH), Extracted groundwater pump station

from Regional Extraction Wells to Newell Creek Pipeline (1 duty, 1 standby, 2,220 gpm, 420 ft TDH), Brine pump station at El Pueblo AWTF to SVWD outfall (1 duty, 1 standby, 510 gpm, 440 ft TDH)

- 49,300 LF of 16-inch-diameter secondary effluent pipeline from Santa Cruz WWTF to El Pueblo AWTF, 10,100 LF of 14-inch-diameter pipeline from El Pueblo AWTF to Regional Injection Wells, 25,700 LF of 14-inch-diameter extracted groundwater pipeline from regional extraction wells to existing Newell Creek Pipeline, 23,700 LF of 6-inch-diameter brine pipeline from El Pueblo AWTF to SVWD outfall
- 9 injection wells (including 2 back-up wells), 9 monitoring wells, 4 new production wells and associated buildings.
- The use of an existing potable water intertie between SVWD and SLVWD.

A summary of loaded capital costs, by facility component, as well as annual unit life cycle costs is summarized in Table 8-11.

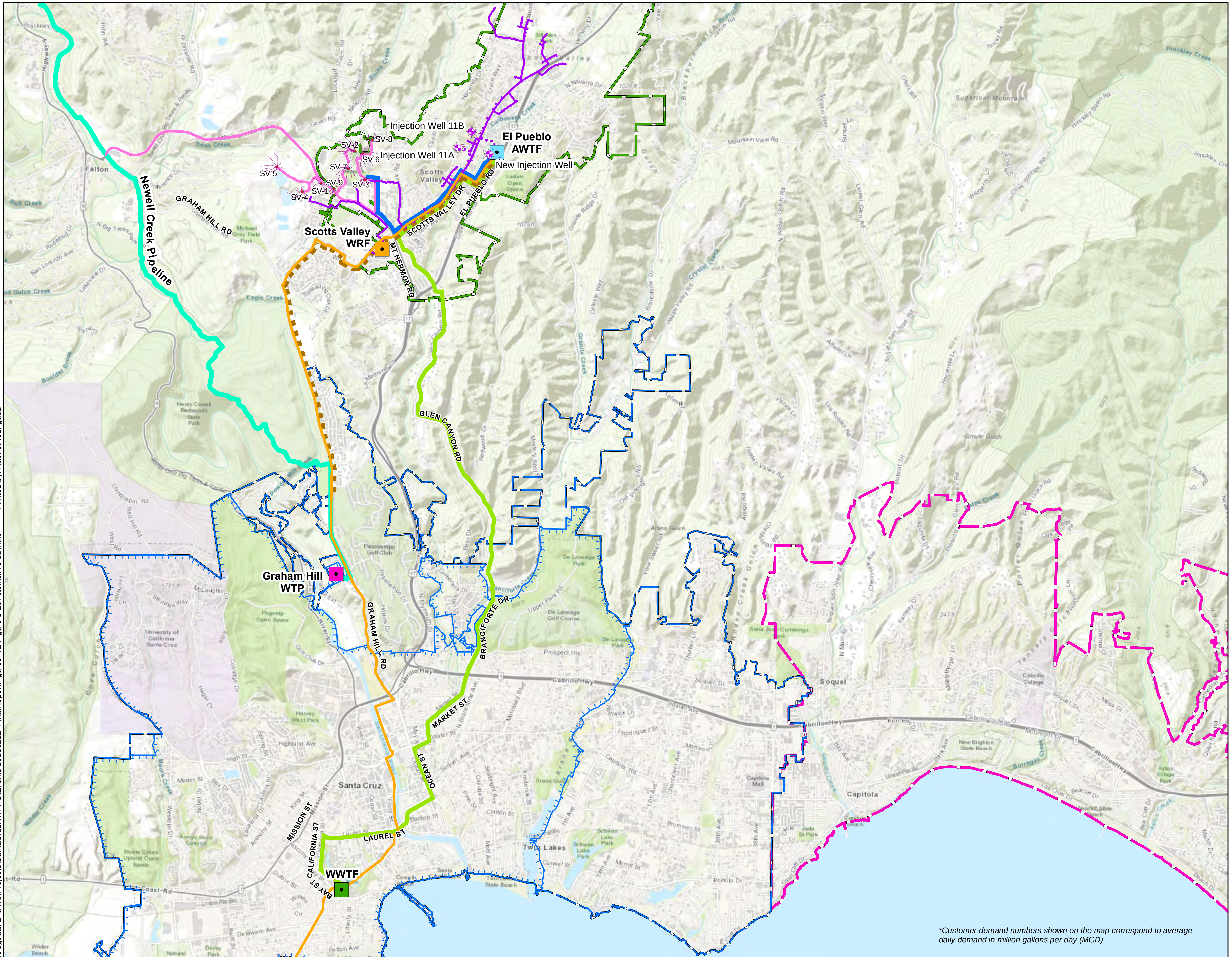
Table 8-11: Alternative 8 – Summary of Probable Costs

Facility Component	Alt 8A	Alt 8B
Treatment	$55,600,000	$56,300,000
Pipelines	$33,820,000	$40,990,000
Pump Station	$13,440,000	$18,750,000
Wells	$21,580,000	$24,700,000
Total Capital Cost ($mil)	**$124.4**	**$140.7**
Annualized Unit Capital Cost ($/AF)	$1,800	$2,100
Annual Unit O&M Cost ($/AF)	$1,700	$1,600
Life Cycle Unit Cost ($/AF)	**$3,500**	**$3,700**
Life Cycle Unit Cost ($/CCF)	**$8.00**	**$8.50**
Life Cycle Unit Cost ($/MG)	**$10,700**	**$11,400**
Average Annual Reuse in Santa Cruz (AFY)	**3,584**	**3,584**

Note: Costs shown represent the City's proportional share based on flow. Facility component costs are loaded (i.e. include additional facility costs, contractor markups, contingencies and escalation to the midpoint of construction). See Appendix F for detailed project sheets.

Summary of Alternative 8

A Regional GRRP project would maximize beneficial reuse of wastewater and offer potential for cost-sharing and pursuing funding as a region. Like other IPR projects, operating and maintaining an AWTF and meeting GRR monitoring requirements is more complex with greater energy requirements compared to tertiary treatment. To convey water over the large regional area, there would be significant additional infrastructure, pumping and energy requirements for conveyance to the place of use and back to the potable distribution system. This type of project would require a greater level of cooperation and coordination between multiple agencies, with interagency infrastructure challenges related to ownership, operations, construction, etc. Water rights and transfer agreements would need to be developed along with future studies to confirm groundwater recharge injection and extraction capacities.



Legend

- El Pueblo Groundwater Injection Wells
- Santa Cruz WWTF
- Scotts Valley WRF
- El Pueblo AWTF
- Drinking Water Treatment Plant
- Regional GW Injections Wells
- Secondary Effluent Pipeline
- Newell Creek Pipeline
- Tertiary RW Pipeline
- Tertiary RW Pipeline - To Be Constructed
- Brine Pipeline
- New GW Extraction Pipeline
- SVWD Outfall Pipeline
- AWT Pipeline
- City of Santa Cruz Limit
- City of Santa Cruz Water Service Area
- Scotts Valley Water District Water Service Area
- Soquel Creek Water District Water Service Area
- Particle Flow Lines

*Additional hydraulic evaluation to be conducted as part of future alignment study to determine if booster pumps and storage would be needed

*Customer demand numbers shown on the map correspond to average daily demand in million gallons per day (MGD)

N
0 1,600 3,200
Feet

Kennedy/Jenks Consultants

Santa Cruz Water Department
Santa Cruz, California

Alternative 8B – 3-way Regional GRRP

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February 2018
Figure 8-16

Note: Service laterals to individual meters are not shown

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Details on alternative cost sharing options are described in Appendix F4. Current water rates and fees for the City, SqCWD and SVWD are included for reference in Appendix H.3. Each agency would assess the impact of cost allocations, associated with participation in a regional project, on customer rates and the overall rate structure as part of future studies.

8.2.9 Summary of Alternatives

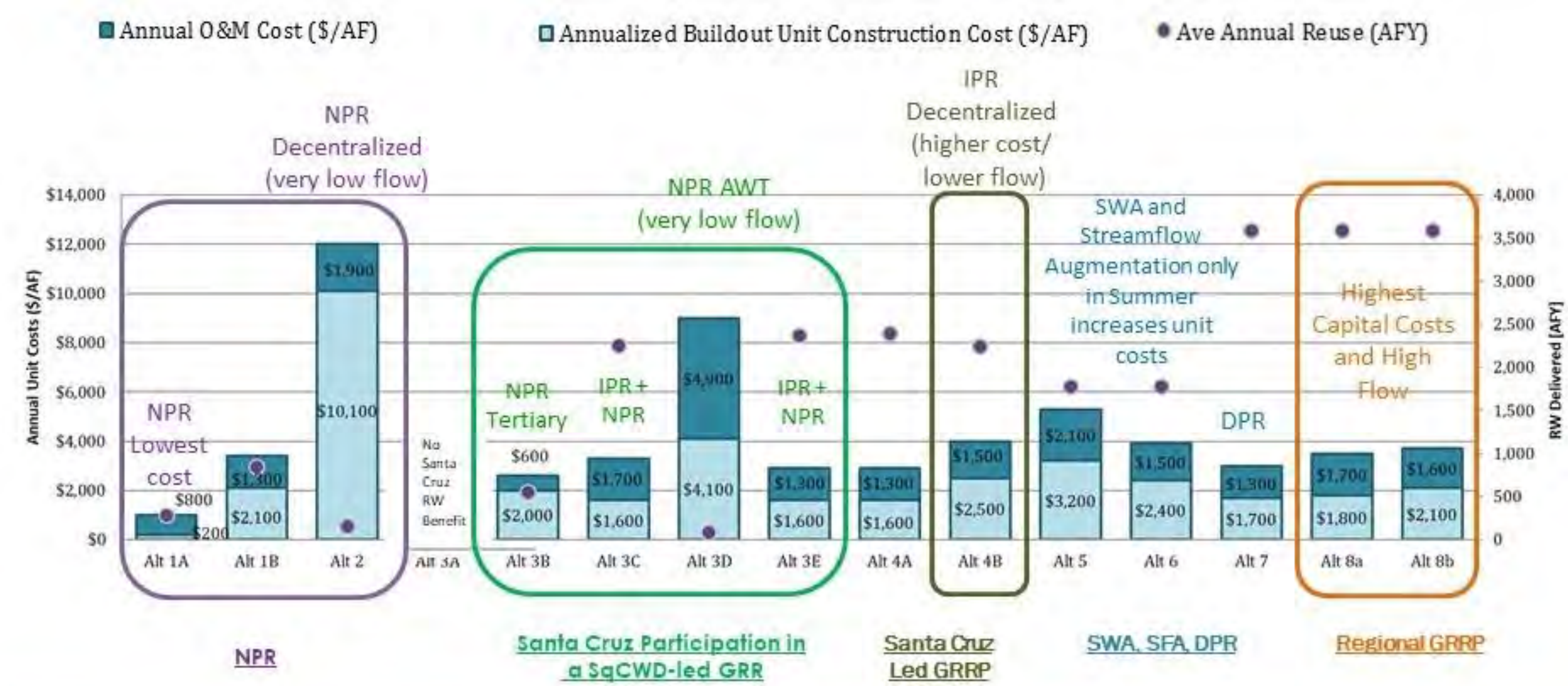
The engineer's opinion of probable capital, O&M and annualized unit costs for each alternative are summarized in Table 8-12 and Figure 8-17.

Table 8-12: Summary of Alternative Project Demands and Costs

Alternative	Project	Ave Annual Reuse in the City		Total Capital Cost[1]	Life Cycle Unit Cost		
		(mgd)	(AFY)	($mil)	($/AF)	($/MG)	($/CCF)
Alternative 1 – Centralized NPR	Alt 1A	0.25	282	$1	$1,000	$3,100	$2.30
	Alt 1B	0.74	840	$34	$3,400	$10,400	$7.80
Alternative 2 – Decentralized NPR	Alt 2	0.14	155	$28	$12,000	$36,800	$27.50
Alternative 3 – Santa Cruz Participation in SqCWD led GRRP	Alt 3A [2]	0	0	n/a	n/a	n/a	n/a
	Alt 3B	0.49	550	$20	$2,600	$8,000	$6.00
	Alt 3C [3]	2.0	2,248	$69	$3,300	$10,100	$7.60
	Alt 3D	0.08	88	$7	$9,000	$27,600	$20.70
	Alt 3E [3]	2.1	2,368	$69	$2,900	$8,900	$6.70
Alternative 4 – Santa Cruz GRRP	Alt 4A [3]	2.1	2,389	$70	$2,900	$8,900	$6.70
	Alt 4B [3]	2.0	2,240	$99	$4,000	$12,300	$9.20
Alternative 5 – SWA	Alt 5 [4]	1.6	1,777	$107	$5,300	$16,300	$12.20
Alternative 6 – Streamflow Aug	Alt 6 [4]	1.6	1,777	$75	$3,900	$12,000	$9.00
Alternative 7 – DPR	Alt 7 [5]	3.2	3,584	$111	$3,000	$9,200	$6.90
Alternative 8 – Regional GRRP	Alt 8a [5]	3.2	3,584	$124	$3,500	$10,700	$8.00
	Alt 8b [5]	3.2	3,584	$141	$3,700	$11,400	$8.50

[1] All costs represent City's share based on the recycled water produced and conveyed to SCWD's service area.
[2] Alt 3A provides 0 AF of recycled water use in the City, therefore the facility and unit cost for the City are not calculated.
[3] Alts 3C, 3E, 4A and 4B are limited by the available GRR capacity at the Beltz Wellfield, 2.0 mgd (2,240 AFY), plus additional NPR customers along each alignment.
[4] Discharge for Alts 5 and 6 is seasonally limited to the summer and shoulder months, when there would be available capacity in the reservoir or when flows are low in the San Lorenzo River. The supply of recycled water is assumed to be limited to the average daily dry weather flow less other demands (in-plant uses plus deliveries to Pure Water Soquel) and losses from advanced treatment (i.e. brine concentrate), 3.2 mgd (3,584 AFY). Since discharge would only occur during the summer and shoulder months, an assumed 181 dry day period, the average annual reuse would be 1.6 mgd (1,777 AFY).
[5] Alts 7 and 8 have no seasonal limitations.

Figure 8-17 Comparison of Alternative Projects



Capital Cost ($mil)	$1.1	$34	$28	Not incl	$20	$69	$7	$69	$70	$99	$107	$75	$111	$124	$141

Notes: The stacked bars represent the life cycle unit cost for each project (left y-axis).
The purple dots represent the average annual reuse in SCWD's service area.
All costs represent City facilities or the City's proportional share of regional facilities based on flow.

8.3 Alternatives Screening Approach

This section describes the alternatives screening approach, with a focus on the alternatives screening criteria and weighting themes developed to evaluate each project. Appendix G includes a more detailed discussion of the screening criteria and scoring guidelines and provides more detailed results of the scoring, ranking and sensitivity analysis.

8.3.1 Development of Alternative Screening Criteria

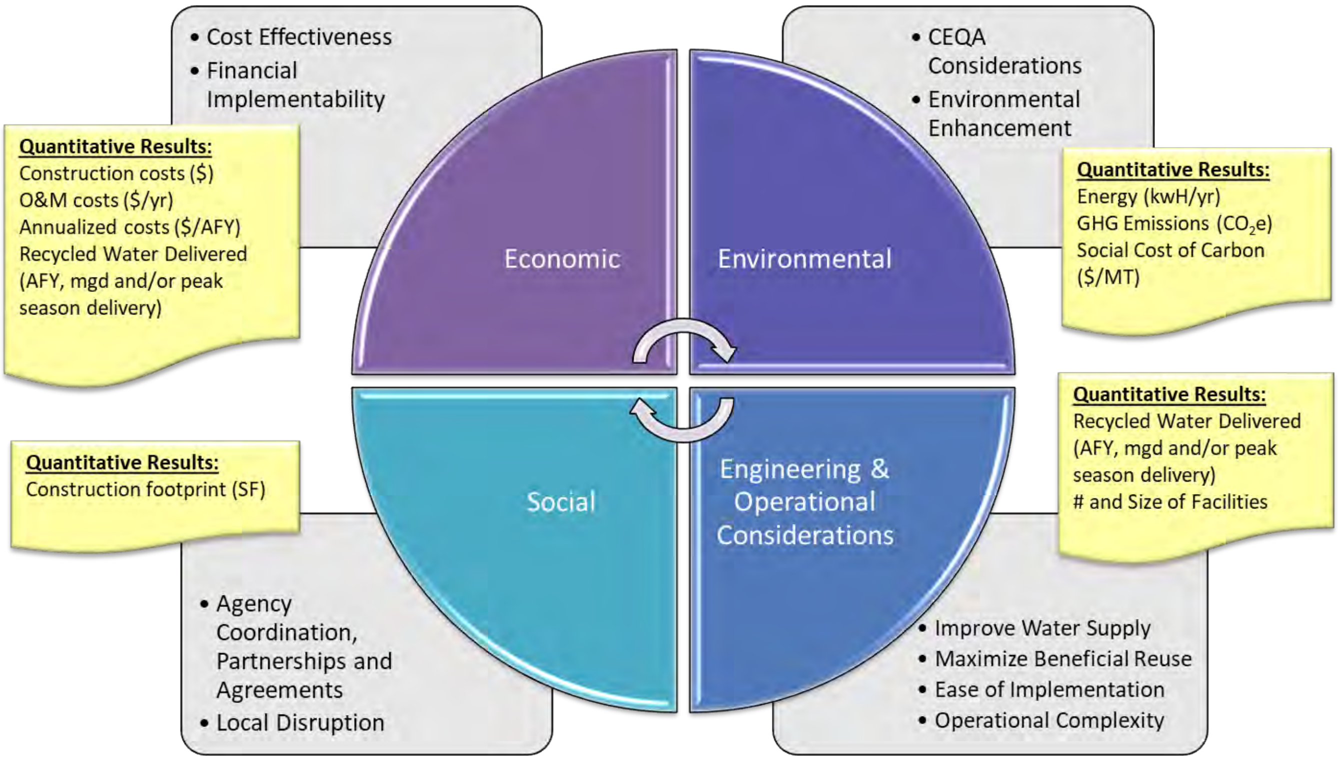
The Triple Bottom Line paradigm (economic, environmental, social) can help frame the full range of benefits from recycled water projects in a manner that has successfully resonated with diverse stakeholders and decision makers, even in contentious arenas where cost allocations, environmental and community impacts are critical considerations. For this study, four categories were used to compare alternatives against one another. The typical three bottom lines recognize that recycled water projects often provide several types of highly valued benefits beyond financial returns. A fourth bottom line was added to emphasize the important role engineering and operational considerations play in project selection. For each category, benefits and limitations of an alternative were based on quantitative and qualitative information.

The development of screening criteria applied to the alternatives was based on objectives and guidelines introduced earlier in this study:

- The **Study Objectives** (Section 1.3) were developed by the City and Study Partners during the kick-off meeting and approved by the large group of stakeholders. They are not necessarily measurable or tangible.
- The **Basic Guidelines for Evaluation of Project Components** (Table 7-1) were developed during the Alternatives Workshop to align with the Study Objectives. These were the metrics used to better understand the extent to which the project components would meet the Study Objectives. The application of the guidelines resulted in identification of project components to develop alternatives for further evaluation.
- The **Alternative Screening Criteria** (introduced in Section 8.3.1) are more definitive and were used to score and then rank the project alternatives. The screening criteria also align with the Study Objectives and were the metric used to score a project based on the more detailed quantitative results and qualitative findings from the alternatives evaluation.

For each category, quantitative results and qualitative screening criteria were used to evaluate and score each recycled water alternative to identify a preferred project or list of prioritized projects. Figure 8-18 depicts the qualitative screening criteria (in white boxes) and quantitative results (in yellow boxes) associated with each category.

Figure 8-18 Quantitative Results and Qualitative Screening Criteria



Quantitative results for were developed for each project as part of the alternatives evaluation described in Section 8.2. In many cases, the quantitative data were used to inform qualitative scoring for comparing alternatives. Table 8-13 provides considerations for qualitatively assessing each alternative based on the screening criteria. Appendix G (Table G-1) provides a more detailed discussion of considerations for each criterion.

Table 8-13: Considerations for Assessing Projects based on Screening Criteria

Categories	Alternatives Screening Criteria	Considerations for Assessing Project
ENGINEERING & OPERATIONAL CONSIDERATIONS	Improve Regional Water Supply	Ability to fill water supply gap, supplement supply in peak season, timeline for implementation
	Maximize Beneficial Reuse	Maximize reuse of wastewater effluent now, potential to limit future options at the WWTF
	Ease of Implementation	Permitability, construction complexity, flexibility for phasing and potential for expansion
	Operational Complexity	Treatment requirements and known impacts to and potential impacts to SCWD and SCPWD operations
ECONOMIC	Cost Effectiveness	Relative unit costs (capital and O&M)
	Financial Implementability	Relative capital costs and tradeoffs
ENVIRONMENTAL	CEQA Considerations	Potential environmental impacts and mitigation requirements
	Potential for Environmental Enhancement	Potential to enhance ecosystem, and the relative social cost of carbon (GHG emissions)
SOCIAL[1]	Agency Coordination, Partnerships and Agreements	Level of effort and willingness to work together
	Local disruption	During construction and ongoing maintenance

[1] Public Acceptance was originally included in the criteria development to reflect perceived public acceptance and comfort with level of public health and safety associated with reuse. This consideration has been removed from the scoring of alternative projects. The City recognizes its importance and will include it in the next analysis of water supply alternatives when more information can be drawn from the community in terms of their preferences and acceptance of the different types of beneficial reuse.

8.3.2 Scoring, Weighting and Ranking Approach

Alternative projects were scored on a scale of one to five against each screening criteria, where:

Score = 5 Fully Meets Criteria
Score = 4 Mostly Meets Criteria
Score = 3 Partially Meets Criteria
Score = 2 Somewhat Meets Criteria
Score = 1 Unable to Meet Criteria

The process used for scoring, weighting and ranking the alternatives is as follows:

1. **Scoring:** Each alternative was initially scored by the consultant team using the scoring scale above to establish one set of scores. Project partners (SCWD and SCPWD) reviewed and provided input on the preliminary scores and other project partners provided input on scoring during the Scoring and Ranking Workshop.
2. **Weighting:** Project partners provided criteria weighting factors to reflect the relative importance of each criteria. Based on input from SCWD, SCPWD and the consultant team, weighting themes were developed, as presented in Table 8-14, to represent the various perspectives. Screening criteria with more than one consideration (i.e. two or more scores)

will take the average of the scores before applying the weighting. A weighted score for each alternative was calculated as the sum of the scores for each criterion multiplied by the weighted factor, where the maximum score is 100.

3. **Ranking:** Alternative Projects were then ranked such that the highest score receives a rank of one and the lowest score receives a rank of 15. A sensitivity analysis was performed to see how weighting criteria impacts ranking.

A summary of some of the key considerations for scoring is provided in the following sections. Table G-1 in Appendix G provides additional direction for assigning scores of one to five for each project against each screening criteria.

Engineering and Operational Considerations

A sliding scale approach was applied for scoring the ability of a project to improve water supply or maximize reuse based on the amount of reuse in the City. The projects, as defined, would not be able to fully meet the WSAC defined gap of 3,700 AFY each year; however, it is assumed that GRR projects could bank recharged water over multiple years and pull 3,700 AFY during a drought. Projects that were able to be implemented in a shorter time frame scored higher, as did those that allowed for flexibility to expand in the future.

Scoring a project to reflect ease of implementation and operational complexity was based on a qualitative assessment of requirements to permit, construct and operate each type of beneficial reuse. Projects that require advance treatment and a significant amount of infrastructure would score lower due to the potential challenges associated with siting, constructing and operating infrastructure.

Table 8-14: Weighting Factors for Alternatives Screening Criteria

Categories	Alternatives Screening Criteria	Baseline (Balanced)	Maximize Water Supply	WSAC Criteria	WSAC Values	Maximize Beneficial Reuse	Maximizing Engineering & Operational Considerations	Low Cost	Minimize Local Impacts
ENGINEERING & OPERATIONAL CONSIDERATIONS	Improve Water Supply	15%	40%	70%	55%	10%	5%	10%	10%
	Maximize Beneficial Reuse	10%	5%	0%	0%	30%	10%	5%	5%
	Ease of Implementation	10%	10%	0%	0%	10%	5%	10%	5%
	Operational Complexity	10%	5%	0%	0%	15%	45%	5%	5%
ECONO MIC	Cost Effectiveness	15%	5%	15%	15%	5%	5%	30%	5%
	Financial Implementability	15%	10%	15%	15%	5%	5%	30%	5%
ENVIRON-MENTAL	CEQA Considerations	10%	10%	0%	5%	5%	5%	3%	20%
	Potential for Environmental Enhancement	5%	5%	0%	5%	10%	10%	2%	20%
SOCIAL	Agency Coordination, Partnerships and Agreements	5%	5%	0%	5%	5%	5%	3%	5%
	Local Disruption	5%	5%	0%	0%	5%	5%	2%	20%
	TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Economic Considerations

Cost effectiveness was scored on a sliding scale based on relative Unit Life Cycle Costs. Financial implementability was similarly scored on a sliding scale based on relative Capital Costs, where a higher capital cost would mean a larger loan and less borrowing power for other projects. Financial implementability also took relative O&M costs into consideration as rates would likely be most impacted by the annual costs. Financial implementability also took relative O&M costs into consideration as rates would likely be most impacted by the annual costs, which ultimately impacts customer rates.

Environmental Considerations

A qualitative evaluation was applied to score projects based on the anticipated extent of environmental impacts that would need to be evaluated in CEQA/NEPA documents, together with the amount and complexity of mitigation likely to be required. Secondary considerations also included the potential relative cost and duration of the CEQA/NEPA process for a given project. Appendix G.2 includes supporting information for the environmental evaluation to support the alternatives analysis and screening.

Projects that have the potential to directly benefit the environment, i.e., by maintaining or enhancing streamflow, lake levels and groundwater levels during period of droughts, scored higher than those that would have no direct environmental benefit. Environmental considerations also considered the relative contribution to climate change (based on GHG emissions), which was scored on a sliding scale based on relative estimated social cost of carbon. Appendix G.3 describes the rationale and assumptions for estimating the social cost of carbon for each project.

Social Considerations

Social considerations were scored qualitatively based on the level of cooperation required to implement a project and the potential for disruption within the community. Projects where the City would be the lead with control of a project, or where an agreement exists or is in progress to facilitate regional coordination and cost-sharing scored higher. The level of impact on local residents for new construction and ongoing maintenance was scored based on a sliding scale to reflect the relative amount and type of facilities under and above ground.

Public Acceptance

Public acceptance was initially included as a criterion within social considerations to address the perceived public acceptance and comfort with the level of public health and safety associated with the reuse. During the course of evaluating the alternatives, it was decided that the public acceptance criteria would not be scored as part of this RWFPS due to uncertainty related to the lack of clarity of the larger water supply portfolio of which advanced treated recycled water is one component. While SCWD is making progress with the development of information about the feasibility of groundwater replenishment with in lieu transfers, aquifer storage and recovery, and seawater desalination, it is too early to judge the perceived acceptance of the various types of reuse options being considered by the Santa Cruz community. The City recognizes the importance of public acceptance and will include it in the next analysis of water supply alternatives when more information can be drawn from the community in terms of their preferences and acceptance of the different types of beneficial reuse. See Section 9.5.3 for preliminary recommendations. The City is committed to future efforts to listen to the community and communicate about recycled water issues to more fully understand their preferences and interest in reuse in Santa Cruz.

8.4 State Priorities

The SWRCB requires an assessment of how the project alternatives address State Planning Priorities and State Water Resources Management Priorities. However, this assessment does not need to be part of the alternatives screening approach, and has not been evaluated during the scoring, weighting and ranking exercise. Table 8-15 describes how the alternatives address State priorities.

Table 8-15: Description of How Alternatives Address State Priorities

State Priorities	How Alternatives Address Priorities
State Planning Priorities[1]	
(a) To promote infill development and equity by rehabilitating, maintaining, and improving existing infrastructure that supports infill development and appropriate reuse and redevelopment of previously developed, underutilized land that is presently served by transit, streets, water, sewer, and other essential services, particularly in underserved areas, and to preserving cultural and historic resources.	Recycled water would serve all existing areas and promote infill development by making more water available.
(b) To protect environmental and agricultural resources by protecting, preserving, and enhancing the state's most valuable natural resources, including working landscapes such as farm, range, and forest lands, natural lands such as wetlands, watersheds, wildlife habitats, and other wildlands, recreation lands such as parks, trails, greenbelts, and other open space, and landscapes with locally unique features and areas identified by the state as deserving special protection.	Potentially applicable to streamflow augmentation, if augmentation with advanced treated water is considered a benefit and not a detriment
(c) To encourage efficient development patterns by ensuring that any infrastructure associated with development, other than infill development, supports new development that does all of the following:	
(1) Uses land efficiently.	Applies/addresses requirements for all alternatives - assumes all facility sites would use land efficiently.
(2) Is built adjacent to existing developed areas to the extent consistent with the priorities specified pursuant to subdivision (b).	Applies/addresses requirements for all alternatives - assumes new facilities at the existing SC WWTF and off-site locations would be designed consistent with local development priorities.

State Priorities	How Alternatives Address Priorities
(3) Is located in an area appropriately planned for growth.	Applies/addresses requirements for all alternatives - assumes new facilities consider development plans, and demands are based on current needs and future growth.
(4) Is served by adequate transportation and other essential utilities and services.	Applies/addresses requirements for all alternatives - most new facilities are proposed within urban areas of the City at or near essential utilities and services.
(5) Minimizes ongoing costs to taxpayers.	To be addressed through the distribution of project costs between rates, connection fees, and partnerships.
State Water Resources Management Priorities[2]	
The State Water Board:	
1. Continues to commit to sustainability as a core value for all Water Boards' activities and programs	Recycled water projects are inherently sustainable given the beneficial use of a local, drought-proof resource.
2. Directs Water Boards' staff to require sustainable water resources management such as Low Impact Development (LID) –and climate change considerations, in all future policies, guidelines, and regulatory actions	All alternatives include climate change considerations since reuse addresses future uncertainties of climate change with regards to water sustainability and reliability. LID (low impact development) primarily refers to stormwater management approaches, which were not considered as part of this study.
3. Directs State Water Board staff to identify policies and program areas to integrate climate change strategies and comply with the goals stated in Assembly Bill 32, based on the Water-Energy Climate Action Team process.	All alternatives would integrate climate change strategies by addressing future uncertainties of climate change through the development of a local, reliable and sustainable supply.
4. Directs Regional Water Boards to aggressively promote measures such as recycled water, conservation, and LID Best Management Practices where appropriate and work with Dischargers to ensure proposed compliance documents include appropriate, sustainable water management strategies.	All alternatives would promote recycled water and develop sustainable water management based on beneficial reuse and the creation of a local and reliable supply. Conservation and LID are not applicable for this study.
5. Directs State Water Board staff to assign a higher grant priority to climate-related and LID projects, particularly those that are supported by local policies or ordinances.	All alternatives would address climate-related considerations by addressing future uncertainties of climate change through the development of a local, reliable and sustainable supply. The RWFPS notes that updates to local-ordinances would be developed as appropriate. LID projects were not considered as part of this study.

State Priorities	How Alternatives Address Priorities
6. Supports training for Water Board staff and stakeholders to ensure successful implementation of climate change strategies and LID practices.	Coordination with Regional Water Board Staff and the Division of Drinking Water through the permitting process would support training. Implementation of the program would involve public involvement through CEQA (and possibly NEPA) as well as through the public outreach and communication program.
7. Directs Water Boards' staff to coordinate with partners from other government agencies, non-profit organizations, and private industry and business to further enhance and encourage sustainable activities within the administration of Water Board programs and activities.	All alternatives would involve coordination with project stakeholders, including the water board staff, regional partners, NGOs and potentially UCSC or other private entities that would use recycled water. The beneficial reuse and the creation of a local and reliable supply is in itself a sustainable activity.

[1] State Planning Priorities in Section 65041.1 of the Government Code accessed from http://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=65041. 1.&lawCode=GOV

[2] State Water Resources Management Priorities accessed from http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/docs/rs2008_0_030.pdf

8.5 Alternative Ranking Results

This section summarizes the results of the alternative ranking evaluation. Appendix G includes more detailed tables listing quantitative results and the scoring for each project for each criterion as well as the weighted score for each project for the various weighting themes. The recommended project, as identified by the project partners, is presented in Section 9. Table 8-16 presents the results of the ranking for the 15 alternative projects and Table 8-17 summarizes some of the benefits and limitations that drove the ranking outcomes.

As previously described, the weighting themes were used to perform a sensitivity analysis to assess how variation in weighting for certain categories or criteria would change the project ranking. The percent weighting factors were multiplied by the raw scores for each criterion to get a total weighted score and ranking for each project. Conditional shading in Table 8-16 shows GREEN as top scoring/top ranking and RED as bottom scoring/bottom ranking of all projects.

Table 8-16: Summary of Alternative Project Ranking for Weighting Themes

Summary of Alternative Project Ranking and Sensitivity Analysis

Alternative	Sub-Alt #	Description	Baseline (Balanced)	Maximize Water Supply	WSAC Criteria	WSAC Values	Maximize Beneficial Reuse	Maximizing Engineering & Operational Considerations	Low Cost	Minimize Local Impacts
			SENSITIVITY RANKING							
Alternative 1 – Centralized Non-Potable Reuse	**1a**	Santa Cruz PWD Title 22 Upgrades	1	1	4	1	1	1	1	1
	1b	Maximize Tertiary Treatment for NPR	4	5	8	7	7	2	10	2
Alternative 2 – Decentralized Non-Potable Reuse	**2**	UC Santa Cruz Campus NPR	5	7	11	11	8	5	6	3
Alternative 3 – Santa Cruz Participation in SqCWD led Groundwater Recharge Reuse (GRR) Project	**3a**	SqCWD GRRP (Baseline)	*Not Analyzed*							
	3b	SqCWD GRRP with Tertiary NPR in Santa Cruz	2	6	6	5	9	3	2	4
	3c	SqCWD GRRP with GRR at Beltz Wellfield and NPR in Santa Cruz	7	4	3	4	2	4	9	9
	3d	SqCWD GRRP with AWTF and NPR in Santa Cruz	8	8	9	9	12	6	3	5
	3e	SqCWD GRRP with AWTF, GRR at Beltz Wellfield and NPR in Santa Cruz	6	3	1	3	6	7	5	7
Alternative 4 – Santa Cruz GRRP	**4a**	Santa Cruz Centralized GRRP at Beltz Wellfield	3	2	1	2	3	8	4	5
	4b	Santa Cruz Decentralized GRRP at Beltz Wellfield	9	9	5	6	10	11	7	12
Alternative 5 – Surface Water Augmentation (SWA) in Loch Lomond Reservoir	**5**	SWA at Loch Lomond Reservoir	14	11	10	10	14	14	14	10
Alternative 6 – Streamflow Augmentation	**6**	Augmentation of the San Lorenzo River	13	13	12	11	13	13	13	8
Alternative 7 – Direct Potable Reuse	**7**	Raw Water Blending at GHWTP	10	10	7	8	11	12	8	13
Alternative 8 – Regional GRRP	**8a**	4-way Regional GRRP (City, SVWD, SLVWD and SqCWD)	12	14	12	14	5	10	12	14
	8b	4-way Regional GRRP (City, SVWD and SLVWD)	11	12	12	13	4	9	11	11

Table 8-17: Summary of Ranking Outcomes

Alternative Project	Major Benefits / Advantages	Significant Limitations / Challenges	Outcome
Alt 1a - Santa Cruz PWD Title 22 Upgrades	• Lowest cost alternative • Shortest time to implementation • Easy to implement with minimal impact on City operations • Few environmental and social obstacles • Opportunity to introduce RW to the community in near-term • Minimal upgrades to existing infrastructure needed	• Limited reuse outside of the WWTF • Total potable offset is less than the amount of recycled water use due to in-plant demands	Selected as Preferred Alternative - to be modified based on recent design efforts.
Alt 1b - Maximize Tertiary Treatment for NPR	• Right water for the right use • Short time to implementation • Existing regulations with straightforward permitting • Minimal impact on City operations • Few environmental and social obstacles	• Significant conveyance and pumping to serve all demands • High capital and unit costs due to extensive infrastructure required	Selected as an expansion of the Preferred Alternative – only include the alignment to UCSC and customers along the way.
Alt 2 - UC Santa Cruz Campus NPR	• Utilizes a local resource • Reduces pumping requirements • Does not limit WWTF expansion • Easy to implement with minimal impact on City operations • Diverse on-campus demands (including dual-plumbed buildings)	• Limited reuse due to small on-campus demands • Treatment facility siting challenges on campus • Complexity for MBR operation	Not selected
Alt 3a - SqCWD GRRP (Baseline)	Not analyzed because it provides no water to the City and would have no value in the ranking exercise		
Alt 3b - SqCWD GRRP with Tertiary NPR in Santa Cruz	• Investment in regional infrastructure can be realized in the long term. • Potential for cost-sharing and pursuing funding as a region • Avoids sending secondary effluent through the City	• Minimal reuse in the City • Interagency infrastructure challenges (ownership, ops, construction, etc.) • May limit future expansion at the Santa Cruz WWTF	Not selected
Alt 3c - SqCWD GRRP with GRR and NPR in Santa Cruz	• Investment in regional infrastructure can be realized in the long term. • Potential for cost-sharing and pursuing funding as a region • Potential to bank recharged water for extraction during dry years • Greater water supply benefits and beneficial use • Does not limit WWTF expansion • Environmental benefit of maintaining groundwater levels	• Operational complexity and energy for treatment and injection • Additional studies to confirm GW basin capacity, ability to capture recharged flow and meet all regulatory requirements • Water quality exceeds needs for NPR (though minimal NPR demand is served in the City) • Interagency infrastructure challenges (ownership, ops, construction, etc.)	Identified as a potential Mid-Term GRRP – support the Pure Water Soquel project and leverage regional benefits
Alt 3d - SqCWD GRRP with AWTF and NPR in Santa Cruz	• Same as Alt 3b	• Same as Alt 3b • Water quality exceeds needs for NPR (however, minimal NPR reuse in the City) • May limit future expansion at the Santa Cruz WWTF	Not selected

Alternative Project	Major Benefits / Advantages	Significant Limitations / Challenges	Outcome
Alt 3e - SqCWD GRRP with AWTF, GRR and NPR in Santa Cruz	• Same as Alt 3b • Potential to bank recharged water for extraction during dry years • Greater water supply benefits and beneficial use	• Same as Alt 3c • May limit future expansion at the Santa Cruz WWTF	Identified as a potential Mid-Term GRRP – support the Pure Water Soquel project and leverage regional benefits
Alt 4a - Santa Cruz Centralized GRRP	• City controlled project • Potential to bank recharged water for extraction during dry years • Greater water supply benefits and beneficial use • Environmental benefit of maintaining groundwater levels	• Water quality exceeds needs for NPR (however, minimal NPR reuse in the City) • Operational complexity and energy for treatment and injection • Additional studies to confirm GW basin capacity, ability to capture recharged flow and meet all regulatory requirements	Identified as a potential Mid-Term GRRP – support the Pure Water Soquel project and leverage regional benefits
Alt 4b - Santa Cruz Decentralized GRRP	• Same as Alt 4a • Does not limit WWTF expansion	• Same as Alt 4a • Limited source water supply from DA Porath Pump Station • Significant MBR siting and construction challenges • Complexity for MBR operation	Not selected.
Alt 5 - SWA at Loch Lomond Reservoir	• Maximize beneficial reuse in summer/shoulder months • Potential to modify operational practices to maximize supply benefits • Potential environmental benefits to maintaining reservoir levels	• High capital and unit costs due to extensive infrastructure required • Challenging regulatory, CEQA/NEPA and permitting requirements • Operational complexity for treatment and reservoir management • Significant energy for conveyance and treatment • May limit future expansion at the Santa Cruz WWTF • Additional limnological studies needed to confirm assumptions	Not selected.
Alt 6 - Augmentation of the San Lorenzo River	• Maximize beneficial reuse in summer • Limited new conveyance infrastructure needed • Potential environmental benefits to maintaining streamflow	• High unit costs due to ability to augment in summer months only • Regulatory viability is highly uncertain (TMDL/WQOs) • Challenging regulatory, CEQA/NEPA and permitting requirements • Operational complexity for treatment • Proximity of point of discharge to San Lorenzo River Diversion • May limit future expansion at the Santa Cruz WWTF • Additional studies needed to assess impacts to anadromous fish	Not selected.
Alt 7 - Raw Water Blending at GHWTP	• Maximize available beneficial use year-round • Maximize development and use of a local, sustainable new water supply – with fewest limitations and minimal losses • Lower unit cost than other potable reuse alternatives due to limited new conveyance infrastructure needed and higher amount of reuse	• High capital cost and operational complexity due to additional treatment steps • Existing regulations have not been developed; no DPR project is currently permitted in California • Long timeline for implementation • Potential impact to GHWTP operations and source water issues • Significant energy for treatment • May limit future expansion at the Santa Cruz WWTF	Not selected.

Alternative Project	Major Benefits / Advantages	Significant Limitations / Challenges	Outcome
Alt 8a - 4-way Regional GRRP (City, SVWD, SLVWD and SqCWD)	• Potential for more beneficial reuse than in the Beltz Wellfield area alone • Potential to bank recharged water for extraction during dry years • Investment in regional infrastructure can be realized in the long term • Potential for cost-sharing and pursuing funding as a region • Does not limit WWTF expansion • Environmental benefit of maintaining groundwater levels	• Highest capital cost alternative • Longest timeline to implementation • Complex institutional arrangements and multi-agency coordination • Interagency infrastructure challenges (ownership, operations, construction, etc.) • Challenging water rights and transfer agreements • Operational complexity and energy for treatment and injection • Significant energy for conveyance and treatment • Additional studies to confirm GW basin capacity, ability to capture recharged flow and meet all regulatory requirements	Identified as a potential Long-Term GRRP – continue discussions to make the region more resilient in the long term.
Alt 8b - 4-way Regional GRRP (City, SVWD and SLVWD)	• Same as Alt 8a • Reduced energy and infrastructure capacity as compared to Alt 8a	• Same as Alt 8a	Identified as a potential Long-Term GRRP – continue discussions to make the region more resilient in the long term.

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The outcome of the sensitivity analysis found that the following non-potable and indirect potable projects consistently rose to the top:

- ✓ Alt 1 Santa Cruz PWD Title 22 Upgrades (combination of Alt1a and Alt1b)
- ✓ Alt 3c SqCWD led GRR in Purisima Formation with AWTF at Soquel, and GRR and NPR in the City's service area.
- ✓ Alt 3e SqCWD led GRR in Purisima Formation with AWTF at Santa Cruz WWTF, and GRR and NPR in the City's service area.
- ✓ Alt 4a City led GRR in Purisima Formation

The projects that fell to the bottom included

- ✓ Alt 5: SWA
- ✓ Alt 6: Streamflow Augmentation
- ✓ Alt 7: DPR

Though overall projects that ranked at the top and the bottom did so across weighting themes, there were some cases where ranking was particularly influenced by weighting theme. For example, the high-volume reuse projects dominated the ranking results for the WSAC Criteria and WSAC Values weighting themes, which heavily weight projects that improve water supply. The DPR and Regional GRRPs scored higher from a Maximizing Beneficial Reuse perspective because these projects reused the most recycled water. Non-potable reuse projects ranked higher for the Maximizing Engineering/Operations Considerations, Low Cost, Minimize Local Impacts weighting themes because NPR is easier to permit, construct and operate than the more complex potable reuse alternatives.

8.6 Preferred Alternative Projects

The sensitivity analysis exercise helps puts the ranking of projects into perspective when selecting a preferred project. However, it is important to recognize that numbers do not pick projects, people do. In the case of the City's preference for a project; there are parallel activities being performed to support the WSAC's recommended strategies. The City is first looking at the potential for conservation and groundwater recharge/storage via ASR using winter surface water flows to fill the water supply gap. The City's Water Department and Water Commission are tasked to consider pursuit of reuse and/or desalination after a determination about the feasibility and likelihood of sufficient ASR yields is made. Thus, the preferred alternative project that has been developed by the project partners in this study provides for near-term local action while leaving the door open for larger regional coordination in the future.

The preferred alternative the NPR Alternative 1 Santa Cruz PWD Title 22 Upgrades (combination of Alt 1A and Alt 1B) and includes two projects that would provide non-potable reuse in the City:

- **Santa Cruz Public Works Department (SCPWD) Title 22 Upgrade Project (Alternative 1A)** – implement a near-term non-potable reuse project to meet in-plant demands, develop a bulk water station and serve the near-by La Barranca Park.

- **BayCycle Project (Alternative 1B Phase 4)** – expand the SCPWD Title 22 Upgrade Project to increase production and non-potable reuse to serve UCSC and City customers along the way**.**

The City is also committed to exploring other reuse opportunities, including:

- **Coordination with Pure Water Soquel** – continue to work closely with SqCWD to support the evaluation of the Pure Water Soquel project including, but not limited to, the delivery of source water and considerations for benefits of shared infrastructure.
- **Explore GRR at Beltz Wellfield** – to replenish the Santa Cruz Mid-County Groundwater Basin in the Beltz Wellfield area, through a collaborative project with Pure Water Soquel or as an independent City led project
- **Explore GRR in SMGB –** continue regional discussions related to the benefits and limitations for a Regional GRRP in the SMGB, which has the potential to make the region more resilient in the long term.

The SCPWD Title 22 Upgrade Project and the BayCycle Project are the focus of the Recommended Project and Construction Financing Plan in Sections 9 and 10, respectively, since these projects would be constructed in the near-term. Specifically, these projects present a unique opportunity:

- ✓ For City departmental collaboration (between SCWD, SCPWD and the Parks and Recreation Department),
- ✓ To partner with UCSC to explore technologies and techniques to reduce potable water demand
- ✓ To develop a redundant water supply and beneficially reuse wastewater, and
- ✓ To initiate outreach and education for the community to better understand and increase public acceptance of recycled water.

Exploring other reuse opportunities offers a unique opportunity to create a multi-beneficial project and work collaboratively with regional partners to develop local, sustainable supplies and increase resiliency in the region for the long term. Due to the unique nature of these projects; additional evaluation is needed to confirm the feasibility, permitability and public acceptability of groundwater replenishment in the Santa Cruz Mid-County Groundwater Basin and SMGB. Thus, Sections 9 and 10 qualitatively address the next steps to confirm the viability of GRR and to address some financial considerations for implementing regional projects.

Section 9: Recommended Project

As described at the end of Section 8, the recommended projects are focused on non-potable reuse in the near-term:

- **Santa Cruz Public Works Department (SCPWD) Title 22 Upgrade Project (Alternative 1A)** – implement a near-term non-potable reuse project to meet in-plant demands, develop a bulk water station and serve the near-by La Barranca Park.
- **BayCycle Project (Alternative 1B Phase 4)** – expand the SCPWD Title 22 Upgrade Project to increase production and non-potable reuse to serve UCSC and City customers along the way**.**

The City is also committed to exploring other reuse opportunities in the mid-term, including:

- **Coordination with Pure Water Soquel** – continue to work closely with SqCWD to support the evaluation of the Pure Water Soquel project including, but not limited to, the delivery of source water and considerations for benefits of shared infrastructure.
- **Explore GRR at Beltz Wellfield** – to replenish the Santa Cruz Mid-County Groundwater Basin in the Beltz Wellfield area, through a collaborative project with Pure Water Soquel or as an independent City led project
- **Explore GRR in SMGB –** continue regional discussions related to the benefits and limitations for a Regional GRRP in the SMGB, which has the potential to make the region more resilient in the long term.

The SCPWD Title 22 Upgrade and BayCycle projects are the focus of the Recommended Project and Construction Financing Plan sections of the RWFPS, since these projects are assumed to be constructed in the near-term. The Recommended Project starts with Alternative 1A and Alternative 1B Phase 4 and makes refinements and modifications to the facilities and costs based on input from the City.

GRR opportunities represent efforts in the mid-term that would require more time to work collaboratively with regional partners and future studies to confirm the viability of groundwater replenishment in the Santa Cruz Mid-County Groundwater Basin and/or SMGB. Thus, these two GRR projects are discussed together, in terms of the next steps or other considerations for implementing regional projects.

Other long-term opportunities for direct potable reuse and surface water augmentation did not demonstrate any real or substantial benefits; thus, these opportunities would be reserved for future consideration when and if 1) DPR regulations are established and 2) issues related to surface water augmentation at Loch Lomond can be resolved (e.g. confirming capacity for advanced treated water in the reservoir, demonstrating ability to meet dilution and mixing requirements, verifying nutrient removal requirements and identifying modifications to operations to realize the potential benefits of SWA). Long-term opportunities are not further discussed in this section.

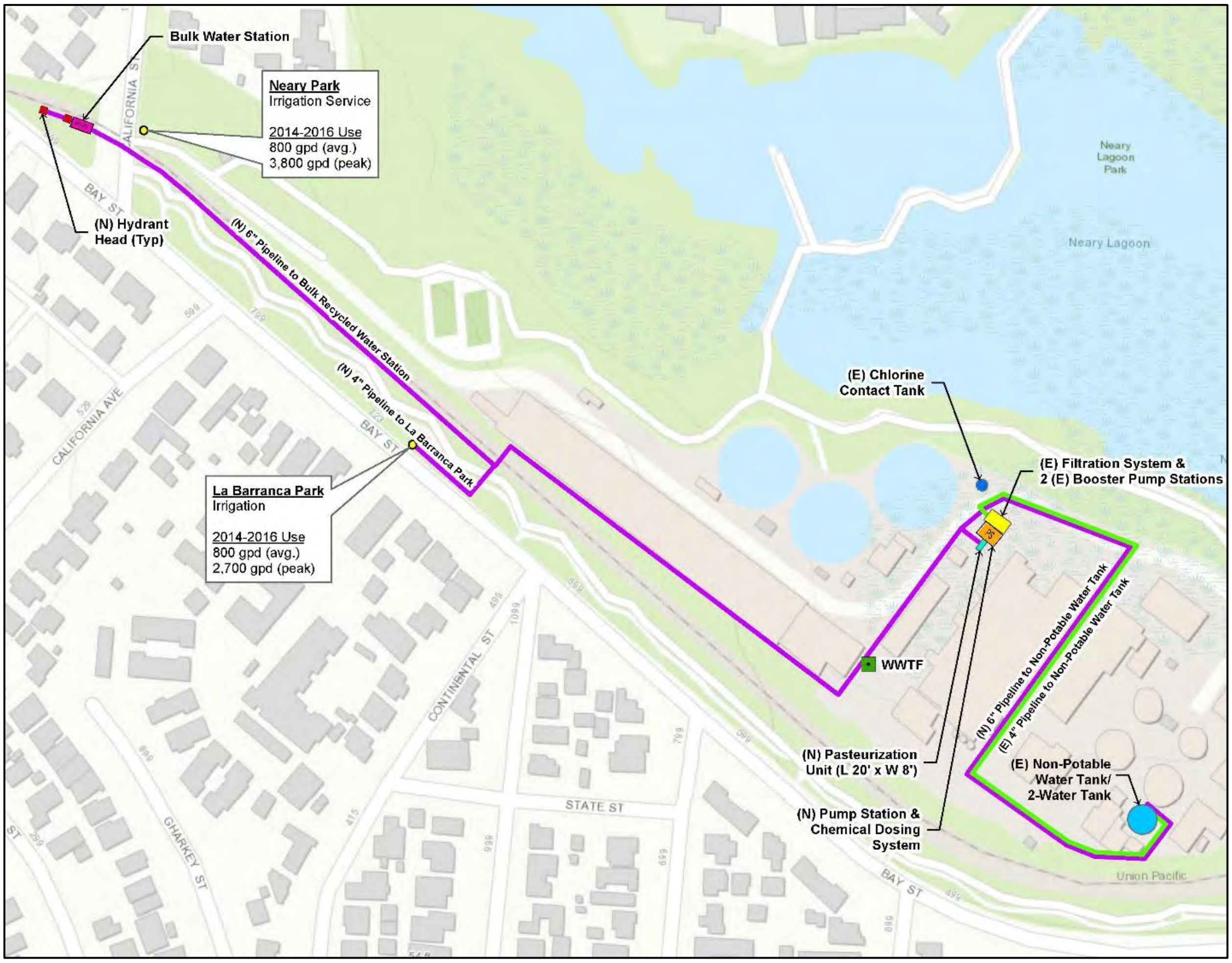
9.1 Description of Recommended Project

9.1.1 SCPWD Title 22 Upgrade Project

The Santa Cruz WWTF currently operates a reclaimed water system that treats secondary wastewater utilized for daily facility operations, such as equipment cleaning, pump priming and chemical dilution. Disinfected secondary treated wastewater effluent is diverted to the existing reclaimed water system, where it is filtered, disinfected and reused for facility applications. The existing reclaimed water system currently does not meet Title 22 standards.

The City proposes to develop a recycled water system that meets Title 22 standards to avoid the use of potable water for the process system at the WWTF and to provide recycled water for off-site use. The objectives of the SCPWD Title 22 Upgrade Project are to: (1) replace the disinfected secondary reclaimed water used at the WWTF with tertiary treated recycled water, (2) meet the irrigation requirements of City parks adjacent to the WWTF, and (3) offer recycled water at a bulk water station. Figure 9-1 shows project facilities and customers served.

Figure 9-1: SCPWD Title 22 Upgrade Project Facilities and Customers



The project would produce 0.13 mgd (150 AFY) of non-potable recycled water that meets Title 22 standards for non-potable reuse. Key components of the upgrades at the WWTF include upgrading secondary effluent booster pumps, adding a Title 22 pasteurization unit, converting the existing chlorine contact tank to storage and a dedicated pipeline to the existing non-potable "2 water" tank. Off-site demands for La Barranca Park, Neary Park and a new bulk water station would be served by a new distribution system pump station and pipeline that would cross under the railroad tracks utilizing a City easement. A bulk water station would offer recycled water to trucks for dust control and other approved uses. Residential hose bibs could be included in the bulk water station or a mobile truck station program could be initiated to provide recycled water to the general public on the weekends or during the peak irrigation season.

The City of Santa Cruz would need to obtain a recycled water permit from the RWQCB and DDW for the production and distribution of recycled water which would require completion of a Title 22 Engineering Report, cross-connection testing, and establishment of a monitoring, operations and training program.

9.1.2 BayCycle Project

The next step would expand the SCPWD Title 22 Upgrade Project to increase production and non-potable reuse to serve customers along Bay Street including City customers and UCSC. Figure 9-2 shows project facilities and customers served.

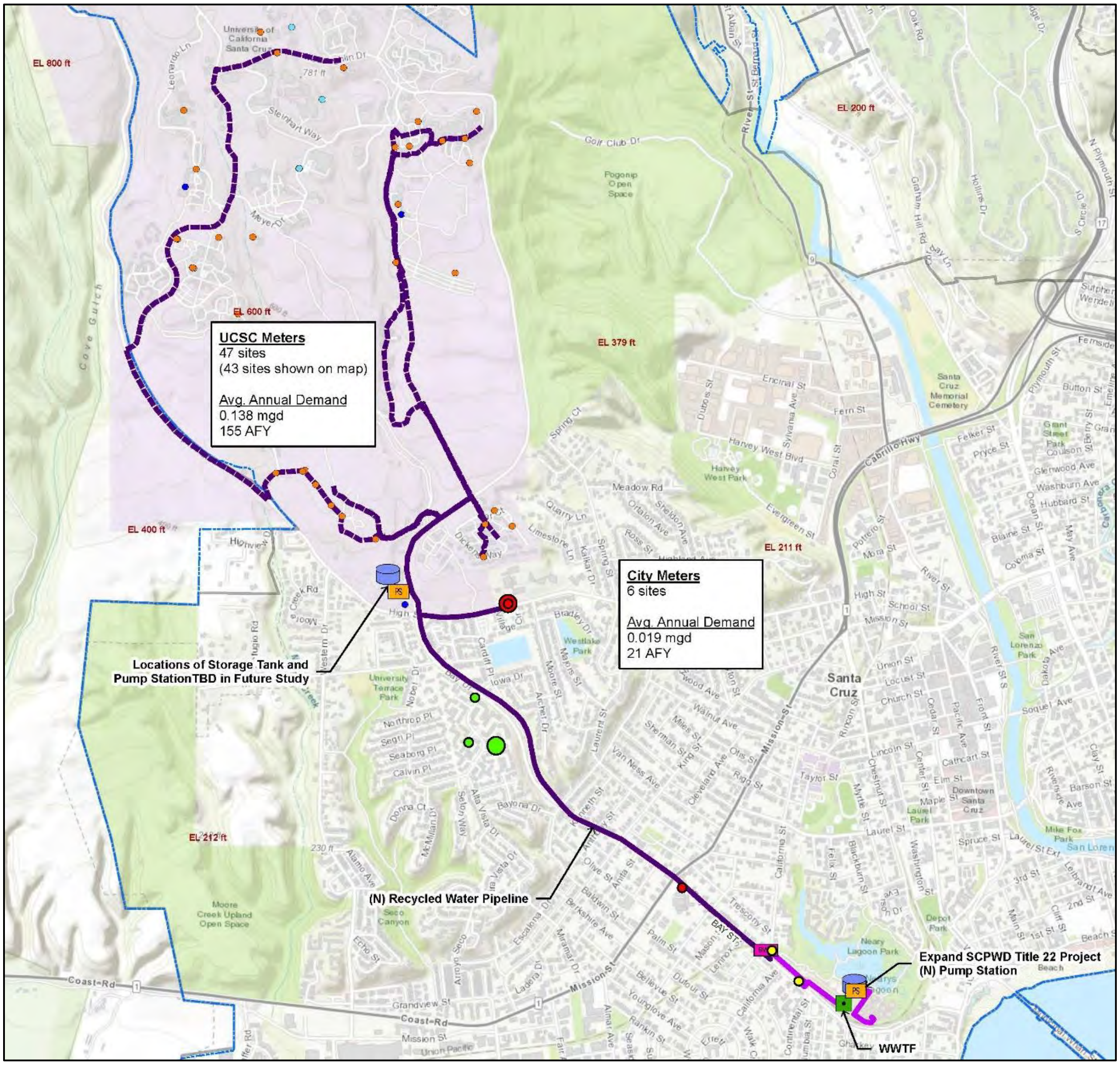
The project would produce 0.16 mgd (176 AFY) of non-potable recycled water that meets Title 22 standards for non-potable reuse for irrigation of landscapes, organic farms, and dual plumbed institutional buildings.

The treatment upgrades for the SCPWD Title 22 Upgrade Project would increase recycled water production capacity to approximately 0.30 mgd, which would be sufficient to meet demands (0.13 mgd) plus additional non-potable demands for BayCycle Project customers (0.16 mgd). Additional treatment facilities are therefore not included in BayCycle Project; however, filter optimization and rehabilitation may be required to reach the full capacity.

The BayCycle Project includes expansion of the pump station and a new conveyance pipeline extending from the Bulk Water Station up a major arterial street (Bay Street) to the UCSC campus (see Figure 9-2). It is assumed that the SCPWD Title 22 Upgrade Project design would allocate space to expand pumping capacity at the WWTF and size pipeline conveyance capacity outside of the WWTF to meet future anticipated demands.

The project would also include a pump station and storage tank on or near the UCSC campus, along with pipelines for distribution to campus customers. Additional hydraulic evaluation and siting studies would be conducted as part of a future alignment study to determine the optimal location for a pump station and storage on or near the UCSC Campus.

Figure 9-2: BayCycle Project Facilities and Customers



9.1.3 Other Reuse Opportunities

Other reuse opportunities include:

1. Coordination with Pure Water Soquel
2. Exploration of GRR at Beltz Wellfield
3. Exploration of GRR in the Santa Margarita Basin

These projects represent longer term efforts that would require more time to work collaboratively with regional partners and/or future studies to confirm the viability of groundwater replenishment.

These groundwater replenishment projects are also aligned with the WSAC strategies to address the water supply gap of 1.2 billion gallons per year (3,700 AFY) during times of extended drought.

The WSAC recommendations also include the evaluation of aquifer storage and recovery (ASR) with raw water supplies. As the City continues to work on groundwater modeling, development of regional partnerships and pilot testing for ASR, the details and opportunities for groundwater recharge would be better defined and would guide the potential opportunity for a GRRP in conjunction with or independent of an ASR project.

The following sections provide additional information about the next steps to explore GRR opportunities. Due to the longer-term nature of these projects – implementation and operational considerations for a GRRP are not discussed. Refer to Section 8 for additional details and costs for the GRR alternative projects.

9.1.4 Coordination with Pure Water Soquel

The City is committed to continuing to work closely with SqCWD to support the evaluation of the Pure Water Soquel project including, but not limited to, the delivery of source water and considerations for benefits of shared infrastructure. As discussed in Section 8.2.3, Pure Water Soquel is a groundwater replenishment project using advanced water purification methods to supplement the natural recharge of the Santa Cruz Mid-County Groundwater Basin in SqCWD's service area, reduce the degree of overdraft conditions, protect it against seawater intrusion, and promote beneficial reuse by reducing discharge of treated wastewater to the Monterey Bay National Marine Sanctuary. The Pure Water Soquel project's treatment facilities would be sized to produce 1,500 AFY (1.3 mgd) of advanced treated water; however, the Project's underground infrastructure would be sized to accommodate the Basin's needs for 3,000 AFY (2.7 mgd) (Carollo 2016). The schedule for the Pure Water Soquel project targets construction starting in 2019 with the project coming on line in 2023. The option to develop an AWPF facility at the Santa Cruz WWTF and associated advanced treated water pipeline extending from Santa Cruz WWTF to recharge well sites was added to the EIR (ESA 2017).

The City and SqCWD have signed a Memorandum of Understanding (MOU) which was approved by the Santa Cruz City Council in the June 27, 2017 meeting (included in Appendix H). The MOU is specifically intended to do two things:

1. Provide clarity and certainty to SqCWD that, should SqCWD ultimately decides to pursue an IPR project, it would have a reliable source of secondary treated effluent to use for its project; and

2. Clarify that providing SqCWD with treated wastewater does not alter the City's course to implement the Recommendations of the WSAC, which direct winter water transfers and ASR as the City's priority water supply projects.

The City is committed to continued coordination with SqCWD for the Pure Water Soquel project.

9.1.5 Explore GRR at Beltz Wellfield

Exploration of a GRRP to replenish the Purisima Formation of the Santa Cruz Mid-County Groundwater Basin at the Beltz Wellfield in the SCWD's service area could be accomplished through a collaborative project with Pure Water Soquel or as an independent City led project. Potential GRRPs are previously defined in Section 8 – Alternatives 3c, 3e, 4a and 4b.

The potential to build up drought reserves in the Beltz Wellfield area with advanced treated recycled water could become an important element in the strategy of the Santa Cruz Mid-County Groundwater Basin JPA to bring it into sustainability and protect the aquifer from seawater intrusion. The City is a partner in the Santa Cruz Mid County Groundwater Basin JPA, which intends to submit a groundwater sustainability plan to DWR by 2020. It is estimated that 3,000 AF per year of water is needed to address the state of critical overdraft in the Basin.

If the City and SqCWD collaborate to plan GRRPs in a sequential manner (i.e. Alternatives 3c or 3e), SqCWD could build an AWPF that leaves room for expansion once the City has obtained approval and funding to invest in GRR. Due to the economies of scale of constructing a larger regional project, there may be financial benefits in terms of minimizing infrastructure requirements, cost sharing and competitive advantages for the regional pursuit of federal and state funding.

An independent City-led GRRP (Alternative 4a or 4b) could similarly benefit the Santa Cruz Mid-County Groundwater Basin. This type of project would provide the City more flexibility in terms of timeline, since the project would not be linked to the Pure Water Soquel schedule. A flexible timeline would also provide an opportunity for the Santa Cruz community to become familiar with recycled water through the SCPWD Title 22 Upgrade Project, BayCycle Project, and the Pure Water Soquel project. There would however be a lost opportunity to share costs and underground infrastructure with a regional partner.

9.1.6 Explore GRR in the Santa Margarita Basin

Exploration of a Regional GRRP to replenish the SMGB has been a part of regional discussions related to making the region more resilient in the long term. Potential Regional GRRPs are previously defined in Section 8 – Alternatives 8a and 8b. There are several other regional efforts related to the management of the SMGB that would be actively considered in the development of a GRRP.

The Santa Margarita Groundwater Agency (SMGWA) was established in June 2017 to develop and implement a groundwater management plan for the Santa Margarita Basin. The SMGWA replaced the Santa Margarita Groundwater Basin Advisory Committee, which has been meeting for 22 years to oversee coordinated management of the SMGB. As of June 2017, a JPA between the SVWD, the SLVWD, and the County of Santa Cruz was recommending that the Board of the SMGWA hold a public hearing to consider declaring that the SMGWA intends to be the GSA for the SMGB[11]. A groundwater sustainability plan would then be prepared by the GSA pursuant to the requirements of the Sustainable Groundwater Management Act (SGMA).

The City of Santa Cruz will continue to explore the option to do a GRR project with regional partners in the Santa Margarita Basin as the JPA agencies consider potential projects in the future. Similar to a Mid-County GRRP, a Regional GRRP could realize benefits from shared infrastructure, economies of scale and a more competitive strategy to pursue funding and cost-sharing.

9.2 Preliminary Design Criteria

9.2.1 Existing Treatment Facilities

The Santa Cruz WWTF has an existing recycled water system, which filters and disinfects recycled water but does not currently meet Title 22 standards. Proposed treatment upgrades would enhance the robustness of the recycled water system to offset the use of potable water for the process system at the WWTF and to provide recycled water for off-site use.

The SCPWD is hiring an external consultant to design the necessary treatment improvements under another contract. The following sections discuss design considerations for major components to be upgraded for SCPWD Title 22 Upgrade Project to make the recycled water system Title 22 compliant, and minor upgrades to be implemented in the BayCycle Project to utilize the recycled water system to its full capacity.

9.2.2 Upgrade to Title 22

The overall treatment approach would convey secondary effluent into two existing tertiary filters in parallel and pump filtered effluent into a Title 22 Certified pasteurization unit, provided by the Pasteurization Technology Group (PTG). A pre-filter coagulation dosing system and a post-filter chemical dosing system would be installed. Disinfected Title 22 recycled water would be pumped to two repurposed storage tanks for reuse at the WWTF or off-site.

The existing filtration system consists of two Contra Clarifier filters (Figure 9-3) in parallel with upflow fluidized dual media composed of 10-inches of sand and 20-inches of anthracite (Trussell 2015). Filter design parameters are provided in Table 9-1. Rehabilitation of the filters, necessary upgrades to the pumps and valves, and media replacement would be identified during the design phase.

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[11] Per SMGWA Agenda Report, June 14, 2017 http://smgwa.org/wp-content/uploads/2017/06/061417AgendaPacket.pdf

Figure 9-3: Existing Contra Clarifier Filters

Table 9-1: Existing Filter Parameters

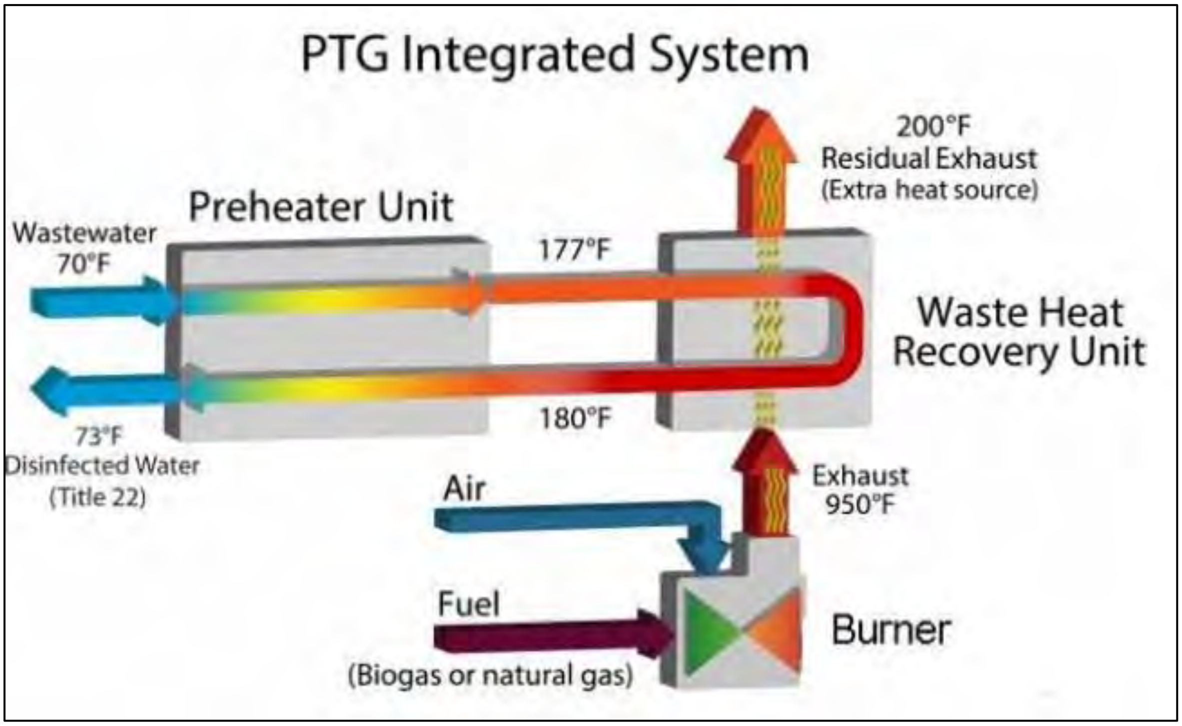
Parameter	Rate (gpm)	Rate (gpm/ft^2)
Filtration Rate	175	4.96
Air Scour Rate	160	4.54
Backwash Rate	635	18
Area per Filter (ft^2)	65.25	--

Source: (Trussell 2015), gpm = gallons per minute, ft^2 = square feet

The current disinfection process injects sodium hypochlorite into a static mixer prior to filtration and conveys post-filter flow to a 25,000-gallon chlorine contact tank (CCT) with eight vertical baffles (Trussell 2015). A coagulant feed system would be added prior to filtration to comply with Title 22 requirements for nephelometric turbidity units (NTU); not to exceed 2 NTU on a 24-hour average, 5 NTU more than five percent of the time and 10 NTU at any given time. The CCT would be replaced with a certified pasteurization unit that would meet Title 22 disinfection requirements.

The pasteurization unit would be provided by the Pasteurization Technology Group (PTG). The system was previously used for six years by Ventura Water and Melbourne Water and would be upgraded and refurbished prior to delivery to the City. Figure 9-4 provides an overview of the unit process components for the PTG integrated system. Additional details about major components, instrumentation, and system specifications are provided in PTG's proposal to the City, which is included in Appendix A.4. The unit could likely be installed in the vicinity of the existing tertiary treatment facility. A new concrete pad would be constructed to support the 15.5-ton weight of the 20' (L) x 8' (H) x 12' (H) pasteurization unit. The preferred location, specifications for the concrete pad and modifications to connect the pasteurization unit to the existing system would be identified in the design phase.

Figure 9-4: Pasteurization Unit Process Overview



Source: X-500 Pasteurization System - Proposal for Santa Cruz's WWTF (included in Appendix A) – included in Appendix A.4. Note: temperatures shown are approximate and would vary depending upon specific application requirements.

A chemical dosing system would be added to maintain the desired disinfection residual prior to park irrigation and distribution at the bulk water station.

The existing 25,000-gallon chlorine contact tank would be converted to a storage tank for disinfected Title 22 recycled water. An existing 75,000-gallon tank currently used to store non-potable water (also referred to as 2water) for on-site use would also be available to store the recycled water. A new pipeline would be needed to convey recycled water from the pasteurization unit to the existing 2water tank (previously shown in Figure 9-1).

The treatment upgrades for SCPWD Title 22 Upgrade Project would need to meet an average annual recycled water demand of 0.13 mgd with a peak day demand of 0.2 mgd. The design of the Title 22 upgrades should consider upsizing facilities or leaving room for expansion to meet the additional BayCycle Project demands (0.16 mgd average annual and 0.3 mgd peak day demand).

9.2.3 Expansion for BayCycle Project

The upgraded Title 22 system could have sufficient capacity to meet the demands for SCPWD Title 22 Upgrade and BayCycle Projects (approximately 0.29 mgd average annual and 0.5 mgd peak day) with minor improvements. The two 0.25 mgd Contra Clarifier filters, which are currently being used one at a time, could be used simultaneously to treat 0.5 mgd if the filter performance is optimized. The refurbished pasteurization unit has a 0.5 mgd capacity rating and the existing booster pumps have a 0.5 mgd capacity rating. Pumps, valves and media would be replaced, as-needed, to meet the combined demands.

Additional study would be conducted to assess performance of the Title 22 upgrades post implementation and identify necessary upgrades to meet BayCycle Project demands.

9.2.4 Infrastructure Design Criteria

New pipelines would be located to convey recycled water between the upgraded Title 22 treatment facility and place of use, in some cases connecting to new or existing pipeline or storage facilities. New pipelines are sized using velocity and head loss criteria to meet peak hourly demands. Peak day demands are used to accommodate flows to UCSC as it is assumed that diurnal storage would be provided on or near campus. Infrastructure would be designed to accommodate peak hourly flows. Design criteria for pipelines and pump stations are presented in Table 8-1. This section discusses some considerations unique to the SCPWD Title 22 Upgrade and BayCycle Projects.

The SCPWD Title 22 Upgrade Project design should consider allocating capacity to meet combined demands, which includes expandable pumping capacity at the WWTF and sizing of conveyance capacity outside of the WWTF to meet future anticipated BayCycle Project demands.

The SCPWD has looked at alternative pipeline alignments to convey recycled water from the converted 25,000-gal tank to the bulk water station. Options explored include repurposing a 2water pipe, routing pipeline through the equipment gallery or installing all new pipelines. The existing 2water pipeline is 4-inch diameter, which is more than adequate to serve the SCPWD Title 22 Upgrade Project off-site demands. Extensions of new pipeline could be 4-inches or 6-inches depending on the City's preference. The SCPWD Title 22 Upgrade Project conveyance system is anticipated to be designed in house by the City at which time specific design criteria would be confirmed. As previously stated, the BayCycle Project would include increasing the pump station capacity at the WWTF, extending the recycled water pipeline from the Bulk Water Station to the bottom of UCSC campus, and a new pump station and storage tank on or near the UCSC campus, along with pipelines for distribution to campus customers. Much of the design criteria for the BayCycle Project is dependent on the location of the new pump station and storage tank, as that would guide the timing and lift requirements for pumping at the WWTF.

For the BayCycle Project, delivery of peak hourly flows to meet City demands and peak daily flows to the boundary of UCSC could be accomplished with a 4-inch diameter pipeline, however, it may be preferable to install larger pipeline on Bay Street to UCSC for ease of maintenance and to provide excess capacity to accommodate future increased demands. Thus, the City may want to consider installing a 6-inch or even 8-inch diameter pipeline from the Title 22 treatment facility to provide for the most flexibility in future operations.

The BayCycle Project conveyance system would likely be designed under an outside contract and would require coordination with UC Santa Cruz for on-campus facilities. Additional hydraulic evaluation and siting studies would be conducted as part of a future alignment study to determine the preferred location for a pump station and storage tank.

9.3 Engineer's Opinion of Probable Costs

The engineer's opinion of probable cost is based on a conceptual level estimate (with -30% to +50% accuracy) of the capital and operating costs for each alternative considered for the RWFPS. Section 8.1.3 and Appendix F describe the capital and annual operations and maintenance (O&M) cost approach. Life cycle unit costs are calculated based on annualized capital costs (assuming 4% interest over the useful life of each component) plus annual O&M costs, divided by annual reuse. Detailed cost sheets for the recommended project are provided in Appendix F.5. Table 9-2 summarizes the engineer's opinion of probable costs for the SCPWD Title 22 Upgrade and BayCycle Projects. Section 10 provides an additional discussion of financing and cost sharing opportunities for the recommended projects.

Table 9-2: Cost Summary for SCPWD Title 22 Upgrade and BayCycle Projects

Project Component	SCPWD Title 22 Upgrade Project:	BayCycle Project:
RW Demand (AFY)	**148**	**176**
Loaded Facility Costs ($)		
Treatment	610,000	230,000
Pipelines	380,000	4,570,000
Pump Stations	110,000	2,450,000
Storage	60,000	460,000
Site Retrofit Costs	100,000	1,650,000
Total Capital Cost ($)	**$1,260,000**	**$9,360, 000**
Annual O&M Costs ($/year)	**$260,000**	**$380,000**
Annualized Capital Cost ($/AF)[1]	450	2,700
Annual O&M Costs ($/AF)	1,700	2,100
Life Cycle Unit Cost ($/AF)	**$2,150**	**$4,800**
Life Cycle Unit Cost ($/CCF)	$4.90	$11.00
Life Cycle Unit Cost ($/MG)	**$6,600**	**$14,700**

[1] Capital cost annualized based on 4% over the expected life of each facility and divided by AFY delivered.

9.4 Summary of Potential Users

9.4.1 Potential Users for SCPWD Title 22 Upgrade Project

The average and peak demand for SCPWD Title 22 Upgrade Project users are shown in Table 9-3.

Table 9-3: SCPWD Title 22 Upgrade Project Demands

	Total Demand (gpd)	Peak Demand (gpd)
In-plant Use	126,000	193,000
Bulk Water Station Use	4,800	11,000
La Barranca Park	800	2,700
Neary Park	800	3,800
TOTAL	**132,400**	**210,500**

Sources: (Trussell 2015) and (City of Santa Cruz 2017)

In-plant use is the largest potential SCPWD Title 22 Upgrade Project use. Recycled water use onsite at the WWTF would replace the existing use of secondary reclaimed water on a 1:1 basis. Reclaimed water is used 24 hours a day, with additional daytime uses (e.g. washing down tanks). Potable water has historically been used minimally to supplement the reclaimed water for in-plant non-potable uses, according to WWTF records.

Bulk water station use would be the second largest potential SCPWD Title 22 Upgrade Project use. Currently, potable water is provided to construction contractors through four bulk water stations located around the City's service area. Potable water provided in 2014 between three bulk water stations was reported to be an average of 4,800 gallons per day with a peak day use of approximately 11,000 gallons per day (SCWD 2016). A fourth bulk water station was installed in 2015.

The SCPWD Title 22 Upgrade Project would serve recycled water at a new, fifth, bulk water station to provide a non-potable water alternative for contractors using it for construction dust control and residential non-potable applications. Preliminary assumptions are that the new bulk water station would be located at the northwest corner of Bay Street and California Street (see Figure 9-1) and would include at least two truck filling stations, and may include several residential hose bibs. For the purposes of analyzing cost/benefit, it was assumed that the recycled water bulk water station would replace the potable water being used at 3 of the existing 4 stations. However, it may be unrealistic to assume contractors would go out of their way to use recycled water. Vehicles would enter the lot area from California Street and exit to Bay Street. Approximately 850 linear feet of pipe would be installed from the railroad crossing and run under the new Santa Cruz County Rail Transportation Commission Pedestrian Coastal Rail Trail to the proposed bulk water station.

City parks would be the smallest use for SCPWD Title 22 Upgrade Project, but would provide a critical first step in showcasing recycled water use to the community. Title 22 recycled water would be provided to offset potable use for landscape irrigation at La Barranca Park and Neary Park (see Figure 9-1). La Barranca Park is adjacent to the Wastewater Treatment Facility and contains over 75,000 square feet of irrigated area. The average potable water use, from 2012-2014, to irrigate La Barranca Park and Neary Park was approximately 800 gpd at each park. The parks have a peak use of approximately 2,700 gpd and 3,800 gpd respectively. Irrigation of the parks would occur primarily at night, from 9 pm to 5 am.

A **residential fill station** program, allowing the general public access to recycled water for outdoor irrigation, could be established as part of SCPWD Title 22 Upgrade or BayCycle Projects. The public fill station could be located at the bulk water station or a mobile unit could fill up at the bulk water station and bring recycled water to a different part of the City. The residential fill station would likely be open during typical working hours during the summer months. The demands for this use would be minimal. Due to the uncertainty in the facility and timing of a residential fill station, facilities and costs have not been included in the recommended projects at this time.

9.4.2 Potential Users for BayCycle Project

The potential non-potable reuse City customers in close proximity to or along Bay Street include City schools and two HOAs with a total average demand of approximately 0.05 mgd (Table 9-4). HOAs were excluded from the NPR market assessment (Section 6.2) since such conversions would typically not be cost effective. However, these two HOAs have been included as part of the recommended project since the main

Potential uses at UC Santa Cruz include irrigation of landscapes, an organic farm, and existing dual-plumbed buildings. There are ~4 clusters of customer sites (with 47 sub-sites) of non-potable on-campus uses in four major demand areas; (1) Athletic Fields, (2) Arboretum and Center for Agroecology & Sustainable Food Systems UCSC Farm and Garden, (3) Faculty Housing, and the (4) West Demand Cluster. UCSC participated in the identification of these sites which together total ~0.14 mgd of demand.

Since 2009, UC Santa Cruz has installed non-potable water pipelines in new campus roads and implemented efficient irrigation systems. UCSC is in the process of updating their 2013 Water Action Plan that would address how the campus intends to achieve the goal adopted by the UC Office of the President in 2016. The goal is for UC campuses to demonstrate leadership in sustainable water systems by reducing potable water use by 36% per capita by 2025 as compared to a 2005-2008 baseline period which was measured on a per student basis. The use of Title 22 recycled water would offset the use of 0.14 mgd of potable water. The provision of recycled water on campus may lead to the incorporation of dual plumbing into the design of future construction projects on campus in the future.

Table 9-4: BayCycle Project Demands

	Total Demand (gpd)	Peak Demand (gpd)
City Demands (Irrigation)[1]		
Westlake School	2,100	3,800
Bayview School	1,400	2,500
SC City Schools	2,200	4,000
Bay Tree HOA	1,200	2,200
Round Tree HOA[2]	6,800	12,800
Round Tree HOA[2]	5,300	9,900
Total City Demands	**19,000**	**35,200**
UCSC Demands[3]		
UCSC Dual-Plumbed	6,400	11,900
UCSC Irrigation	118,100	222,000
UCSC Cooling Towers	14,100	26,400
Total UCSC Demands	**132,200**	**248,400**
TOTAL BayCycle Project Demands	**151,200**	**283,600**

[1] 2013 City meter data
[2] There are two irrigation meters at Round Tree HOA
[3]See Table B-7 for complete list of the 47 UCSC customer sites.

9.4.3 Non-Potable Use Reliability

The design, engineering and operation of the tertiary treatment facility and associated facilities would be in full compliance with the existing Title 22 requirements for non-potable reuse. The recycled water treatment facility would be designed and operated to ensure reliability for public health protection. Overall, recycled water is a highly reliable and sustainable source of water because local wastewater is being continually produced.

9.5 Implementation Plan

There are many items that need to be considered to fully implement the SCPWD Title 22 Upgrade and BayCycle Projects. Implementation Plan items are summarized in Table 9-5 and detailed in the sub-sections that follow. Some of the items for consideration are unique to one of the projects, while others are generally the same for each project.

Table 9-5: Summary of Implementation Plan Considerations

Considerations	SCPWD Title 22 Upgrade Project	BayCycle Project
Coordination	SCPWD and SCWD	City and UCSC
Ability and Timing of Users	Santa Cruz WWTF = Ready to connect Bulk Water Station = New Park = Retrofit needed	City customers = retrofit UCSC = Agreement and retrofits
Water Recycling Requirements	Title 22 Report, Title 17 cross-connection, Supervisor training, monitoring and reporting, etc.	
Commitments from Potential Users	Memo or Letter of intent to use from SCPWD, SCWD and City Parks	Letter of interest from UCSC; develop agreement prior to initial design work or other financial commitments
Water Rights Impact	None required as Water Code Section 2010 assigns ownership of the treated wastewater to the owner of the wastewater treatment plant.	
Permits, Right-of-Way, Design and Construction	RWQCB/DDW permits for production and distribution, NOI for RW program, obtain ROW for pipelines and infrastructure, design, construction & environmental	

SCPWD = Santa Cruz Public Works Department, SCWD = Santa Cruz Water Department, WWTF = Wastewater Treatment Facility, UCSC = University of California Santa Cruz, RWQCB = Regional Water Quality Control Board, DDW = Division of Drinking Water, NOI = Notice of Intent, RW = recycled water.

9.5.1 Coordination

Coordination for SCPWD Title 22 Upgrade Project is relatively simple as it would be entirely within the City of Santa Cruz. Initial discussions between the SCPWD and the SCWD have already begun during preparation of this RWFPS and coordination would continue through implementation of the project.

Critical coordination items for the SCPWD Title 22 Upgrade Project include, but are not limited to:

- identifying each City department's responsibilities for recycled water,

- identifying the recycled water operator for the purpose of the recycled water permit compliance (discussed in Section 9.5.3),
- coordinating activities related to design/construction/operation of facilities inside vs. outside of the Santa Cruz WWTF boundary,
- negotiating cost sharing between departments, and
- establishing a rate structure for recycled water.

For BayCycle Project, the City would coordinate with UCSC and other City water customers to evaluate the feasibility and interest in serving recycled water to the identified user sites. The City has initiated discussions with UCSC regarding their interest and ability to participate in a non-potable program.

BayCycle Project critical coordination items include:

- evaluating pipeline alignments,
- defining operational responsibilities,
- working through issues of formal partnerships/governance with UCSC
- developing cost sharing agreements, and
- establishing rate structures.

9.5.2 Ability and Timing of Users to Join System

SCPWD Title 22 Upgrade Project users would be readily available to connect to the non-potable reuse system, as they are all within the City's control. The largest quantity user, the Santa Cruz WWTF, has already started planning for the improvements necessary to deliver Title 22 compliant recycled water for in-plant use. While the Bulk Water Station would be a new facility, the City has extensive experience constructing and delivering bulk potable water at four stations. The recycled water Bulk Water Station would be in addition to the existing four stations and it is expected that a new Bulk Water Station would get immediate use upon completion of construction and cross-connection testing due to the added convenience of an additional location. The customer site retrofits and cross-connection testing for City Parks should be relatively straightforward given that these are independent irrigation systems.

The ability and timing of users to join the system in BayCycle Project would take more time as there are many more sites and details to work out with the largest potential user, UCSC. City schools typically have some scheduling limitations for implementing customer side retrofits during non-school sessions. HOAs may also require additional attention to solicit buy-in from residents and train site supervisors. Customer site retrofits and cross connection testing would be required for all 42 UCSC sites. Independent irrigation customers may be relatively straightforward, particularly if a defined site supervisor is responsible for multiple sites. Dual-plumbed facilities may require a more complex retrofit and cross-connection testing procedures depending on the level of inspection conducted during construction and the complexity of the site. It would be prudent to confirm details in an agreement between the City and UCSC prior to making any significant financial commitments. The timing of UCSC joining the system would be clearer upon completion of an agreement.

9.5.3 Public Outreach and Communication

There is a wide variety of existing literature in existence that provides a variety of approaches and suggestions for discussing recycled water issues, including public outreach for non-potable and potable reuse.

Four prominent studies by the WateReuse Research Foundation, now known as the Water Environment & Reuse Foundation, evaluated and addressed public communication issues for non-potable and potable reuse projects:

- WRRF 13-02 - Model Public Communication Plans for Increasing Awareness and Fostering Acceptance of Potable Reuse – Millan, Tennyson & Snyder
- WRRF-01-004 Public Perceptions of Indirect Potable Reuse - John Rutten
- WRRF 09-07 Pharmaceuticals and Personal Care Products Communications Toolkit – Recycled Water: How safe is it? - Kennedy, Debroux & Millan
- WRRF 03-05 Marketing Non-Potable Recycled Water: A Guidebook for Successful Public Outreach & Customer Marketing - Humphreys

In addition, local and statewide efforts by SqCWD, Santa Clara Valley Water District and the Xylem Corporation have surveyed California communities to analyze perceptions for potential reuse projects before and during outreach:

- An initial telephone survey was conducted in 2015 for Soquel Creek Water District by New Water Resources to assess initial consideration of their groundwater replenishment project.
- As part of the WRRF 13-02 study referenced above, Fairbank, Maslin, Maullin, Metz & Associates conducted focus groups and telephone surveys with residents in the Santa Clara Valley Water District service area and residents of the City of San Diego to assess their feelings about direct and indirect potable reuse of recycled water. The focus groups and surveys in each location were segmented by gender, and were otherwise designed to reflect the demographic diversity of the local population, with a mix of ages, ethnicities, partisan affiliations, and socioeconomic status. The combination of these two geographic areas were selected and analyzed to best replicate demographics reflective of the state of California population in 2014.
- In 2016, Xylem had a California telephone survey conducted by Edelman Berland to assess public sentiment in California toward the consideration of potable reuse projects.

Overall there are consistent lessons and recommendations throughout the non-potable and potable reuse outreach literature. These generally suggest beginning outreach early, developing consistent terminology and messaging, having the utility become a source of trusted information, and focusing on water quality rather than the history of its use. Additionally, it was commonly stated that knowledge and understanding of the water treatment process increased acceptance of water reuse. Specifically cited are the benefits received from the use of demonstration sites. These have been found to be fundamental toward increasing community knowledge and education in understanding the potential of new water resource technologies.

The literature and surveys described above cite many frameworks, steps, principles and timelines for effective community outreach efforts. Much of this work is synthesized in the recent World Health Organization's publication, "WHO Guidelines for Potable Reuse", particularly the chapter entitled Potable Reuse and the Art of Engagement (World Health Organization 2017)[12].

The City recognizes the importance of public acceptance and will include it in the next analysis of water supply alternatives when more information can be drawn from the community in terms of their preferences and acceptance of the different types of beneficial reuse. The City is committed to future efforts to listen to the community and communicate about recycled water issues to more fully understand their preferences and interest in reuse in Santa Cruz.

9.5.4 Water Recycling Requirements

Both the SCPWD Title 22 Upgrade and BayCycle Projects would be covered under State Water Resources Control Board Order WQ-2016-0068-DDW[13], Water Reclamation Requirements for Recycled Water Use (General Order) which requires preparation of a Notice of Intent (NOI) to comply with the General Order. For SCPWD Title 22 Upgrade Project, the City would be Producer, Distributor and User of recycled water and a recycled water operator would need to be identified as part of the submitted NOI. The NOI is accompanied by a Water Recycling Program Technical Report that includes the following information:

- Description of existing and/or proposed treatment storage and transmission facilities for recycled water,
- Recycled Water Application, describing how the recycled water will be used, including maps and quantities of use,
- Description of Water Recycling Program, including agency authority, cross-connection testing, monitoring and reporting program, inspection, compliance, training and emergency procedures,
- Additional description of site-specific conditions including California Environmental Quality Act (CEQA) documentation, and
- Water Recycling Program Administration, providing organizational descriptions and responsibilities.

Other requirements include:

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[12] http://www.who.int/water_sanitation_health/publications/potable-reuse-guidelines/en/

[13] http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2016/wqo2016_0068_ddw.pdf

- Submittal of an approved Title 22 Engineering Report that demonstrates or defines compliance with the Uniform Statewide Recycling Criteria (and amendments),
- Completion of an applicable Salt and Nutrient Management Plan adopted by the RWQCB as a Basin Plan Amendment,
- Securing Waste Discharge Requirements (WDRs) or NPDES permits for recycled water production facilities,
- Completion of applicable CEQA documentation of mitigation measures, and
- Updates to local-ordinances, as-appropriate.

It is likely that an initial submittal would be made for SCPWD Title 22 Upgrade Project and then amended and updated as appropriate for BayCycle Project.

9.5.5 Commitments from Potential Users

The majority of SCPWD Title 22 Upgrade Project users are City controlled entities that have been active participants or stakeholders for this RWFPS. Letters of commitment from the City Parks and Recreation Department for use at the parks and the SCPWD for use at the Santa Cruz WWTF are included in Appendix H.2. It is anticipated that potential bulk water station and public fill station users would be solicited through an outreach program, then registered and trained to receive Title 22 water.

Commitment letters for BayCycle Project users (e.g., schools and HOAs), would be pursued after the SCPWD Title 22 Upgrade Project is in operation. UCSC is preparing an update to its Long-Range Development Plan, which will include a discussion of potable and non-potable water needs, and will directly influence the need and desire to serve recycled water. A letter of interest from UCSC is included in Appendix H.2.

9.5.6 Water Rights Impact

No water rights impacts are expected since Water Code Section 2010 assigns ownership of the treated wastewater to the owner of the wastewater treatment plant. In addition, the secondary effluent is currently discharged to the Pacific Ocean, not to a freshwater receiving water, therefore does not impact downstream water rights.

9.5.7 Permits, Right-of-Way, Design and Construction

As discussed in Section 9.5.2, before commencing with a recycled water project, compliance with the General Order, including preparation of a Title 22 Engineering Report would be required. The report describes the recycled water project, distribution system and use areas. Once the Title 22 Engineering Report is completed, a NOI, and other information, is required to be submitted to the RWQCB to comply with the General Order. In addition, the projects would likely require a Mitigated Negative Declaration (MND) to satisfy CEQA requirements.

Changes at the Santa Cruz WWTF may require an updated NPDES permit to document planned process changes (i.e. pasteurization). The planned SCPWD Title 22 Upgrade Project infrastructure would be located on City property, in the City Right of Way, or along the Santa Cruz Rail

Transportation Commission's planned pedestrian Coastal Rail Trail. Detailed survey, utility location, and geotechnical information would be obtained prior to design. Right of entry on the railroad would be required for survey and construction and long-term O&M.

BayCycle Project improvements can likely be addressed with updates to the Title 22 Engineering Report, amendments to the NOI documents and MND. Additional survey, utility location, and geotechnical information specific to BayCycle Project should be obtained prior to design. Completion of BayCycle Project would require private-side plumbing improvements on HOA and UCSC property, which would be addressed during BayCycle Project pre-design efforts.

9.5.8 Detailed Schedule

Potential schedules for SCPWD Title 22 Upgrade and BayCycle Projects are provided in Figures 9-1 and 9-2, respectively. These high-level schedules provide detail about the duration and sequence of five primary activities to implement a recycled water program; (1) Predesign, (2) Permitting, (3) Design, (4) Construction and (5) Commissioning. Advancing the projects into Predesign is contingent on establishing agreements between City departments (for SCPWD Title 22 Upgrade Project) and with UCSC (for BayCycle Project) to identify primary cost sharing responsibilities, as well as consultant selection as-required to perform the work.

9.5.7.1 SCPWD Title 22 Upgrade Project Schedule

The **predesign** of SCPWD Title 22 Upgrade Project would be critical to confirm the basic assumptions regarding the project including sizing, treatment component locations, pipeline alignments, and utility location, which can be used to prepare a project description sufficient to initiate Permitting. Consideration for upsizing facilities, including treatment and conveyance, to accommodate BayCycle Project demands should occur at this time. Predesign would also include coordination of surveying and confirming the pipeline alignment as well as timing of construction with the Santa Cruz County Rail Transportation Commission's planned pedestrian Coastal Rail Trail along the railroad tracks (SCCRTC 2017). Completion of survey and geotechnical investigations, if needed, would be critical prior to Design.

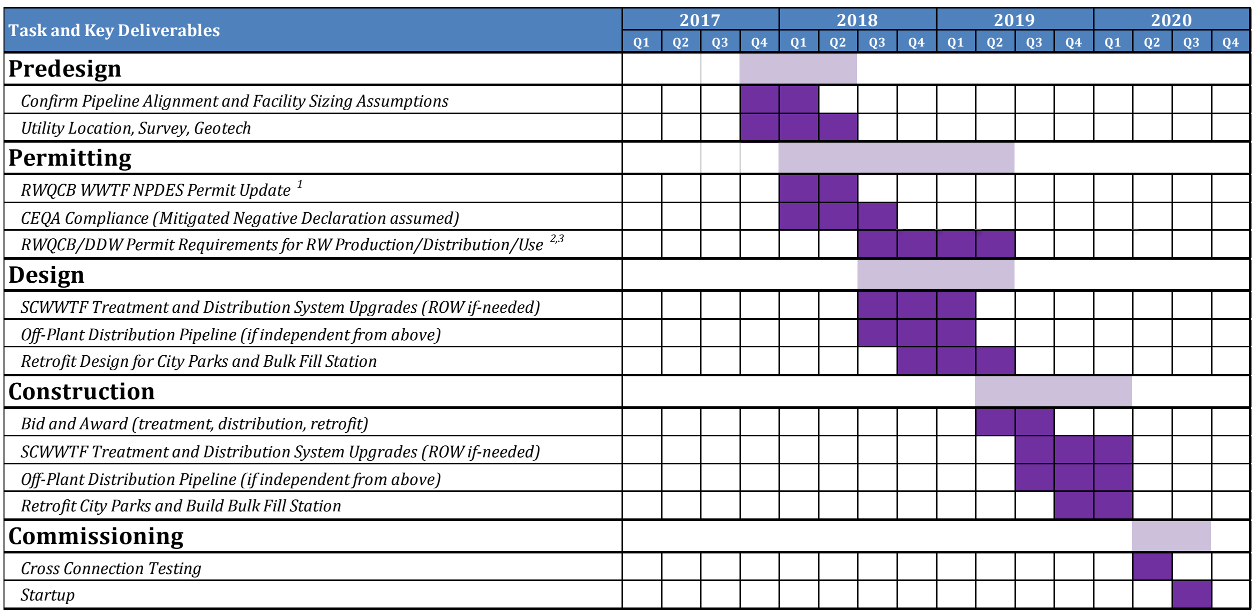
The critical path for **permitting** activities includes preparation of environmental documentation under CEQA. Any mitigation activities identified by CEQA that relate to water quality would also need to be submitted with the recycled water permit application. CEQA documentation is required to modify the Report of Waste Discharge (ROWD), as part of the NPDES permit, to implement upgrades to the Santa Cruz WWTF.

The preparation of plans and specifications during the **design** phase could be divided into three areas of work: (1) facilities in the Santa Cruz WWTF, (2) pipeline alignment outside the WWTF boundary and (3) customer retrofits at the identified City parks and the Bulk Fill Station. The design would build on the pre-design effort, incorporating any new information obtained during land and utility surveys and the geotechnical investigation. Acquisition of Right of Way (ROW) from the Santa Cruz County Regional Transportation Commission is assumed to be completed prior to the award of the construction project.

Construction activities include bid and award for the three areas of work. Coordination with the operations staff at the Santa Cruz WWTF and with the planned Coastal Rail Trail schedule would be critical during construction. At present, the Coastal Rail Trail segment from California Street at Bay to the Santa Cruz Wharf is planned for construction by the SCPWD in the summer/fall of 2018. Therefore, it would be ideal for the northern 800-feet of pipeline segment to be constructed concurrent with the Coastal Rail Trail segment to avoid future trail shut down for pipeline construction.

Following construction, the **commissioning** phase includes testing of the treatment facilities prior to producing recycled water for delivery and cross connection certifications at each use area to verify that the recycled water system is not connected to the potable water system.

Figure 9-5: Potential SCPWD Title 22 Upgrade Project Schedule



[1] Changes at the WWTF, even if discharge limits are not likely to change, would likely trigger an update to the 2010 NPDES permit currently under its 5-year update. The NPDES permit changes are likely in the Findings section and could be accomplished during this current update once a decision to pursue the project(s) is made.
[2] Per SWRCB Order WQ 2016-0068-DDW
http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2016/wqo2016_0068_ddw.pdf
[3] Includes Title 22 Engineering Report, Retrofit Report and Notice of Intent for Uses.

9.5.7.2 BayCycle Project Schedule

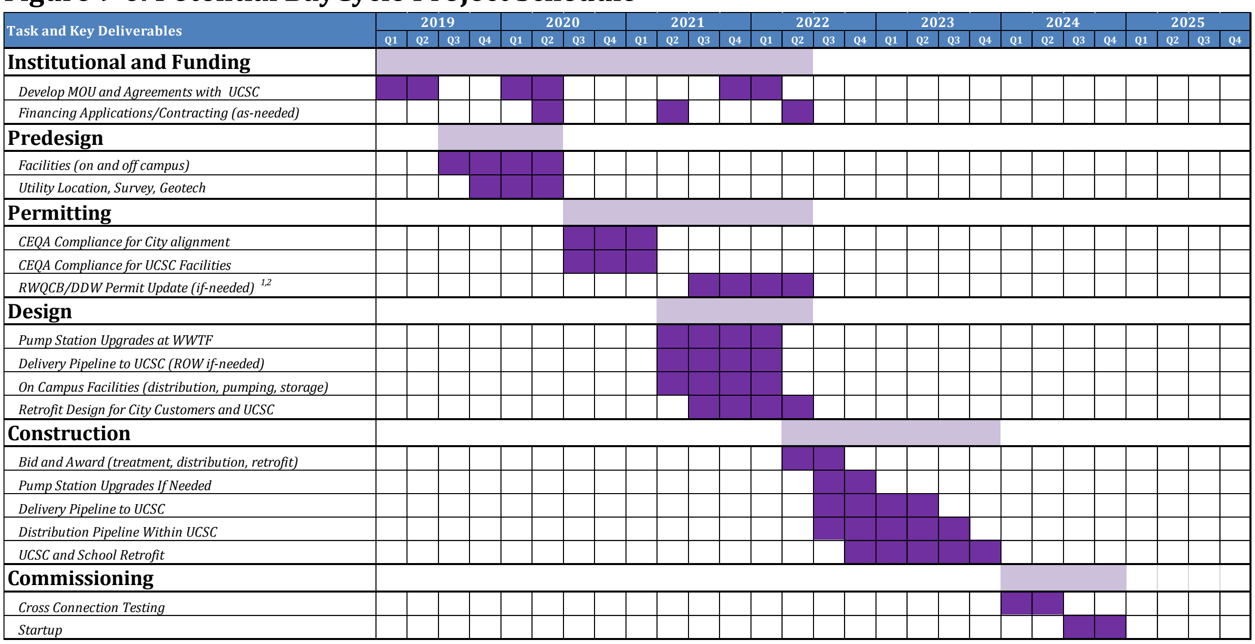
Of particular importance to the BayCycle Project schedule is the development of an agreement between the City and UCSC to detail responsibilities, ownership, and confirm financing and allocation of costs for predesign, permitting (including CEQA Lead Agency), design, construction and commissioning.

The **predesign** of the BayCycle Project would occur in several steps, with the first critical step to confirm customer sites within UCSC to be served to identify pipeline alignments, pumping requirements, and storage infrastructure on campus. This information would be used to prepare a project description sufficient to initiate permitting. Once infrastructure location is confirmed, the next predesign steps of utility location, survey, and geotechnical investigations can be initiated and would be critical to design.

As in SCPWD Title 22 Upgrade Project, the critical path in the **permitting** activities includes preparation of environmental documentation under CEQA because any mitigations identified by CEQA related to water quality would also need to be submitted with the amended recycled water permit application; CEQA is also required if construction funding applications are prepared.

The preparation of plans and specifications during the **design** phase could be divided into two areas of work: (1) facilities within the City, including any treatment and pump station upgrades for BayCycle Project flows, and (2) facilities at UCSC. The design would build on the pre-design effort, incorporating any new information obtained during land and utility surveys and the geotechnical investigation.

Figure 9-6: Potential BayCycle Project Schedule



[1] Per SWRCB Order WQ 2016-0068-DDW
http://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2016/wqo2016_0068_ddw.pdf
[2] Includes Title 22 Engineering Report, Retrofit Report and Notice of Intent for Uses.

Construction activities include bid and award for the two areas of work. Coordination with UCSC school calendar is likely critical as pipeline, storage and retrofit construction may interfere with campus activities. Similarly, construction schedules for retrofits at City schools would likely need to occur in summer months when classes are not in session.

Following construction, the **commissioning** phase includes testing of the treatment facilities prior to producing recycled water for delivery and cross connection certifications at each use area to verify that the recycled water system is not connected to the potable water system.

9.6 Operational Plan

A Recycled Water Operations Plan would identify Responsible Parties, Equipment Operation and Maintenance, Monitoring, and Irrigation Scheduling, as summarized in Table 9-6 and detailed in the sub-sections that follow. There is overlap in the operational plan items between the two projects; experience gained in the SCPWD Title 22 Upgrade Project would be relevant to the BayCycle Project.

Table 9-6: Summary of Operational Plan Considerations

Considerations	SCPWD Title 22 Upgrade Project	BayCycle Project
Responsible Parties	Water Dept (SCWD), Public Works (SCPWD), City Parks & Recreation Supervisor	City, UCSC, Customer Site Supervisors
Equipment Operations & Maintenance	SCPWD = Title 22 Treatment upgrades SCPWD = on-site distribution SCPWD/SCWD[1] = off-site distribution SCPWD/SCWD[1] = bulk water station SCP&R = City Parks SCWD = residential fill station[2]	SCWD = distribution SCWD = City customers UCSC = campus customers
Monitoring	SCPWD = production SCWD = distribution/customers	SCPWD = production SCWD = distribution & customers UCSC = Campus customers
Irrigation Scheduling	SCWD = work with customers	SCWD = work with customers UCSC = Campus customers

[1] City department lead for facilities outside of the WWTF to be determined
[2] Residential fill stations could be initiated as part of SCPWD Title 22 Upgrade Project or BayCycle Project

9.6.1 Responsible Parties

There are several models of assigning responsible parties within the current City structure; one where each City department maintains responsibility as currently assigned and another where a single City department assumes responsibility for the entire program requirements. Responsible parties could be assigned based on the areas of responsibility, expertise of the staff and terms set forth in the agreements between the parties involved in each project.

Table 9-6 lists suggested roles and responsibilities using the first model and is based on information available at the time of this study. SCPWD would be responsible for production of recycled water and use of recycled water at the Santa Cruz WWTF. The SCWD would be responsible for distribution of recycled water and use at the bulk water station, as well as cross connection testing and certification. A Parks & Recreation Supervisor would be responsible for managing recycled water use in terms of the application at agronomic rates, overspray prevention and evening irrigation scheduling. There may be overlap between SCWD and Parks & Recreation, such as in areas related to water conservation, therefore activities should be coordinated for consistency and efficiency. BayCycle Project would add HOAs and City schools, which would each need a site supervisor to report to SCWD. UCSC would likely require multiple site supervisors to oversee individual sites and may benefit from identifying an overall campus recycled water supervisor to report to SCWD and ensure consistency for on-campus use. The responsibilities of site supervisors would be similar to those of the Parks & Recreation Supervisor, to manage the end uses of recycled water, which are defined as part of the overall recycled water program.

A second model could be where a single department such as the SCPWD assumes responsibility from treatment, through distribution and end use while coordinating with the other City departments such as SCWD and Parks and Recreation.

9.6.2 Equipment Operations and Maintenance

Table 9-6 assumes responsibilities would be distributed across City departments depending on their main recycled water role as Producers, Distributors or Users of recycled water. Equipment O&M responsibilities would be similarly distributed. For example, SCPWD, as the Producer, is charged with O&M for facilities at the Santa Cruz WWTF required to produce Title 22 compliant recycled water, including the primary, secondary, and tertiary treatments. SCWD, as the Distributer, would be responsible for the O&M of the conveyance and pumping system, as well as customer service at the bulk fill station. Individual site supervisors, at City Parks, schools, HOAs, and UCSC sites, would be responsible for the O&M of the irrigation and/or dual-plumbed system facilities. UCSC would likely also be responsible for O&M of any on-campus infrastructure (i.e. pump stations, storage tanks and pipeline alignments). Alternatively, a single department such as SCPWD could also assume all responsibilities for O&M. Specific responsibilities and regulatory requirements for recycled water would be delineated in the agreements between the parties.

9.6.3 Monitoring

A Monitoring and Reporting Program for recycled water production, distribution and use is required by the General Order, as defined in Attachment B. Requirements include annual priority pollutant and Total Coliform Bacteria and turbidity monitoring for the treatment facility and Use Area Monitoring requirements for irrigation and dual-plumbed systems. Monitoring information is required to be submitted in an annual report by the recycled water operator. The annual report includes a summary table of all recycled water users and use areas, a summary table of inspections and enforcement activities at use areas, evaluation of performance of the recycled water treatment facility, summary of monitoring data collected as well as the name, contact information and certification of the recycled water operator responsible for operation, maintenance, and system monitoring. SCWD would work collaboratively with SCPWD to complete monitoring and reporting requirements for SCPWD Title 22 Upgrade Project, adding UCSC for BayCycle Project.

9.6.4 Recycled Water Delivery Scheduling

For SCPWD Title 22 Upgrade Project, scheduling for delivery of recycled water for irrigation and other in-plant uses should be relatively straightforward as there would be sufficient capacity with the Title 22 Upgrades at the WWTF and use of the converted CCT and 2-water tank for storage.

For BayCycle Project, the average and peak flow requirements for added City and UCSC customers would use the remaining capacity of the Title 22 treatment upgrades and require increasing the capacity of the pump station at the Santa Cruz WWTF. A new recycled water storage tank and pump station would need to be located on or near the UCSC campus to provide irrigation scheduling flexibility and flatten the peak demands. This would allow flows to be conveyed to a storage tank during the day (off-irrigation hours) and then serving customers from the storage tank during the evening hours. Hydraulic modeling would be performed to optimize storage and pump station sizing and to establish a schedule to meet peak flow demands and pressure requirements for on-campus users. Once the SCPWD Title 22 Upgrade Project is operational, the City would have a better sense of the peak capacity of the upgraded Title 22 treatment system and scheduling required to meet peak BayCycle Project demands.

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Section 10: Construction Financing Plan and Revenue Program

As previously stated in Section 9, the SCPWD Title 22 Upgrade and BayCycle Projects are the focus of this Construction Financing Plan section of the RWFPS, since these projects would likely be constructed in the near-term.

Implementation of a GRR project would require collaboration with regional partners and future studies to confirm the viability of groundwater replenishment at Beltz Wellfield or in the SMGB, thus, general financing considerations for long-term GRRPs are only discussed at a concept-level herein.

10.1 Construction Funding Sources and Considerations

In recent years, agencies across the United States have faced water reliability concerns which have resulted in an increase in agencies evaluating the feasibility of implementing recycled water systems. A large portion of recycled water project costs are initial costs incurred to construct the system. Funding these significant construction costs is one of the largest obstacles to overcome when implementing a recycled water system. Most often, agencies do not have sufficient reserves set aside to fund recycled water construction costs. However, depending on the type of recycled system being implemented and the intended use of the water, there may be other funding options available to the City. The following sections briefly describe some of the funding mechanisms the City may consider followed by brief discussions related to funding of each proposed project. While potential funding mechanisms that are currently available have been identified below, the City will continue to evaluate additional funding mechanisms during the course of these projects.

10.1.1 Utility Rates

Utility rates from water, wastewater, or recycled water customers may fund recycled water construction projects on a pay-as-you-go (PAYGO) basis or additionally through the use of rate funded reserves. Using utility rates to fund capital projects avoids incurring additional costs such as interest, issuance costs, and administrative costs, however, it also requires the existing customers absorb the entire burden of a system that would last for many years.

10.1.2 Capacity Fees

Capacity fees are one-time fees, collected as a condition of establishing a new connection to the City's utility systems (water, wastewater, etc.) or the expansion of an already existing connection. These fees are intended to pay for development's share of the costs of existing or new facilities needed to serve the new or expanded connection. While capacity fees can be a good source of revenue for some agencies where significant additional growth is expected, the City is nearly fully developed with some limited remaining in-fill potential. Therefore, capacity fees would likely not be considered as a potential funding mechanism for the City as they are not likely to provide sufficient revenue.

10.1.3 Short or Long-Term Bonds

Several debt financing options are available to fund recycled water projects such as General Obligation Bonds, Revenue Bonds, and Certificates of Participation. Debt financing is often considered when liquid cash is not sufficient to fund major capital projects. There are several advantages to issuing debt, such as, mitigating impact to existing customers, proceeding with capital projects despite having insufficient reserves, and achieving intergenerational equity by recovering costs of capital over those that benefit from the system in the future in addition to existing customers. Other considerations regarding short and long-term bonds should be considered. For example, agencies are typically required to meet debt coverage requirements which limits additional debt if significant debt already exists, or agencies must have the necessary taxing capacity to issue the bonds.

10.1.4 Grants and Loans

Many State and Federal funding programs have been created to assist agencies with funding recycled water feasibility studies, as well as design and construction of recycled water projects. In determining whether to pursue grant and loan funding, the City should consider the following factors in addition to the type of recycled water project being constructed.

- Grant and loan funding can minimize the impact to rate payers. Low interest loan funding can save a significant amount of interest on capital projects with a 30-year payment term.
- Grant funding is highly competitive, low interest loan funding can be comparatively less competitive.
- Grants are typically reimbursements which means the City must initially fund the entire construction project and wait for reimbursements requiring sufficient cash flow during construction. Loans and grants may require a substantial (9 months to 1 year) lead time before an agreement is in place and expenses would be reimbursed. The availability of low interest loans may vary by fiscal year depending on the amount of capitalization and the priority system of the loan funding agency, therefore timing of the application could be critical.
- Grants and loans may require the City submit additional environmental, regulatory, and institutional documents, adhere to additional administrative requirements, and meet annual reporting requirements.
- If construction bid costs exceed estimates, the budget for a loan can sometimes be expanded to accommodate the increased need for funding, whereas granting agencies would not typically offer more grant money once the award has been announced.

Table 10-1 summarizes some of the potential State and Federal funding mechanisms the City may consider.

Table 10-1: Summary of Potential Grant/Loan Options

Program	Funding Mechanism	Brief Description
State		
SWRCB - Water Recycling Funding Program	Grants/ Loans	Intended to promote the beneficial use of treated wastewater **Proposition 1** - Grants and low interest financing for water recycling projects **Proposition 13** - Primarily provides for water recycling facilities planning grants. Eligible projects include, but are not limited to, Water Recycling Construction Program, Seawater Intrusion Control, Coastal Nonpoint Source Pollution Control, and Watershed Protection. **Clean Water State Revolving Loan Fund (CWSRF)** – Low interest (1.7%) loans for planning, design, and construction of water recycling projects.
California Infrastructure and Economic Development Bank - (I-Bank)	Loan terms	Eligible costs for financing of up to $25 mil include, but are not limited to: 1. Construction, renovation, acquisition of lands, structures, real or personal property. 2. Machinery, equipment and financing charges. 3. Reserves for principal and interest and for extensions, enlargements, additions, replacement, renovations, and improvements.
Federal		
US Bureau of Reclamation - Title XVI -Water Reclamation and Reuse	75% Local Cost share	Funding is available for the following types of projects: 1. Authorized Projects: design and construction of congressionally authorized Title XVI water reclamation and reuse project. As of December 2016, the WIIN Act allows new water recycling projects to be eligible for federal funding. 2. WaterSMART Title XVI Feasibility Studies: new water reclamation and reuse study. 3. Research Studies: expand water reuse markets, improve water facilities, implement clean water technology at new facilities.
Office for Coastal Management - NOAA Coastal Resiliency Grants Program	Matching funds	Coastal Management programs include Administrative Grants, Coastal Resource Improvement Program Grants, and Coastal Zone Enhancement Program Grants.

10.1.5 SCPWD Title 22 Upgrade Project

As discussed in Section 9, the SCPWD Title 22 Upgrade Project would enhance the existing reclaimed water system and provide Title 22 water for on-site and off-site use. Most of the recycled water produced would be used inside the WWTF. This project may qualify for funds through the

Water Recycling Funding Program or other grant programs, however, due to the size of the project and the nominal benefit towards water supply, the monetary benefits may not be worth the effort spent trying to pursue grant funding or CWSRF low interest loan programs which are accessed through a single application. It would likely make the most sense for the City to fund construction costs through utility rates.

10.1.6 BayCycle Project

As discussed in Section 9, BayCycle Project would expand the SCPWD Title 22 Upgrade Project to increase production and require significant infrastructure to add non-potable reuse sites. The significant construction costs prevent the City from funding this project entirely via PAYGO, however, this project has a greater potential for obtaining grant funding or low interest rate loans as it is designed to supplement the City's existing water supply. It is anticipated the City would pursue CWSRF loans or other low interest rate loans.

10.1.7 Other Reuse Opportunities (GRR)

Of the projects being considered, groundwater replenishment and reuse has the greatest potential for grant funding as these projects are regionally based and benefit the broader community by addressing regional water supply reliability and potentially seawater intrusion thus making these types of projects more appealing to funding agencies because of their multiple benefits. Grant funding would likely be pursued once feasibility studies have been completed and the City has determined which project or projects provide the greatest benefit to the City and the region.

10.2 Recycled Water Pricing Policy Options

As discussed in Section 9, the successful implementation of recycled water facilities and services would require the cooperative efforts and cost sharing between all project partners. A comprehensive cost of service (COS) study would need to be completed in order to determine the appropriate cost allocations and to determine the recycled water rates, however, general recycled water pricing policies and cost-sharing examples are discussed below.

10.2.1 Pricing Policy Considerations

Another major factor in developing recycled water, besides funding the significant construction costs, is determining how to price recycled water. Historically, non-potable water has been priced at a percentage, ranging from 75%-95%, of potable water to encourage or incentivize customers to use recycled water when it is available.

Ultimately, pricing recycled water is a complex policy decision that considers not only the cost of producing the water but also factors such as the type of recycled water project being implemented, who benefits from the water/project, the level and extent of cost sharing, the age of the recycling system, the potential demand for recycled water, public perceptions, and the impacts to the other utilities. For example, an indirect or direct potable reuse project would benefit the potable water system and its customers by providing a new source of supply as well as the wastewater system and its customers by beneficially reusing a valuable resource and proactively addressing potential regulatory discharge requirements.

In determining how to allocate or recover costs it is important to establish the reason or need for the recycled water system including questions such as:

- Is the project a demonstration to enhance public awareness of the water quality and uses of recycled water?
- Is the project intended to enhance supply reliability and sustainability?
- Is the project needed to meet regulatory or wastewater needs?

Answering these questions can guide the policy decisions and the cost allocations. In addition, each category of costs related to recycled water projects may be recovered in a different manner.

10.2.2 Cost Categories & Allocations

Typically, recycled water costs can be broken into the three categories, Treatment, Distribution, and Operations and Maintenance (O&M) as discussed below.

Tertiary Treatment costs are the costs incurred to treat water to a required standard that meets state regulations for providing recycled water. To reach the required standard for recycled water additional treatment processes are needed above secondary treatment. The incremental costs associated with the higher level of treatment above secondary is considered tertiary treatment (tertiary) costs. It is reasonable to allocate tertiary costs to wastewater customers when the recycled water project provides a benefit to wastewater customers, such as when the wastewater utility needs to treat wastewater to a higher level to meet discharge requirements or when the recycled water would be used within the facility during the treatment process. Typically, tertiary costs are allocated to potable water customers, either through rates or capacity fees, when the recycled water system is designed to enhance the reliability of potable water supply either by offsetting or by supplementing potable irrigation use. In cases of mature and large scale recycled water systems where additional non-potable supply is needed, the tertiary costs may be recovered by the recycled water customers.

Distribution costs are the costs associated with installing a distribution system to deliver recycled water from the treatment plant to end users. The system may include pipelines, pumping stations, and in some instances additional storage facilities. These costs directly benefit recycled water customers; therefore, it is most common to recover these costs from recycled water customers through recycled water rates or capacity fees. However, if the goal is to supplement or offset potable water, then it is reasonable and justifiable to allocate these costs to the potable water customers through potable rates or capacity fees.

O&M costs are the ongoing costs of running and maintaining the recycled water system. Most often O&M costs are allocated to recycled water customers and recovered over the recycled water rates, however, they may also be recovered by potable water rates. In instances where the goal of recycled water is to meet discharge requirements or when the recycled water would be used as part of the wastewater treatment process, it is justifiable to recover the O&M costs via the wastewater rates.

Table 10-2 summarizes the typical recovery sources for each category of recycled water costs.

Table 10-2: Summary of Cost Recovery Options

Costs	Potable Rates	Wastewater Rates	Recycled Water Rates	Water Capacity Fees	Recycled Water Capacity Fees
Treatment	Commonly	Commonly	Not usually	Commonly	Not usually
Distribution	Commonly	Not usually	Commonly	Commonly	Commonly
O&M	Commonly	Not usually	Yes	No	No

10.2.3 SCPWD Title 22 Upgrade Project

As discussed in Section 9, the SCPWD Title 22 Upgrade Project would enhance the existing reclaimed water system and provide limited Title 22 water for on-site and off-site use. The total costs from Section 9 have been summarized by the three cost categories discussed above, annualized, and converted into a price per AF and a price per CCF as shown in Table 10-3.

Table 10-3: SCPWD Title 22 Upgrade Project - Cost Summary

	Total Construction Costs [A]	Annual Costs [B]	Total Demand [C]	Unit Life Cycle Costs[1] ($/AF) [D] = (B÷C)	Unit Life Cycle Costs[1] ($/CCF) [E] = (D÷435.6)
Treatment	$610,000	$35,500	148 AFY	$240	$0.55
Distribution	$650,000	$31,000	148 AFY	$210	$0.48
O&M		$260,000	148 AFY	$1,700	$3.90
Total Project Costs	**$1,260,000**	**$326,500**		**$2,150**	**$4.94**

[1] The unit life cycle costs are based on amortizing the capital costs over the useful life of each facility element at 4%. The treatment facilities have a shorter useful life than the distribution facilities and therefore a higher annualized cost. Costs may differ from Table 9-2 slightly due to rounding.

Most of the recycled water produced, 141 AFY of the total 148 AFY, would be used inside the WWTF with the remaining 7 AFY being used for park irrigation and for the Bulk Water Station supply. At the time of this study, it is anticipated the Wastewater Enterprise Fund would fund the initial construction cost, particularly for the treatment facilities. SCPWD and SCWD would work collaboratively to determine appropriate cost-sharing and potential reimbursement of construction costs, however, the general cost sharing policy options and considerations have been summarized in Table 10-4.

Table 10-4: Potential Cost Sharing Guidelines for SCPWD Title 22 Upgrade Project

Costs	Potable Water Rates	Wastewater Rates	Recycled Water Rates
Treatment	Potentially the proportional share	All or the proportional share	Potentially the proportional share
Distribution	Potentially the proportional share	% related to in-plant pipeline and storage	Potentially the proportional share
O&M	Only as necessary to achieve pricing objectives	All or the proportional share	Proportional share

In-Plant Pricing Considerations

A separate rate for the in-plant use would not be determined, rather any costs allocated to the wastewater enterprise would most likely be recovered from all wastewater customers based on their proportional share of demand placed on the treatment plant.

Parks and Bulk Water Pricing Considerations

The City's existing irrigation rate structure consists of a small monthly fixed charge and a 3-tiered commodity rate, see details in Appendix H.3. At project completion (2020), Inside City Irrigation customer's commodity rates would be $13.04, $17.67, and $19.10 per ccf for tiers 1, 2, and 3, respectively, plus an additional $0.51 per ccf elevation surcharge for customers located at higher elevations. The existing Bulk Water Station rate structure consists of a $30 annual fee plus a commodity charge of $4.78 per ccf. The minimum monthly charge is $30.

The City would need to evaluate whether it is economically feasible to allocate the full amount or proportional share of the SCPWD Title 22 Upgrade Project costs to Parks and Bulk Water Stations. Typically, non-potable water is priced at or below potable rates in order to incentivize the use of recycled water. If, at the time of the cost of service study, the fully burdened recycled water rates are determined to be greater than the potable rates, all or a portion of the costs may be allocated to and recovered by potable customers. Although the portion of this project related to providing non-potable water is relatively small, it is a step towards creating a recycled water system that would begin to reduce demand on the existing potable system and enhances potable supply reliability thus potentially mitigate future costs of additional potable water supplies. Therefore, it is reasonable to consider recovering all or a portion of these costs to potable customers.

10.2.4 BayCycle Project

As discussed in Section 9, BayCycle Project would expand the SCPWD Title 22 Upgrade Project to increase production and non-potable reuse. The total costs from Section 9 have been summarized by the three cost categories discussed above, annualized, and converted into a price per AF and a price per ccf as shown in Table 10-5.

Table 10-5: BayCycle Project - Cost Summary[14]

	Total Construction Costs [A]	Annual Costs [B]	Total Demand [C]	Unit Life Cycle Costs[1] ($/AF) [D] = (B÷C)	Unit Life Cycle Costs[1] ($/CCF) [E] = (D÷435.6)
Treatment	$230,000	$13,300	160 AFY	$100	$0.23
Distribution	$11,820,000	$576,600	160 AFY	$3,600	$8.26
O&M		$380,000	160 AFY	$2,400	$5.51
Total Project Costs	**$12,050,000**	**$969,900**		**$6,100**	**$14.00**

[1] The unit life cycle costs are based on amortizing the capital costs over the useful life of each facility element at 4%.

This project would provide approximately 139 AFY of non-potable water to UCSC and another 21 AFY to City schools and HOA's. It is crucial for the City to work closely with these potential recycled water users to ensure customer buy-in, especially since such a large portion of this project relies on the participation of UCSC. Table 10-6 summarizes the general cost sharing guidelines for the BayCycle project.

Table 10-6: Potential Cost Sharing Guidelines for BayCycle Project

Costs	Potable Water Rates	Wastewater Rates	Recycled Water Rates
Treatment	Typically, allocated to higher potable tiers	No Benefit / Cost Sharing	Potentially allocated
Distribution	Potential allocation based on pricing objectives	No Benefit / Cost Sharing	Most likely allocated to recycled water customers based on COS
O&M	Only as necessary to achieve pricing objectives	No Benefit / Cost Sharing	Allocated to recycled water customers based on COS

UCSC Pricing Considerations

The City's existing UCSC potable water rate structure consists of a small monthly fixed charge and a uniform commodity rate. The rates at project completion, 2024, are not known at this time, however, the rates are anticipated to increase from the currently adopted rates for FY 2021. The FY 2021 UCSC's uniform commodity rate would be $13.06, plus an additional $0.54 per ccf elevation surcharge. Non-potable water is typically priced at or below potable water as mentioned in the prior section. As shown in Table 10-5, the distribution and O&M costs are fairly significant. If necessary, potable customers may share in the distribution and O&M costs of implementing the recycled water system based on the benefits associated with a supplemental water supply. Alternatively, the City may set up a contract rate with an annual minimum charge in order to mitigate the potential risks of revenue loss should UCSC not fully utilize the projected demand.

[14] Numbers shown in the table have been rounded to indicate these are estimates and not actual numbers. There may be slight differences from Table 9-2 due to rounding.

City School and HOA's Pricing Considerations

The City's existing irrigation rate structure consists of a small monthly fixed charge and a 3-tiered commodity rate. The rates at project completion, 2024, are not known at this time, however, the rates are anticipated to increase from the currently adopted rates for FY 2021. FY 2021 Inside City irrigation customer's commodity rates would be $13.86, $18.82, and $20.33 per ccf for tiers 1, 2, and 3, respectively, plus an additional $0.54 per ccf elevation surcharge for customers located at higher elevations. The same considerations as UCSC apply to City School and HOA non-potable irrigation pricing. The City would work closely with potential recycled water customers to determine appropriate cost allocations and to ensure sufficient commitment to make the project a success.

10.2.5 Other Reuse Opportunities (Groundwater Recharge)

The mid-term projects discussed in Section 9, would require agreements between the participating entities. In general, potable water customers would benefit from these projects and once water is extracted from the groundwater the pricing policy would be the same as other sources of water. Most likely there would be no cost sharing between wastewater or recycled water.

10.3 Financial Planning Considerations

The following sections discuss additional financial planning considerations that may be further evaluated during planning and framework meetings and through the development of comprehensive cost of service studies.

10.3.1 Potential Allocation of Costs to Users

Allocation of costs to users can be defined based on a combination of proportional demand and location or primary use of facilities. Table 10-7 and Table 10-8 provide a summary of the costs for the SCPWD Title 22 Upgrade Project and BayCycle Project respectively along with allocation of costs based on use (i.e. proportional flow or location of facilities). Similar to the discussion in Appendix F.4, the cost allocations represent possible cost sharing approaches that could be explored between City departments and/or with UCSC.

It is recommended that a framework for cooperation between the SCWD, SCPWD and UCSC (for BayCycle Project only) be developed to establish key principles for the planning, permitting, design, construction, and on-going operations and maintenance of recycled water facilities and services. The framework should be based on an understanding that the successful implementation of recycled water facilities and services would require the cooperative and coordinated efforts between all project partners (i.e. the producer, distributor and user). The cost-sharing options presented herein are only initial concepts, which should be further vetted as part of the framework process.

Table 10-7: Cost Summary for SCPWD Title 22 Upgrade Project

Total Project	Total Project	Allocation by Use[1] WWTF On-Site Use	City Use (Parks/Bulk Water)
RW Demand (AFY)	**148**	**141**	**7**
Loaded Facility Costs ($)			
Treatment	610,000	580,000	20,000
Pipelines	380,000	130,000	250,000
Pump Stations	110,000	0	110,000
Storage	60,000	60,000	0
Site Retrofit Costs	100,000	0	100,000
Total Capital Cost ($)	**$1,260,000**	**$770,000**	**$480,000**
Annual O&M Costs ($/year)	**$260,000**	**$230,000**	**$30,000**
Unit Costs			
Annualized Capital Cost ($/AF)[2]	450	300	3,400
Annual O&M Costs ($/AF)	1,700	1,600	4,200
Life Cycle Unit Cost ($/AF)	**$2,150**	**$1,900**	**$7,600**
Life Cycle Unit Cost ($/gal)	$0.007	$0.006	$0.024
Life Cycle Unit Cost ($/CCF)	$4.90	$4.40	$17.40
Life Cycle Unit Cost ($/MG)	$6,600	$5,800	$23,300

[1] Facility and O&M costs allocated based on proportional demand, location or primary user of facilities
[2] The $/AF is based on amortizing the capital costs over the useful life of each facility element at 4%.

Table 10-8: Cost Summary for BayCycle Project

Total Project	Total Project	Allocation by Use[1] City Use (Schools/HOAs)	UCSC
RW Demand (AFY)	**176**	**21**	**155**
Loaded Facility Costs ($)			
Treatment	230,000	28,000	200,000
Pipelines	4,570,000	150,000	4,430,000
Pump Stations	2,450,000	110,000	2,340,000
Storage	460000	0	460,000
Site Retrofit Costs	1,650,000	210,000	1,440,000
Total Capital Cost ($)	**$9,360,000**	**$498,000**	**$8,870,000**
Annual O&M Costs ($/year)	**$380,000**	**$40,000**	**$340,000**
Unit Costs			
Annualized Capital Cost ($/AF)[2]	2,700	900	2,800
Annual O&M Costs ($/AF)	2,100	1,500	2,300
Life Cycle Unit Cost ($/AF)	**$4,800**	**$2,400**	**$5,100**
Life Cycle Unit Cost ($/gal)	$0.015	$0.007	$0.016
Life Cycle Unit Cost ($/CCF)	$11.00	$5.50	$11.70
Life Cycle Unit Cost ($/MG)	$14,700	$7,400	$15,700

[1] Facility and O&M costs allocated based on proportional demand, location or primary user of facilities

[2] The $/AF is based on amortizing the capital costs over the useful life of each facility element at 4%.

10.3.2 Potential Unit Prices of Recycled Water

Until the City has developed pricing objectives, determined the level and extent of cost-sharing between utilities, and allocated costs to users, a recommended unit price for recycled water cannot be determined. For the purposes of this study, a high-level analysis was performed. The total annual costs for each project were divided by the anticipated annual demand to determine a project unit price. This analysis assumes no cost sharing and no distinction between users, therefore, the actual recycled water rates may vary significantly from the project unit rates. Based on the pricing policies selected by the City, it is anticipated there would be opportunities to mitigate the fully burdened project rates summarized in Table 10-9.

Table 10-9: High-Level Estimate of Project Unit Recycled Water Rates

	SCPWD Title 22 Upgrade Project	BayCycle Project
Annual Project Costs	$326,540	$969,947
÷ Annual Demand	148 AFY	160 AFY
Project Unit Rate ($/AF)	**$2,206**	**$6,062**
Project Unit Rate ($/CCF)	**$5.07**	**$13.92**

Annual costs and demand projections for the other reuse projects were not provided. These projects would require additional feasibility studies.

10.3.3 Sensitivity Analysis to Underutilization of Recycled Water

As previously discussed, these projects rely on participation from potential recycled water customers and assume a projected level of recycled water demand. Table 10-10 demonstrates the impacts to the unit prices for each project due to lower than expected demand.

Table 10-10: Unit Price Sensitivity

% of Projected Demand	Demand	$ / AF	$ / CCF
SCPWD Title 22 Upgrade Project			
100%	148 AFY	$2,206	$5.07
90%	133 AFY	$2,452	$5.63
80%	118 AFY	$2,758	$6.33
70%	104 AFY	$3,152	$7.24
BayCycle Project			
100%	160 AFY	$6,062	$13.92
90%	144 AFY	$6,736	$15.46
80%	128 AFY	$7,578	$17.40
70%	112 AFY	$8,660	$19.88

The City would work closely with potential recycled water customers to ensure sufficient commitment and customer buy-in. In addition, the City may setup contract rates with annual minimum charges in-lieu of fixed charges to mitigate the potential risks of revenue loss should recycled water customers not fully utilize the projected demand. This structure is commonly known as a "Use it or Lose it" structure.

10.3.4 Costs That Can be Allocated to Water Pollution Control

The Santa Cruz WWTF currently meets or exceeds pollution control requirements, therefore, no costs can be allocated to water pollution control.

10.3.5 Sunk Costs and Indebtedness

SCPWD Title 22 Upgrade Project and BayCycle Project would primarily be funded by utility rates, loans, and possibly grants and therefore would likely result in some debt. Sunk costs result when a project has been built to accommodate greater demand than will initially be utilized, typically to accommodate growth or future demand. The SCPWD Title 22 Upgrade Project and BayCycle Project facilities are sized based on current wastewater flows and anticipated recycled water demands and were not oversized. Therefore, the costs incurred by these projects will be an obligation that will be recovered by those benefiting from the projects and will not result in sunk costs.

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