GOLETA WATER DISTRICT

Potable Reuse Facilities Plan

FINAL

July 2017

RMC water and environment

WOODARD & CURRAN

Goleta Water District
Potable Reuse Facilities Plan
Final Report

Prepared by:

National Experience. Local Focus.

July 2017

GOLETA WATER DISTRICT

Mission

To provide an adequate supply of quality water at the most reasonable cost to the present and future customers within the Goleta Water District

State Water Resources Control Board
Goleta Water District Potable Reuse Facilities Plan
Water Recycling Funding Program Project No. WRFP 3310-010

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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Table of Contents

Appendices

List of Tables

List of Figures

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List of Abbreviations

AF	Acre-foot
AFY	Acre-feet per year
AO	Advanced oxidation
AOP	Advanced oxidation process
AWPF	Advanced water purification facility
AWT	Advanced water treatment
BAC	biological activated carbon
Basin Plan	Water Quality Control Plan for the Central Coastal Basin
BNR	Biological nitrogen removal
CCI	Construction Cost Index
CCWA	Central Coast Water Authority
CDM WTP	Corona del Mar Water Treatment Plant
CDPH	California Department of Public Health
CEC	Constituents of emerging concern
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
Cl	Chlorination
CWC	California Water Code
DDW	SWRCB Division of Drinking Water
DPR	Direct potable reuse
DWR	California Department of Water Resources
ENR	Engineering News Record
Facilities Plan	Recycled Water Facilities Plan
gpm	Gallons per minute
GSD	Goleta Sanitary District
GWA	Groundwater augmentation
GWD, District	Goleta Water District
GWR	Groundwater recharge
H&SC	Health and Safety Code
IPR	Indirect potable reuse
hp	Horsepower

kWh	Kilowatt-hour
MF	Microfiltration
MGD	Million gallons per day
mL	Milliliters
MPN	Most probable number
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Units
O&M	Operations and Maintenance
O_3	Ozone
RO	Reverse osmosis
RRT	Response retention time
RWA	Raw water augmentation
RWC	Recycled water contribution
RWQCB	Regional Water Quality Control Board
SAT	Soil aquifer treatment
SRF	State Revolving Fund
SRP	Stormwater Resources Plan
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWTP	Surface Water Treatment Plant
TOC	Total organic carbon
TWA	Treated water augmentation
UCSB	University of California, Santa Barbara
UF	Ultrafiltration
UV	Ultraviolet light
WRFP	Water Recycling Funding Program
WSMP	Water Supply Management Plan
WWTP	Wastewater treatment plant

Potable Reuse Facilities Plan

Executive Summary

Goleta Water District (GWD) has embarked on an exploration of potable reuse opportunities to provide for a more sustainable water supply portfolio. As part of the District's 2017 Water Supply Management Plan (WSMP) Update, water supplies in normal and dry year conditions were compared with water demand under current conditions and projected 2035 conditions. GWD's normal supplies (Cachuma Project entitlement, SWP Table A entitlement, groundwater rights, and recycled water) typically yield about 17,200 AFY with current infrastructure and entitlements. With the exception of recycled water, GWD's supplies are subject to reductions, particularly during droughts. The WSMP found that GWD's supplies will likely be insufficient in the future to avoid significant and recurring demand reductions that go beyond typical conservation efforts. The WSMP identified a need for 1,500 AFY of new local water supplies to reduce both the frequency and magnitude of the projected shortfalls. Any potential future reductions in Cachuma entitlement would reduce supplies further and create even larger shortfalls. Purchasing supplemental imported water is the least expensive strategy; however, the quantity is limited by pipeline capacity so the additional water needed must be locally available. Potable reuse is a reliable option to reduce both the frequency and magnitude of these shortfalls.

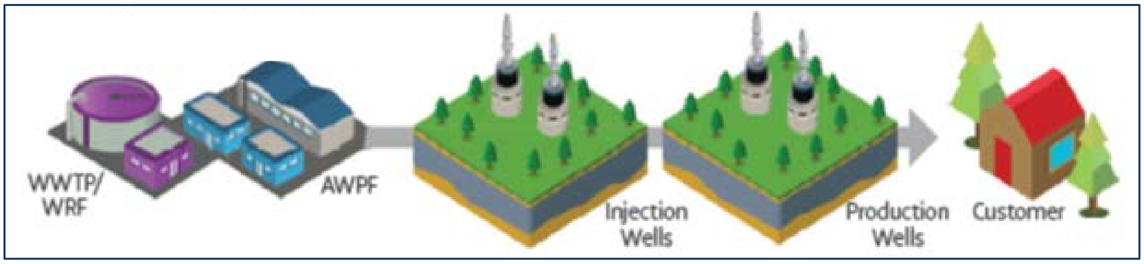
The Potable Reuse Facilities Plan (Facilities Plan) explores the feasibility of expanding the use of recycled water within the District's service area by identifying technologies, processes, infrastructure and permits necessary to maximize the use of recycled water as a highly reliable potable water supply source. The objective of this Facilities Plan is to determine potential pathways to maximize the use of recycled water and increase its long-term viability as a permanent supply source in comparison to alternative supply options, including conservation. Development of the Facilities Plan was driven by GWD's objectives to:

- Diversify the water supply portfolio
- Improve water supply reliability
- Decrease dependence on imported water (i.e., "drought resistant" supply)
- Manage the groundwater basin
- Address climate change

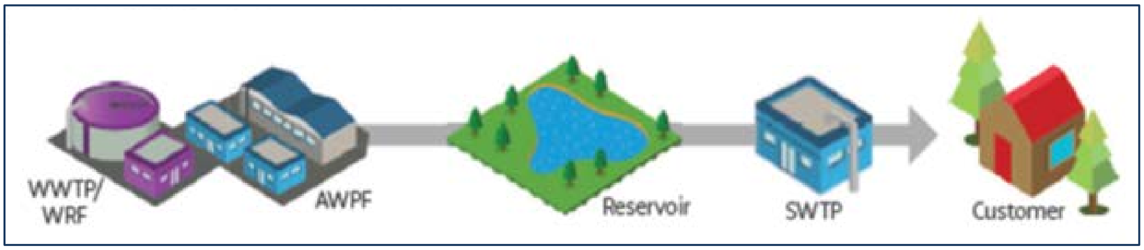
Types of Potable Reuse

There are two types of potable reuse: Indirect Potable Reuse (IPR) and Direct Potable Reuse (DPR). IPR involves the blending of recycled water in a groundwater basin or surface water reservoir where it mixes with water *prior to* treatment and delivery. DPR removes the environmental barrier (e.g., groundwater basin or surface water reservoir) and involves delivering purified recycled water directly into a potable water system or raw water system upstream of a water treatment plant. See Section 4.2 of this Plan for further discussion. The range of potable reuse[1] concepts can be further grouped into four general categories:

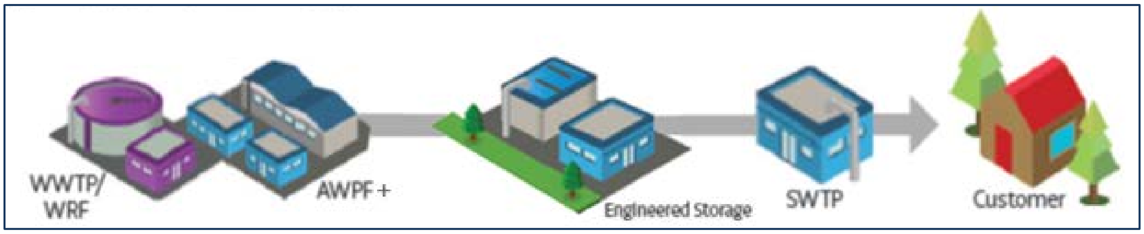
Groundwater Augmentation (GWA) (IPR): Purified water percolated or injected into the groundwater basin



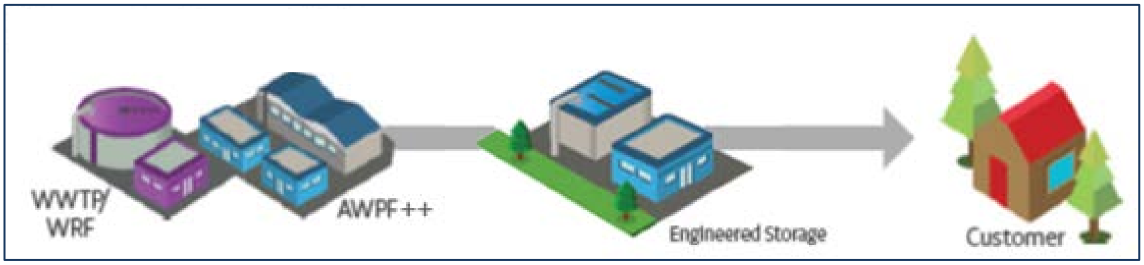
Reservoir Augmentation (RA) (IPR): Purified water discharged to a reservoir with a combination of minimum detention time and dilution required prior to treatment at a conventional surface water treatment plant.



Raw Water Augmentation (RWA) (DPR): Purified water introduced directly to a surface water treatment plant.



Treated Water Augmentation (TWA) (DPR): Finished drinking water, which also meets the requirements of the Surface Water Treatment Rule, introduced directly to the potable water distribution system.



[1] Common terminology for potable reuse concepts is included in Appendix B.

Regulations for groundwater augmentation were established by the State Water Resources Control Board (SWRCB) in 2014 and regulations for reservoir augmentation are expected to be approved in 2017. Regulations for raw water augmentation and treated water augmentation are being considered for development by SWRCB and, in 2016, the *Investigation on the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse* was issued. The Expert Panel convened to support the investigation and determined that "it is feasible to develop uniform water recycling criteria for DPR that would incorporate a level of public health protection as good as or better than what is currently provided in California by conventional drinking water supplies."

Raw water augmentation and treated water augmentation remove the "environmental barrier," such as the groundwater basin or reservoir, between the recycled water supply and the potable water supply; so, the focus of potable reuse regulations has been on engineered measures to replace the environmental barrier, such as:

- Providing multiple, independent treatment barriers
- Incorporating the frequent monitoring of surrogate parameters at each step to ensure treatment processes are performing properly
- Developing and implementing rigorous response protocols

For this Facilities Plan, potential criteria (e.g., minimum treatment, monitoring, blending, etc.) for raw water augmentation and treated water augmentation projects were developed to allow for potential alternatives.

Alternatives Development

Potable reuse alternatives were developed with the following components:

- Available Supply
- Potable Reuse Receptors
- Treatment Requirements
- Treatment Location / Conveyance Options

Available Supplies

Based on GWD demand projections from the 2015 Urban Water Management Plan, wastewater flows to the GSD WWTP are projected to increase from 2015 flows of 4.2 MGD (4,800 AFY) to 6.6 MGD (7,400 AFY) in 2040. Flows in 2030 (6.3 MGD; 7,000 AFY) are selected for alternatives comparison to account for projected flow increases that have higher levels of confidence.

Existing non-potable reuse of approximately 1,100 AFY (1.0 MGD) is projected to increase to 1,265 AFY (1.1 MGD) by 2030 and peak season (demand) may be up to 2.0 MGD. Two potable reuse supply scenarios are considered – one assumes continued operation of the existing non-potable system; the other assumes the existing system is abandoned and, as a result, that all available wastewater is treated for potable use.

All scenarios assumed RO treatment and 85% RO recovery. The first scenario would produce 5.3 MGD (5,900 AFY) of purified water after accounting for monthly wastewater flows and assuming an AWPF input capacity of 6.3 MGD. The net yield of this scenario is 4,620 AFY, after accounting for the existing non-potable demand that would need to be supplied with potable water. The second scenario would produce 4.1 MGD (4,550 AFY) of purified water after accounting for monthly wastewater flows, monthly non-potable system demand, and assuming an AWPF input capacity of 5.1 MGD.

Potential Potable Reuse Receptors

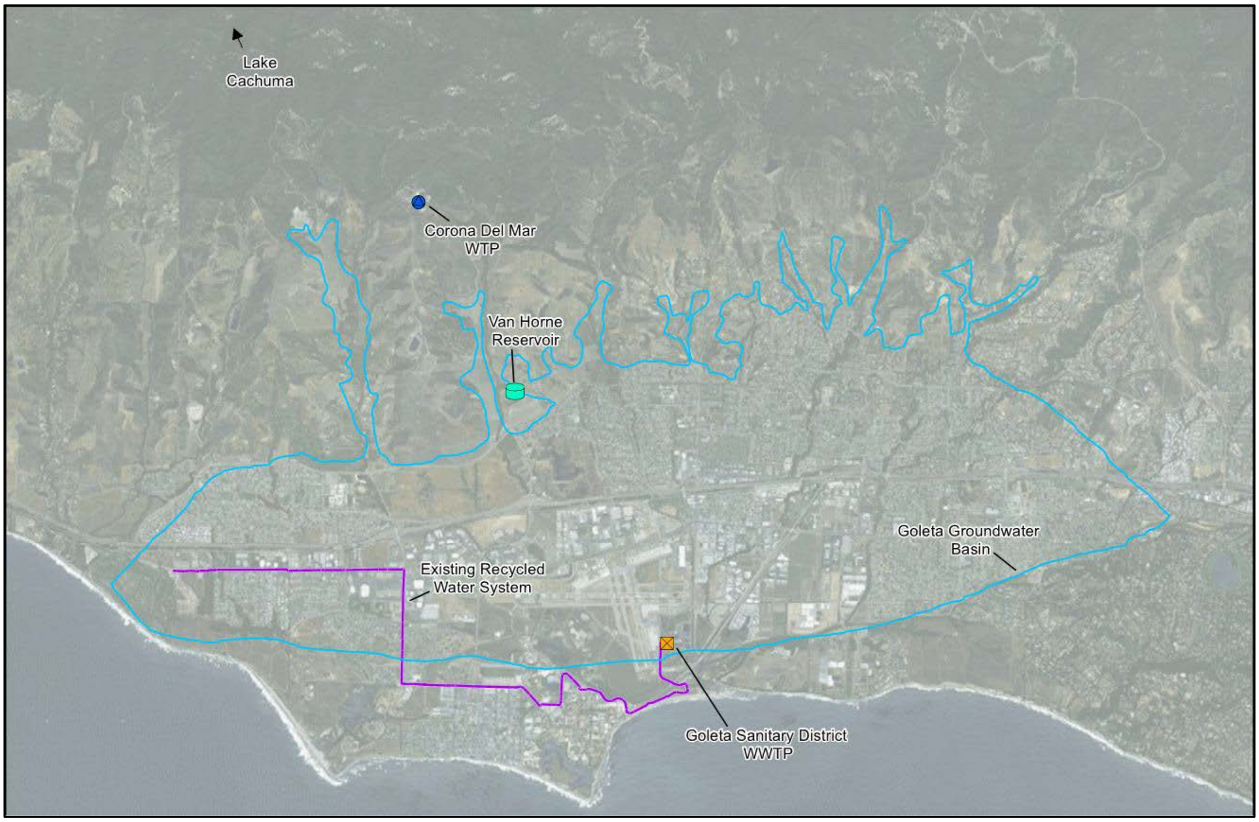
Four potential recycled water receptors were identified, one for each of the four types of potable reuse:

- Groundwater Augmentation (GWA): Goleta Groundwater Basin

- Reservoir Augmentation (RA): Lake Cachuma (open reservoir)
- Raw Water Augmentation (RWA): Corona del Mar Water Treatment Plant (CDM WTP)
- Treated Water Augmentation (TWA): Van Horne Reservoir (a 6 MG tank feeding the potable water distribution system)

Ultimately, reservoir augmentation of Lake Cachuma was not carried forward due to high capital costs (long pipeline) and institutional complexity.

Potential Potable Reuse Locations



Treatment Requirements

Minimum treatment requirements for each of the types of potable reuse are defined to support alternatives development. Minimum treatment requirements for groundwater augmentation are based on existing regulations for recharge via injection wells: advanced water purification facility (AWPF) comprised of microfiltration (MF) or ultrafiltration (UF), reverse osmosis (RO), and an advanced oxidation process (AOP).

Minimum levels of treatment were developed for raw water augmentation and treated water augmentation that attempt to balance the anticipated conservative approach of forthcoming potable reuse regulations with actual treatment trains proposed by agencies based on the DPR Expert Panel recommendations. A raw water augmentation treatment train is assumed to build upon the AWPF for groundwater augmentation with biological nutrient removal (BNR) and a redundant disinfection step in addition to ultimately being treated at a conventional drinking water treatment facility that meets Surface Water Treatment Rules. Extra processes are assumed to be BNR added to secondary treatment and a second chlorine (Cl) disinfection step added to the AWPF.

Treated water augmentation may require additional barriers to address acutely toxic constituents. Full tertiary treatment following secondary treatment with BNR preceding the AWPF, plus a redundant disinfection process (chlorine disinfection) and redundant organics removal process (ozone (O_3) followed by biological activated carbon (BAC)) were assumed.

In summary, the following treatment trains are assumed for each potable reuse type:

- Groundwater Augmentation: “AWPF” (MF/RO/AOP)
- Raw Water Augmentation: BNR + “AWPF+” (UF/RO/AOP + Cl)
- Treated Water Augmentation: BNR + Tertiary Filtration + “AWPF++” (UF/RO/AOP + Cl + O_3/BAC)

In addition to treatment, the following facility assumptions were made:

- **Engineered Storage:** Groundwater augmentation alternatives do not include engineered storage. The raw water augmentation alternatives include three tanks with at least two hours of storage each while the treated water augmentation alternatives include three tanks with at least six hours of storage each. Storage volumes are intended to provide for response retention time.
- **Blending:** Raw water augmentation assumes purified water is limited to no more than 50% of source water to the CDM WTP at any point in time due to concerns regarding effects on WTP operations and the possibility that DDW may not issue full log removal credit for the WTP. Groundwater augmentation does not have blend requirements but does include a minimum retention time of two months. Treated water augmentation blending requirements are also assumed to be limited to no more than 50%; however, there has been little regulatory discussion on the topic to date.
- **Monitoring:** The raw water augmentation alternatives includes a $1 million lump sum for additional system monitoring while the treated water augmentation alternatives include a $5 million lump sum. Detailed critical control point monitoring requirements are not defined well enough at this time to include in this analysis.

It should be noted that the minimum treatment, storage, blend, and monitoring requirements for the potable reuse options without regulations (raw water augmentation and treated water augmentation) are based on an interpretation of the ongoing DPR regulatory discussion. These requirements will be subject to change once regulations are finalized for each type of potable reuse. Future regulations could be more or less conservative than the assumptions in this report.

Treatment Location / Conveyance Options

Two AWPF siting alternatives were evaluated: 1) Goleta Sanitary District (GSD) Wastewater Treatment Plant (WWTP); and 2) CDM WTP. There is sufficient space for all AWPF facilities at both sites but, ultimately, GSD WWTP was selected as the preferred AWPF site due to lower cost, potable reuse type flexibility, and layout flexibility:

- The lower cost of the GSD WWTP site results from avoiding conveying AWPF influent to the CDM WTP and then conveying brine back to the GSD WWTP ocean outfall.
- The GSD WWTP site allows for implementation of groundwater, raw water, or treated water augmentation while use of the CDM WTP site limits potable reuse options to raw water augmentation at the CDM WTP.
- The GSD WWTP has more potentially available space compared to the CDM WTP and, thus, more flexibility to develop a layout for the AWPF.

Two options were considered for conveyance from the GSD WWTP to the CDM WTP: 1) use of the existing non-potable system; and 2) new pipeline. Both options have similar lifecycle costs – use of the existing system reduces capital costs but increases pumping costs compared with a new system.

Alternatives Definition

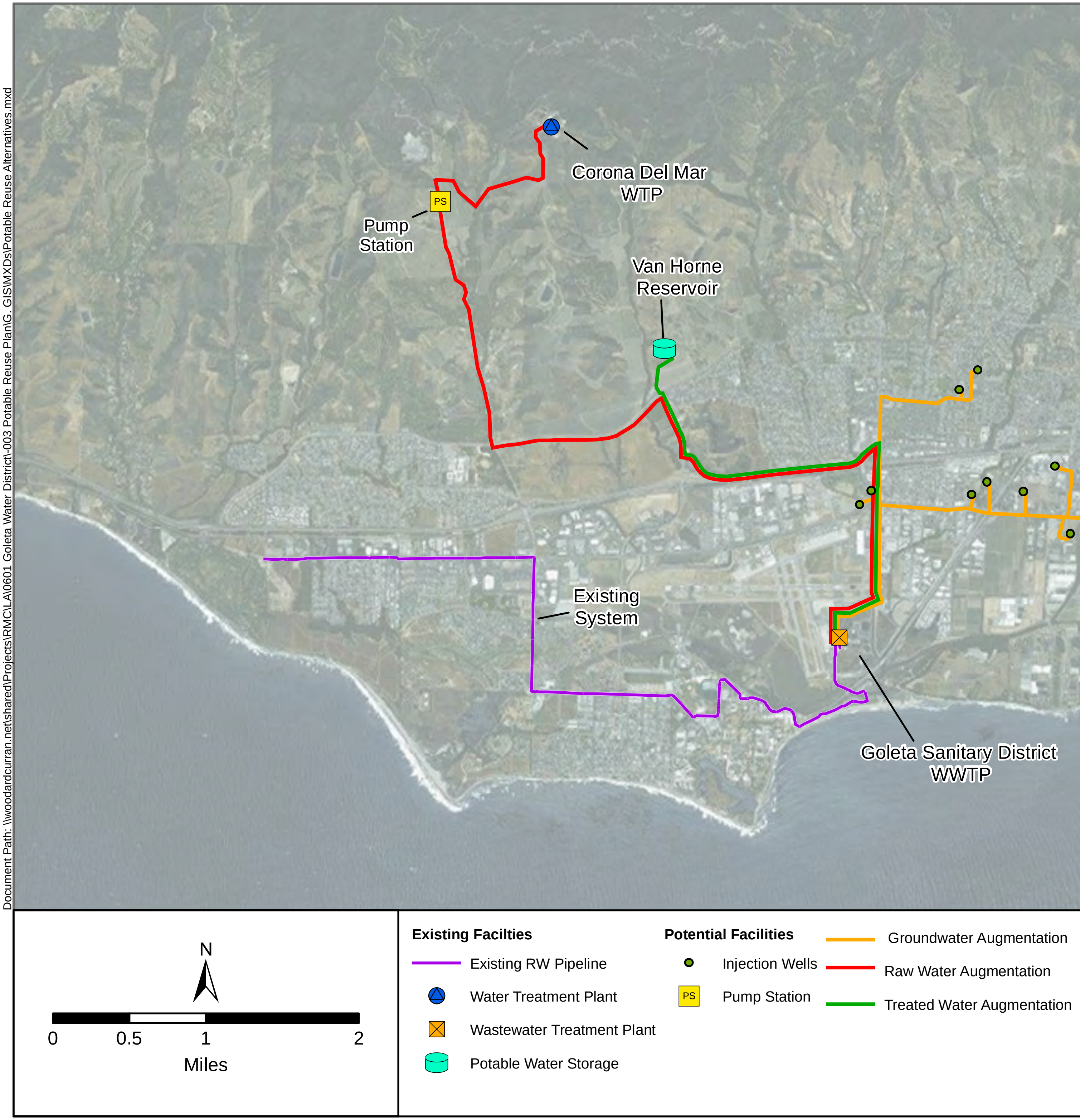
Alternatives were developed for three types of augmentation via potable reuse: 1) GWA (Goleta Groundwater Basin); 2) RWA (CDM WTP); and 3) TWA (Van Horne Reservoir). The alternatives, which are shown on the following page, are divided into two main groups:

- "A" alternatives assume the existing non-potable system would be terminated to apply all available wastewater for potable reuse, resulting in a net project yield of 4,620 AFY.
- "B" alternatives assume continued operation of the existing non-potable system, which limits project yield to 4,550 AFY.

Each alternative includes the following components:

- **Treatment Processes:** A minimum of AWPF treatment (MF/RO/AOP) is assumed. Raw water augmentation alternatives include extra treatment, storage, and monitoring, while treated water augmentation alternatives include additional, expanded treatment. The AWPF is located at the GSD WWTP for all alternatives.
- **Treatment Upgrades:** Both raw water augmentation and treated water augmentation alternatives assume full BNR upgrades at the GSD WWTP. Treated water augmentation alternatives assume expansion of tertiary treatment to treat all flows to the AWPF.
- **Pump Station:** Each alternative includes a new pump station at the GSD WWTP and the raw water augmentation alternatives include a second pump station to boost purified water supplies to the CDM WTP.
- **Pipelines:** Each alternative includes a transmission main ranging from 18 inches to 24 inches in diameter. The groundwater augmentation alternatives include 6-inch diameter distribution mains to each injection well. Also, the raw water and treated water augmentation alternatives include a trenchless crossing of Highway 101.
- **Injection Wells:** The groundwater augmentation alternatives include a sufficient number of injection wells to recharge the product water at a rate of 0.5 MGD per well, based on previous injection studies completed by the District, along with an additional backup well. The cost of a monitoring well is also included with each injection well as part of a future compliance monitoring network.
- **Ocean Outfall Modification:** A lump sum cost of $500,000 is included as a placeholder for potential modifications required to the existing ocean outfall to mitigate periods with low effluent flows predominantly consisting of RO brine. An evaluation is required to determine the impacts of changes to effluent as well as the potential mitigation measures.
- **Avoided NPR System Costs:** The "A" alternatives avoid the need to invest approximately $9.5 million in estimated non-potable reuse (NPR) system capital projects to improve reliability, such as a pipe to loop the currently linear system, and O&M costs of roughly $800,000 per year.

It should be noted that the minimum treatment, storage, and monitoring requirements for the raw water augmentation and treated water augmentation alternatives are based on an interpretation of the ongoing DPR regulatory discussion. These requirements will be subject to change once regulations are finalized for each type of potable reuse.



Potable Reuse Alternatives

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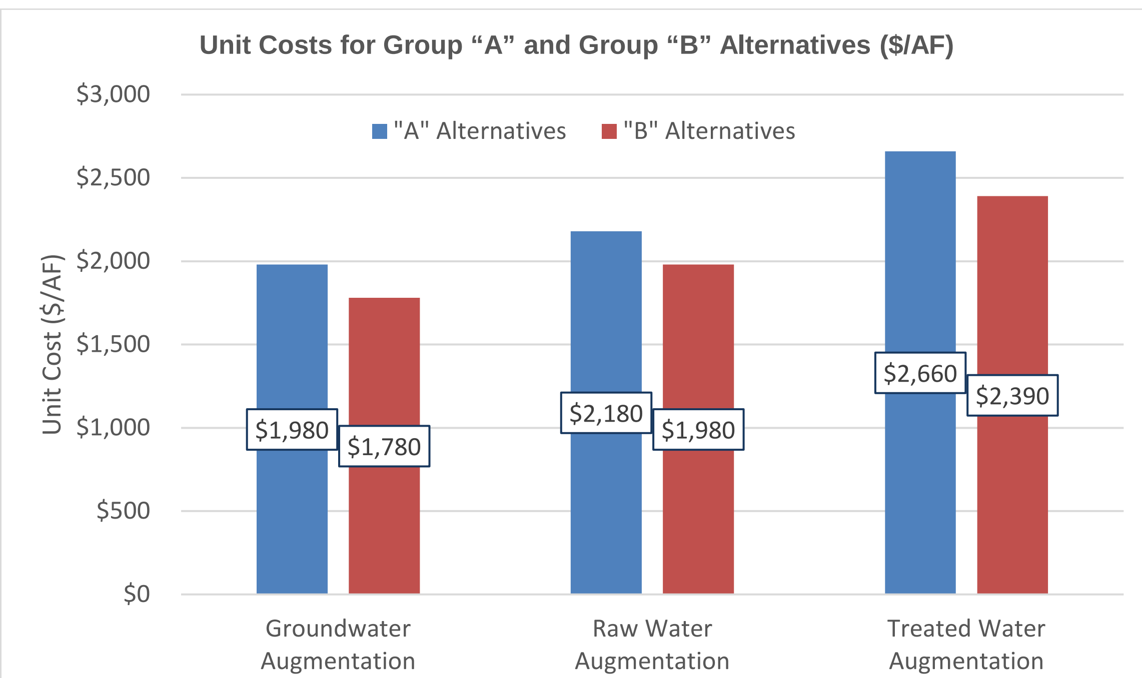
Alternatives Comparison

"A" vs. "B" Alternatives

Evaluating the "A" and "B" alternatives requires a decision on the ultimate fate of the existing non-potable system. The yield of the group "A" alternatives assumes that the existing non-potable deliveries end and that the recycled water is purified for potable reuse. This assumption has several implications:

- Requires delivery of purified water to non-potable customers, for mostly irrigation purposes, which is a much higher quality than needed. This delivery could be accomplished via the existing non-potable distribution system or through the potable water system to these customers, which may have costs for potable conversion and customer rate implications.
- Existing customers are likely to object after investing in non-potable systems, such as dual plumbing, and due to the potential to pay higher potable water rates (and tiers) rather than lower recycled water rates.
- The public may object because irrigation of public green spaces, which is typically reduced in drought conditions (unless recycled water is being used), promotes wellness. Ending recycled water deliveries to parks and schools or other public green spaces may result in reduced irrigation and an increased number of brown spaces during drought periods.
- Continued operation of the existing system requires continued investment for maintenance and replacement of pipes and facilities due to the age of the system and corrosive soil conditions. A total of $9.5 million in capital projects are identified to address existing deficiencies and improve reliability of service and annual system O&M costs (excludes debt service) total roughly $800,000 per year. These avoided costs for the "A" alternatives were accounted for as credits in the cost estimates.

The "B" alternatives still had lower unit costs than the "A" alternatives after accounting for avoided NPR system costs. On the whole, the analysis indicates that the negatives of terminating the non-potable system appear to outweigh the positives. **Therefore, the "A" alternatives are not considered further.**



Comparison of Potable Reuse Types

An alternative was defined for each type of potable reuse with maximum yield of purified water. The associated facilities and estimated costs are shown in the following tables.

Maximum Yield Alternatives, Facilities

Alt	Yield (AFY)	Treatment			Non-Treatment Facilities		
		AWPF	BNR Upgrade	Tertiary Expansion	Pump Station(s)	Conveyance	Other
GWA	4,550	4.3 MGD AWPF	No	No	350 HP	9,800 LF (18") 7,000 LF (12") 11,600 LF (6")	10 Injection Wells
RWA	4,550	4.3 MGD AWPF+	Yes	No	450 HP 600 HP	40,000 LF (24")	3 x 0.4 MG Storage
TWA	4,550	4.3 MGD AWPF++	Yes	2.1 MGD	400 HP	19,800 LF (18")	3 x 1.1 MG Storage

GWA Groundwater Augmentation
RWA Raw Water Augmentation
TWA Treated Water Augmentation
AWPF MF/RO/AOP
AWPF+ UF/RO/AOP + Cl
AWPF++ UF/RO/AOP + Cl + O_3/BAC

Maximum Yield Alternatives, Cost Estimates

Alt	Total Capital Costs ($M)	Annualized Capital Cost ($M)	Annual O&M Cost ($M)	Total Annual Cost ($M)	Project Yield (AFY)	Unit Cost ($/AF)
GWA	$83.6	$4.27	$3.80	$8.02	4,550	$1,780
RWA	$95.0	$4.85	$4.13	$8.93	4,550	$1,980
TWA	$112.9	$5.76	$5.10	$10.81	4,550	$2,390

Note: Refer to Appendix D for detailed cost estimates.

Groundwater augmentation is the lowest cost alternative and provides the following qualitative benefits over raw water and treated water augmentation.

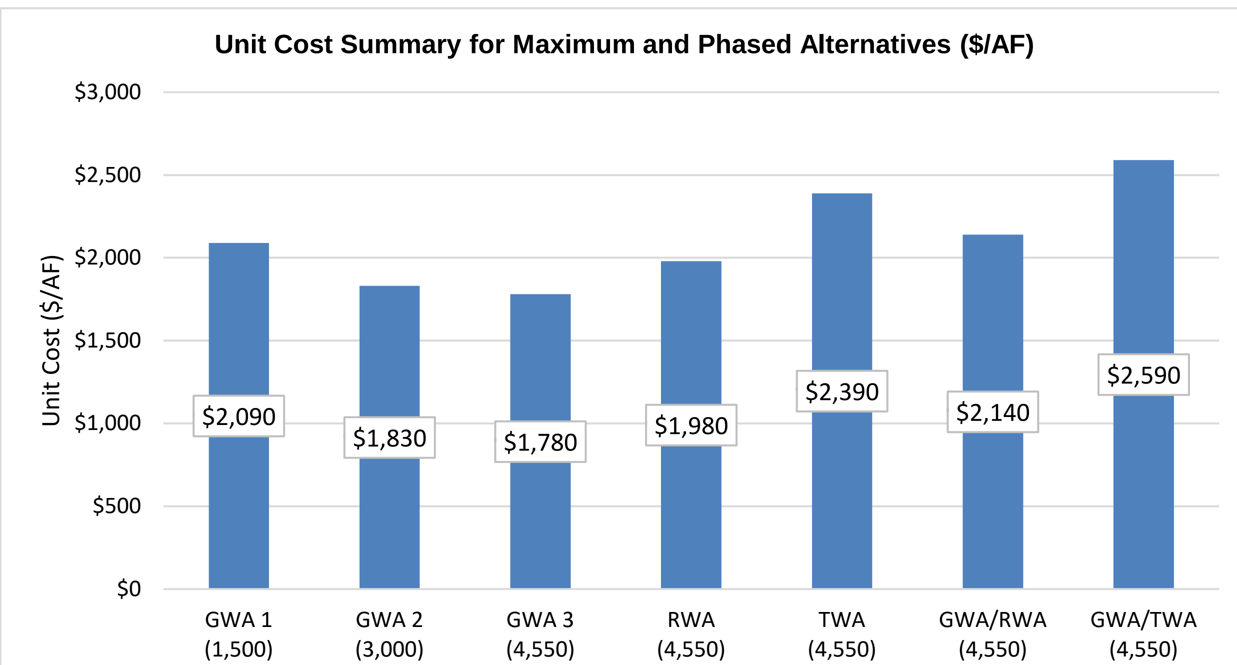
- Lower cost risk associated with the effect of future regulations on facility and operational requirements, which primarily effects project costs.
- Lower schedule risk associated with the absence of existing regulations for raw water augmentation and treated water augmentation that could delay implementation until regulations are in place (or proceed with a higher risk using assumed regulatory requirements)
- Greater flexibility to implement project phases to meet near-term supply shortfalls or provide public and regulatory support
- Greatest level of public acceptance, of the various forms of potable reuse

Based on the cost and qualitative information, groundwater augmentation is preferred over the other alternatives since it has the lowest unit cost, most defined regulatory pathway, most implementation flexibility, and highest likelihood of public acceptance. However, the potable system capacity to handle significant increased use of groundwater and increased operational complexity is recommended for further investigation. In addition, prior to and during project implementation, the District would need to further evaluate the ability to integrate injection of 4,550 AFY of purified water into groundwater basin management plans that coordinate with other water supplies. Finally, only approximately 3,000 AFY is available today for potable reuse (assuming the non-potable system continues to operate) and construction of the full (4,550 AFY) project requires significant capital costs. Therefore, four alternatives were defined that consider phasing of project implementation:

- **GWA Phase 1:** Groundwater Augmentation (1,500 AFY)
- **GWA Phase 2:** Groundwater Augmentation (3,000 AFY)
- **GWA/RWA:** Groundwater Augmentation (up to 3,000 AFY) & Raw Water Augmentation (up to 3,000 AFY) (total of 4,550 AFY)
- **GWA/TWA:** Groundwater Augmentation (up to 3,000 AFY) & Treated Water Augmentation (up to 3,000 AFY) (total of 4,550 AFY)

Phased Alternatives, Facilities

Alt	Yield (AFY)	Treatment			Non-Treatment Facilities		
		AWPF	BNR Upgrade	Tertiary Expansion	Pump Station(s)	Conveyance	Other
GWA Ph. 1	1,500	1.5 MGD AWPF	No	No	100 HP	9,800 LF (18”) 2,900 LF (6”)	4 Injection Wells
GWA Ph. 2	3,000	3.0 MGD AWPF	No	No	200 HP	9,800 LF (18”) 2,800 LF (12”) 6,000 LF (6”)	7 Injection Wells
GWA/ RWA	4,550	4.3 MGD AWPF+	Yes	No	450 HP 500 HP	40,000 LF (24”)	3 x 0.3 MG Storage 7 Injection Wells
GWA/ TWA	4,550	4.3 MGD AWPF++	Yes	2.1 MGD	350 HP	23,400 LF (18”) 2,800 LF (12”) 6,000 LF (6”)	3 x 0.8 MG Storage 7 Injection Wells



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Miles

GSD WWTP

Advanced Water Purification Plant

Recycled Water Pipeline

Production Wells

Potential Injection Sites

Phase 1 (1,500 AFY)

Phase 2 (3,000 AFY)

Phase 3 (4,500 AFY)

Groundwater Augmentation Phases

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Unit costs are higher for GWA Phase 1 (1,500 AFY) and GWA Phase 2 (3,000 AFY) than GWA Phase 3 (4,550 AFY), primarily due to oversizing the transmission pipeline for ultimately implementing a 4,550 AFY project. The hybrid alternatives (GWA/RWA and GWA/TWA) unit costs are roughly 10% higher compared with the RWA or TWA only alternatives and roughly 20% higher than GWA 3 (which is GWA only). Based on these results, the hybrid alternatives are not attractive from a cost perspective compared with GWA only, but the unit costs could become closer once potable system impacts are better understood for the larger GWA alternatives (which could increase its cost) and regulations better define facility requirements for RWA or TWA (which could decrease or increase their costs).

Recommendations

The 2017 WSMP Update identified a new, local water supply need of 1,500 AFY. GWA Phase 1 (1,500 AFY) provides the most cost effective and feasible pathway (considering cost risk, schedule risk, implementation flexibility, and public acceptance) to achieve this target. **Therefore, GWA Phase 1 (1,500 AFY) is the recommended project.**

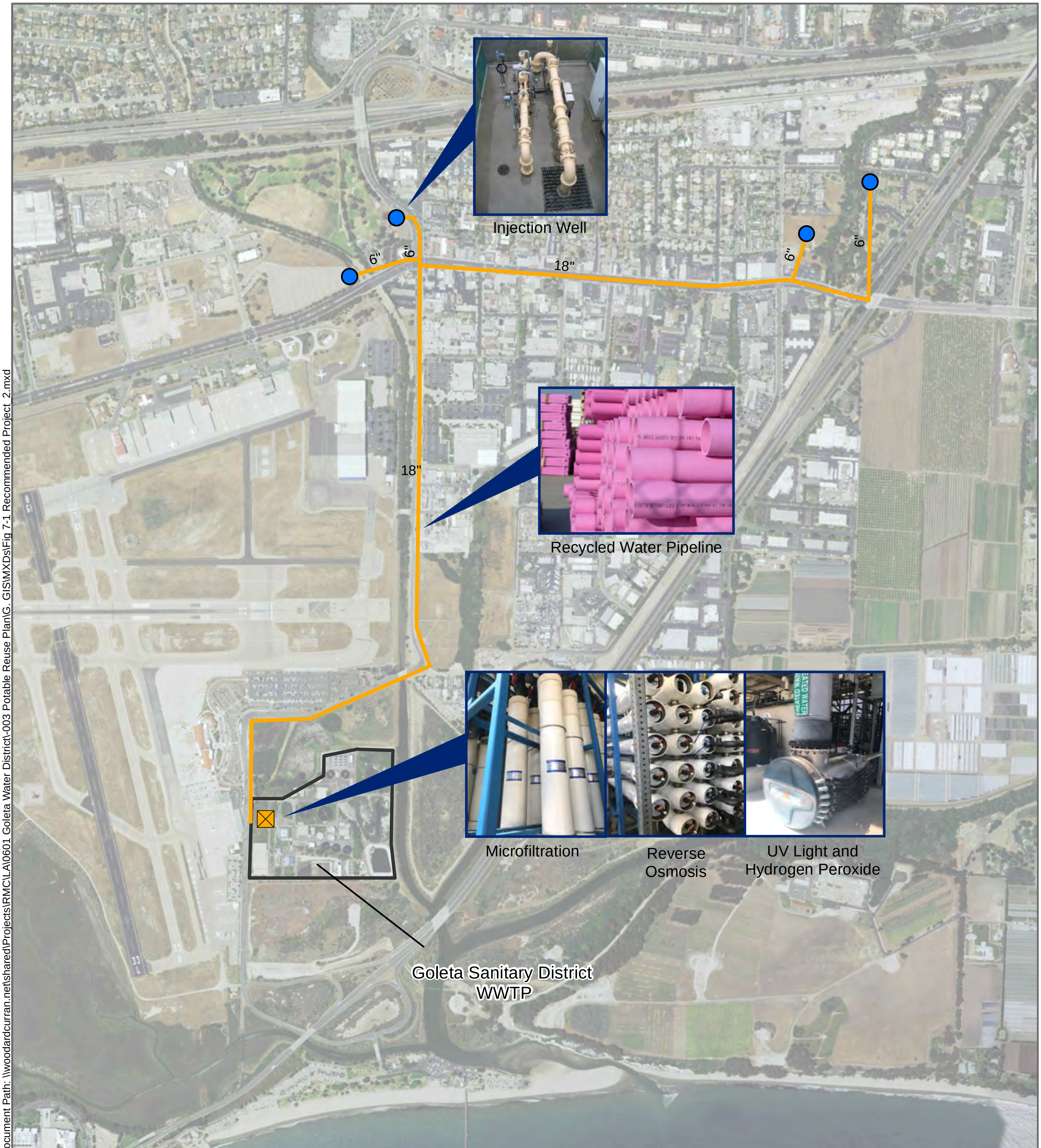
The recommended project can be developed as the first phase of a larger potable reuse program that could ultimately yield up to 4,550 AFY, and future phases may include:

- Additional groundwater augmentation (GWA Phase 2 and/or GWA Phase 3 alternatives);
- Raw water augmentation (GWA/RWA alternative); and/or
- Treated water augmentation (GWA/TWA alternative).

Selection of future phases will be dependent on several factors:

- Groundwater Augmentation (GWA) Cost: GWA is the lowest cost approach based on the alternatives definition assumptions in this report. The biggest unknown cost for a large (i.e., 3,000 to 4,500 AFY) GWA project is potable water system improvement needs such as new production wells, new conveyance pipelines from wells to distribution system, and upgrades to the existing distribution system to increase capacity.
- Raw Water Augmentation (RWA) / Treated Water Augmentation (TWA) Cost: RWA and TWA regulations could ultimately cause project costs to be higher or lower than estimated in this report depending on the ultimate treatment, storage, monitoring, and reporting requirements.
- GWD Supply Need Timing: The timing of approved regulations for RWA and TWA is not known, but regulations are anticipated by the early 2020s. The timing of need for potable reuse supplies beyond the Phase 1 GWA project will be further evaluated by GWD.
- Potable System Operations: An RWA or TWA project would result in operation of the potable distribution system largely as it does today – primarily gravity fed from CDM WTP or Van Horne Reservoir to 18-inch and 24-inch distribution pipelines. A large GWA project, on the other hand, would increase the volume of supplies entering the potable system from individual points with independent pumps, which results in more complex system operation changes.

These factors will be re-evaluated in the future as the District water supply and demand portfolio evolves over time.



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GSD WWTP
Advanced Water Purification Facility
Recycled Water Pipeline
Potential Injection Well Sites

Recommended Project: Groundwater Augmentation, 1,500 AFY

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Recommended Project Description

The Recommended Project entails a 1.5 MGD advanced water purification facility (AWPF) (MF/RO/AOP) to treat effluent from the GSD WWTP for recharge of the Goleta Groundwater Basin via well injection with approximately 1,500 AFY of purified water. The ultimate potable reuse program could yield up to 4,550 AFY; and future phases may include additional groundwater augmentation, raw water augmentation, and/or treated water augmentation.

Table 1-1: Recommended Project Facilities

Item	Description
Treatment	AWPF (MF/RO/AOP) 1.8 MGD Capacity 1.5 MGD Product Yield (1,500 AFY)
Conveyance	18-in Pipe, 9,800 LF 12-inch, 2,800 LF
Pump Station	100 HP, Q = 1,000 GPM, TDH = 200 ft 2 Pumps: 1 Duty, 1 Standby
Injection Wells	4 New Wells
Groundwater Wells	Existing District Wells
Monitoring Wells	4 New Wells

Project Capital Cost

Estimated costs for the Recommended Project and construction financing scenarios are summarized in the following tables. The 18-inch pipeline could be oversized for future potable reuse phases such that future phases could extend off of the initial pipeline terminus. The treatment and pump station facilities would be designed for future expansion.

The District intends to pay for pre-construction planning tasks with available funds and construction costs could be covered with a combination of available grant funds and the balance of capital costs with a low-interest State Revolving Fund (SRF) loan. As shown in the table, the District must generate at least $3.14 million dollars per year in revenue and/or avoided existing costs to ensure SRF loan payback and sufficient O&M funding. Accordingly, the effects on customer rates from the project will require an updated cost of service study prepared in accordance with Proposition 218. The annual payment results in a unit cost for water at this feasibility level of $2,090/AF with a low-interest SRF loan and would be reduced by 13% to $1,820/AF with 25% grant funding of capital costs. Future phases of the project, which would take advantage of capacity constructed as part of the Recommended Project could reduce unit costs down to approximately $1,780/AF (without grant funding).

Recommended Project, Estimated Costs

Item	Value	Cost ($M)
Advanced Water Purification Facility	1.5 MGD	$10.3
Conveyance	18" @ 9,800 LF 6" @ 2,900 LF	$3.0
Pump Station	100 HP	$0.7
Injection Wells / Monitoring Wells	3 + 1 backup	$4.8
Construction Subtotal		**$18.7**
Construction Contingency (30%)		$5.6
Construction Total		**$24.4**
Implementation Costs (30%)		$7.3
Total Capital Costs		**$31.7**
Annual O&M Costs		**Cost ($M/yr)**
Treatment O&M		$1.03
Testing / Monitoring		$0.10
Pumping		$0.39
Total Annual O&M		**$1.52**

Recommended Project, Financing Scenarios

Item	No Grant Funding Scenario ($M)	Grant Funding Scenario ($M)	Notes
Total Capital Cost	$31.7		
Grant Funding	--	$7.9	Assumes 25% of capital costs
Capital Cost for Financing	**$31.7**	**$23.8**	
SRF Annual Payment	$1.62	$1.21	SRF financing at 3.0% over 30 Years
Annual O&M	$1.52		
Total Annual Cost	**$3.14**	**$2.73**	
Annual Yield	1,500 AFY		
Unit Cost	**$2,090 / AF**	**$1,820 / AF**	

Implementation Plan

Implementing the Recommended Project entails public support, regulatory approvals, environmental review, institutional partnerships, additional technical investigations, and facility design, construction, and operations.

The overall implementation plan for the Recommended Project is shown in **Figure 8-1**. Full implementation of the project would take approximately five years. Technical studies required to further refine the project need to be completed in order to: 1) prepare the Engineering Report for the SWRCB Division of Drinking Water (DDW); 2) initiate environmental documentation; and 3) refine project cost estimates. The environmental documentation should be done in parallel with the Engineering Report.

From a project funding and financing perspective, CEQA certification is the critical path for gaining preliminary approval for grant funding and low-interest loans from the SWRCB. From a project start-up perspective, the Engineering Report approval is the critical path for acquiring a recycled water permit from the Regional Water Quality Control Board (RWQCB), which is needed prior to start of operations. CEQA certification is also needed before the RWQCB can issue the GWR permit.

Design of the infrastructure improvements would continue after completion of the relevant preliminary studies in coordination with CEQA and permitting efforts. Funding and stakeholder/public outreach efforts would occur over the lifetime of the project. Pilot testing of treatment processes should be done in coordination with public outreach and preliminary design efforts.

Figure 1-1: Implementation Schedule for the Goleta Groundwater Augmentation Project

	Year 1				Year 2				Year 3				Year 4				Year 5			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Public Outreach	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Funding / Financing	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Technical Studies	■	■	■	■																
Pre-Design			■	■	■	■														
AWPF Pilot Test			■	■	■	■														
CEQA					■	■	■	■	■	■										
GWR Permit							■	■	■	■	■	■								
Final Design											■	■	■	■						
Bid/Award															■					
Construction																■	■	■	■	
Startup																				■

Conclusions

The Goleta Water District partnered with the Goleta Sanitary District and the SWRCB to prepare a recycled water facilities plan in order to explore options for expanding the use of recycled water; the main purpose was to offset reduced surface water supply reliability and the related potential for water shortages in drought years. The Facilities Plan considered use of recycled water for a range of uses: irrigation, groundwater augmentation, reservoir augmentation, raw water augmentation, and treated water augmentation. Groundwater augmentation via injection with full advanced water treatment (MF/RO/AOP) was selected as the preferred use of recycled water for an initial 1,500 AFY project, based on the following:

- Allows use of new water supply at its highest and best use (potable use)
- Utilizes existing facilities – primarily the groundwater basin and GWD wells
- Provides ability to store supplies on a multi-year basis for years with low surface water deliveries
- Provides ancillary groundwater basin benefits, such as higher groundwater levels and lower risk of seawater intrusion

Implementation of a groundwater augmentation project would help GWD meet projected supply shortfalls identified in the 2017 Water Supply Management Plan by reducing its dependence on surface water – which has high variability and increasing costs – with a locally controlled and drought proof water supply. Chapter 8 lays out the next steps to implement the Recommended Project and estimates that the new supply could be on-line within five years of the start of project implementation.

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Chapter 1 Introduction

1.1 Project Background

Goleta Water District (GWD, the District) is located in the South Coast of Santa Barbara County and serves approximately 85,000 residents within a service area of over 29,000 acres. The District was established in 1944 to represent the Goleta Valley in contracts with the Santa Barbara County Water Agency and the Bureau of Reclamation to participate in the Cachuma Project, which captures and stores floodwaters of the Santa Ynez River for municipal and agricultural uses.

In addition to potable water supplies and under a partnership with the Goleta Sanitary District (GSD), the District serves approximately 1,100 acre feet per year (AFY) of recycled water to 35 customers in the Goleta Valley, primarily for irrigation purposes with a small quantity used for toilet flushing. Recycled water is produced at the GSD Wastewater Treatment Plant (WWTP) and delivered to customers through the District's dedicated recycled water distribution system, which consists of approximately 10 miles of pipelines. The largest recycled water users are the University of California, Santa Barbara (UCSB) and several golf courses.

The GSD WWTP has a permitted secondary treatment capacity of 7.64 million gallons per day (MGD). In conjunction with the WWTP, GSD operates a reclamation facility designed to treat up to 3.0 MGD of secondary treated effluent to tertiary standards. In 2015, influent flow to the WWTP averaged 4.2 MGD; and approximately 1,120 AF (1.0 MGD) was treated at the reclamation facility to tertiary recycled water standards. This equates to approximately 24% of the influent to the WWTP in 2015. The balance of flow, roughly 3.2 MGD, was discharged to the Pacific Ocean via an ocean outfall. A limited market for recycled water and constraints in the existing recycled water distribution system limit the District's ability to utilize the full capacity of the water reclamation facility.

This Facilities Plan explores the feasibility of expanding the use of recycled water within the District's service area. It identifies technologies, processes, infrastructure and permits necessary to maximize the use of recycled water as a highly reliable potable water supply source.

This Facilities Plan was partially funded by a grant from the State Water Resources Control Board (SWRCB) Water Recycling Funding Program (WRFP) and was developed in accordance with the requirements and terms of the grant agreement. The completion of this document and acceptance by SWRCB will make GWD and GSD eligible to seek construction grants and low interest loans for a potable reuse project under the SWRCB WRFP.

1.2 Project Objectives

The objective of this Facilities Plan is to determine potential pathways to maximize the use of recycled water and increase its long-term viability as a permanent supply source in comparison to alternative supply options and conservation. Development of the Facilities Plan was driven by GWD's interest to

- Diversify the water supply portfolio
- Improve water supply reliability
- Decrease dependence on imported water (i.e., "drought proof" supply)
- Manage the groundwater basin
- Address climate change

In addition, GSD has supported reuse, as demonstrated by their partnership with GWD on the non-potable system, and fully supports development of increased reuse. Also of interest to GSD is a bill previously introduced in the State legislature that would encourage significant reductions in ocean discharges of treated wastewater.

1.3 GWD Planning Documents

This Facilities Plan was prepared in parallel with multiple other GWD water planning efforts. Several were completed while this report was prepared. Relevant documents include:

- **Groundwater Management Plan:** This plan describes the groundwater basin and explains the general rules by which the groundwater basin can be operated. The plan was updated in 2016.
- **Water Supply Management Plan:** The purpose of this plan is to update the analysis of the most effective use of GWD's various sources of water supply, both in terms of reliability and cost as well as to determine the best use of the water sources to satisfy potential increases in demand in the future and maintain groundwater levels. The plan was updated in 2017.
- **Stormwater Resources Plan:** The plan will quantify maximum stormwater capture potential to increase the beneficial use of stormwater as a water supply with a focus on development of identified feasible centralized (i.e. spreading grounds, recharge basins) stormwater capture sites. The plan is currently being prepared.

Chapter 2 Project Setting

This section provides a characterization of the study area, water supply and use, and wastewater treatment and disposal.

2.1 Study Area Characteristics

GWD is located in the South Coast portion of Santa Barbara County with its western border adjacent to El Capitan State Park and its northern border along the foothills of the Santa Ynez Mountains and the Los Padres National Forest. The City of Santa Barbara borders the eastern edge of the District and the Pacific Ocean lies to the south (**Figure 2-1**). The service area encompasses approximately 29,000 acres and the District provides water service to approximately 85,000 residents. The GWD service area includes the City of Goleta, University of California Santa Barbara, Santa Barbara Airport and an unincorporated area of Santa Barbara County. La Cumbre Mutual Water Company is located within the GWD service area but has its own supply, water distribution facilities, and customers; GWD does not serve these customers.

2.1.1 Hydrologic Features

GWD's service area (the study area) is contained within the Santa Barbara Coastal Watershed and includes eight subwatersheds: Gato Canyon, Dos Pueblos Canyon, Eagle Canyon, Glen Annie Canyon, East Fork, Maria Ygnacio Creek, San Roque Canyon and Goleta Slough. The study area contains a number of sloughs and small creeks with primarily intermittent flows. There are no major rivers or lakes within the study area.

2.1.2 Groundwater Basin

Basin Description

The study area overlies the Goleta Groundwater Basin (Basin) (**Figure 2-2**). The Basin is bounded on the north by bedrock of the Santa Ynez Mountains and to the south by uplifted bedrock along the More Ranch Fault. Tertiary-age bedrock forms the western boundary. The eastern boundary consists of bedrock uplifted along the Modoc Fault. The Basin is approximately eight miles long and three miles wide. There are three subbasins, the North, Central, and West, though the North and Central subbasins are often handled as a single subbasin (North-Central).

The Basin is naturally recharged from the Cieneguitas, Atascadero, San Antonio, Maria Ygnacio, San Jose, Las Vegas, San Pedro, Carneros, and Tecolotito creeks, as well as sections of bedrock in the foothills. The lower reaches of these creeks are intermittent, where they flow across permeable sediments of the North subbasin which is an active area of groundwater recharge. Remaining creek flow runs off into the Pacific Ocean with relatively minor recharge of more fine-grained shallow sediments in the Central and West subbasins.

The majority of useable groundwater in storage in the Basin is present within the Central subbasin. Water-bearing deposits of the basin consist of young alluvium of Quaternary and Holocene age, terrace deposits, older alluvium, and the Santa Barbara Formation of Pleistocene age. The Santa Barbara Formation is the primary water-bearing unit and is composed of sand, silt, and clay.

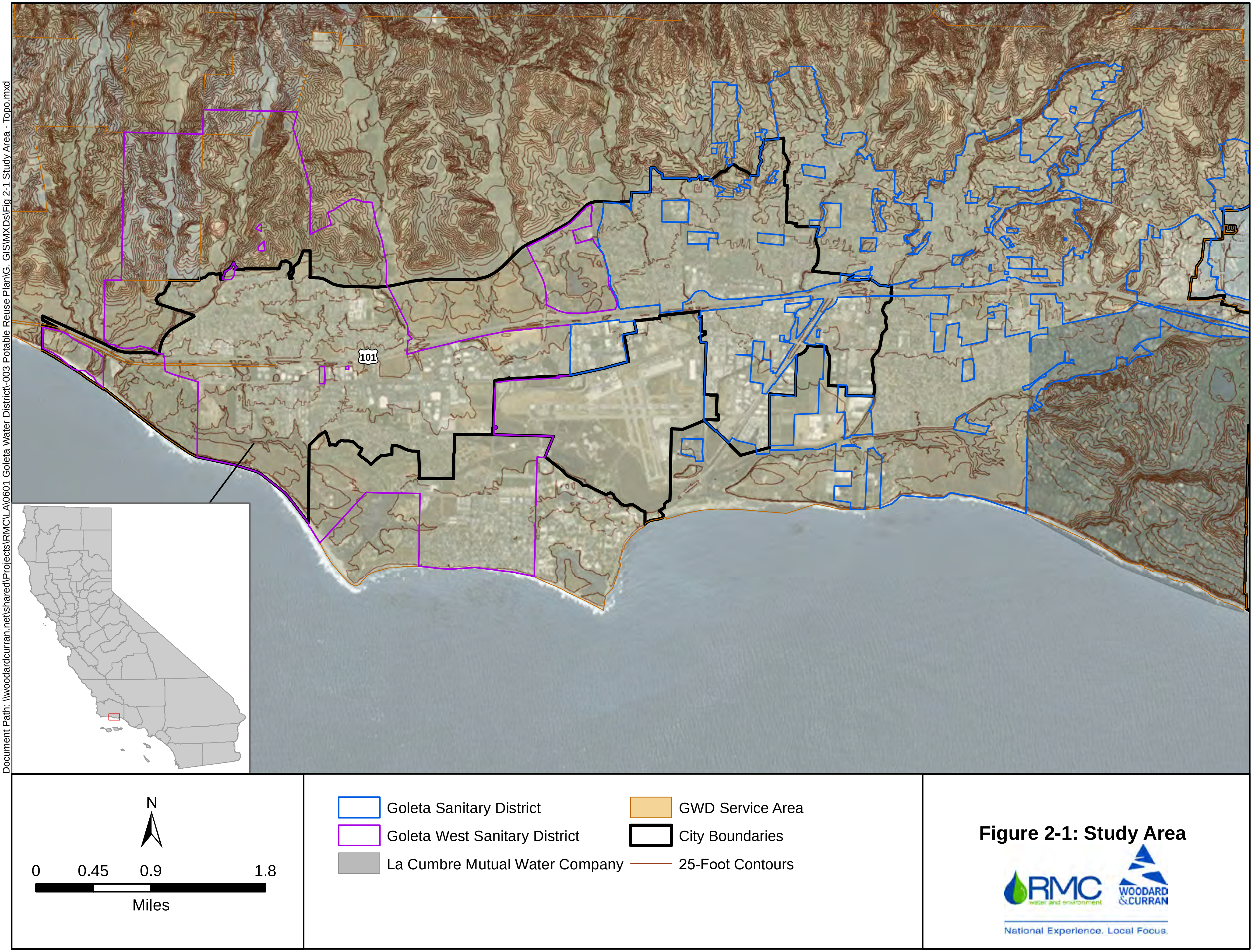

Figure 2-1: Study Area

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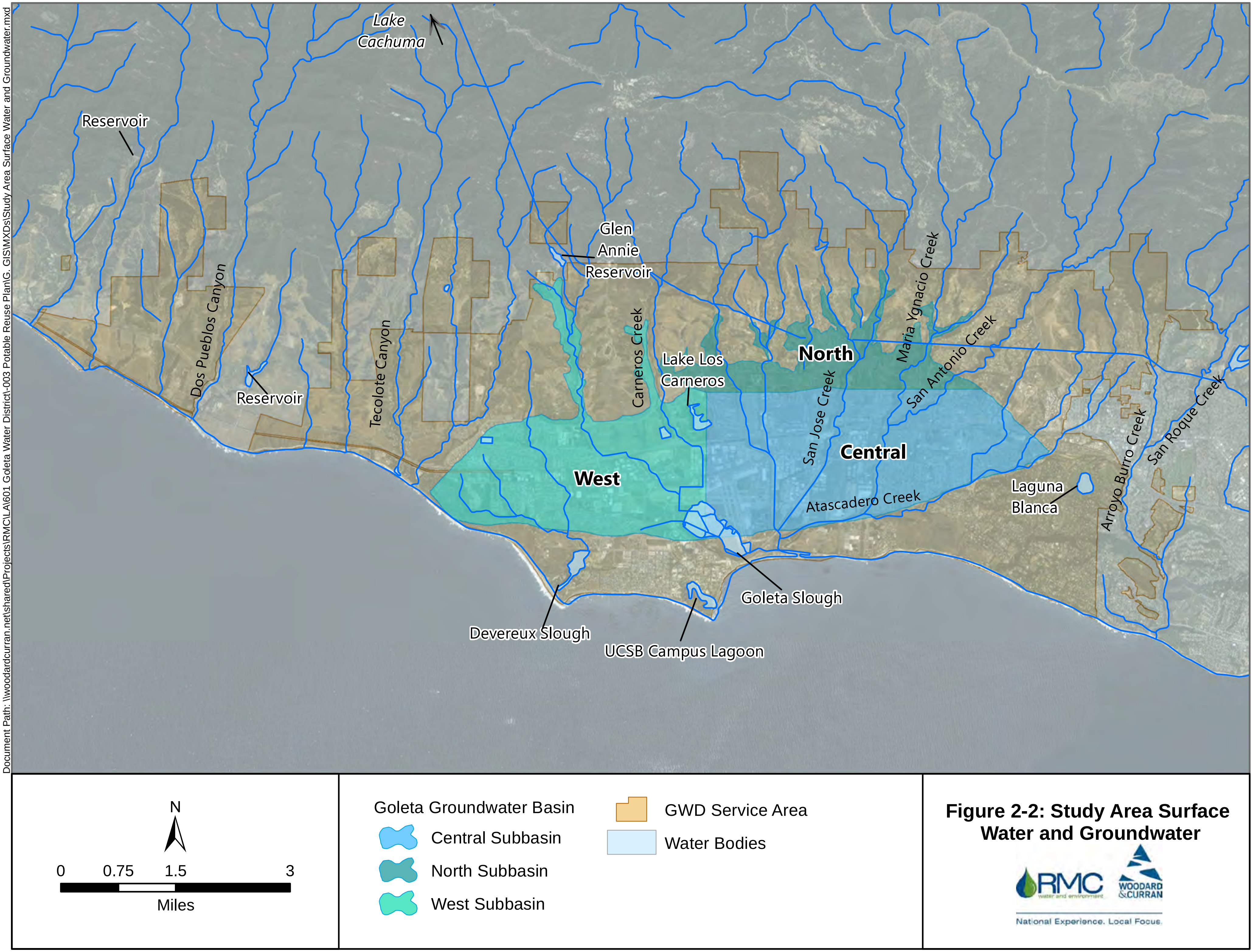

Figure 2-2: Study Area Surface Water and Groundwater

Recharge

In the Goleta Groundwater Basin, confining layers occur in the seaward portion of the basin, effectively eliminating recharge by percolation from surface supplies in this area (GWD, 2016). There is some disagreement as to how far confining layers extend from shore, but the consensus is that much of the Central Basin is likely under confined conditions (GWD, 2016). Instead, recharge from surface supplies enters into the largely unconfined North Basin and flows across the partial barrier into the Central Basin.

In addition to natural recharge, the Goleta Groundwater Basin receives artificial recharge through injection. First initiated in the 1970s, injection has taken place whenever Lake Cachuma spill water is available. From 2000 to 2011, GWD injected an average of 134 AFY of spill water from Lake Cachuma. Spill water has not been available for injection since 2011.

Groundwater Rights and Extraction

Groundwater rights in the North-Central Basin were adjudicated in the Wright Judgment in 1989. The judgement identified the safe yield of the North-Central Basin to be 3,410 AFY. GWD has a current adjudicated, appropriative right to extract and use up to 2,350 AFY of groundwater from the North-Central Basin. The West Basin is only partially adjudicated, and is considered separate from the adjudicated Central and North portions of the Goleta Basin in the Judgment. The Goleta Groundwater Basin was designated as a medium priority basin California Statewide Groundwater Elevation Monitoring[2]. Groundwater level data have been collected from wells in the Goleta Groundwater Basin since the 1940s.

2.1.3 Water Quality

Groundwater

GWD pumps groundwater from the Central subbasin of the Goleta Groundwater Basin. Overall, this water is of high quality. Historically, this groundwater has contained iron and manganese concentrations that did not meet federal and state secondary drinking water standards (GWD, 2016). An evaluation of water quality trends indicates that extracted groundwater with elevated iron and manganese concentrations continues to require treatment prior to delivery to customers. Chloride concentrations in the Central subbasin generally reached a maximum in the late 1980s and early 1990s, coinciding with a period of heavy groundwater pumping. Reduced pumping and injection of lower-chloride Cachuma water have resulted in decreased chloride levels in groundwater.

GWD treats groundwater for iron and manganese with oxidation via chlorination followed by filtration. Chlorination also provides a disinfectant residual that is required by federal and state regulations and helps maintain a safe drinking water supply throughout the distribution system. This treatment has proven sufficient to meet federal and state primary and secondary drinking water regulations.

Groundwater Contamination

There are a number of spills and leaks of contaminants at the ground surface overlying the Goleta Groundwater Basin. The spilled or leaked contaminants range from gasoline (most common) to dry cleaning fluid. The agency responsible for enforcing the cleanup of most of these sites is the Central Coast Regional Water Quality Control Board (Regional Board). The Regional Board tracks each of these sites, approves remediation plans, and eventually determines when the site has been remediated and the case is closed. For the roughly 143 sites in the Goleta-Santa Barbara area (SWRCB, 2016):

[2] California Department of Water Resources (DWR) implemented the California Statewide Groundwater Elevation Monitoring Program in response to legislation enacted in California's 2009 Comprehensive Water package. As part of the program and pursuant to the California Water Code (CWC §10933), DWR is required to prioritize California groundwater basins, so as to help identify, evaluate, and determine the need for additional groundwater level monitoring.

- 80% have been remediated and the cases are closed
- 4% are currently being remediated
- 8% are being assessed for remediation
- 8% are currently being monitored

These spills and leaks are primarily a potential problem for the aquifers in areas of the basin where there are no confining layers that separate the aquifers from the surface soils, and there is a higher risk of contaminants moving freely from the ground surface to the aquifer. These areas are located generally in the foothills to the north of the majority of the spills (GWD, 2016).

Surface Water

GWD's Corona del Mar Water Treatment Plant (CDM WTP) treats raw surface water from Lake Cachuma (a blend of Cachuma and State Water Project (SWP) water). The raw water which contains microbial and particulate matter, does not meet federal and state primary and secondary drinking water regulations. Treatment is required to remove these substances via coagulation, sedimentation, filtration, and disinfection via chlorination. Chlorination provides a disinfectant residual that is required by federal and state regulations, and it helps maintain a safe drinking water supply throughout the potable water distribution system. This multi-barrier treatment process has proven sufficient to meet federal and state primary and secondary drinking water standards. The quality of water from the Cachuma Project and SWP water conveyed through Lake Cachuma is not considered an impediment to water supply reliability.

The decline in water levels of Lake Cachuma coupled with the lack of inflow into the lake has increased the total organic carbon and the resultant potential for higher levels of trihalomethanes (THM) in treated surface water. GWD has developed and implemented adjustments to the treatment processes at the CDM WTP and its distribution system to reduce THM concentrations to acceptable levels.

2.1.4 Land Use

Land use in the GWD service area is shown in **Figure 2-3**. The primary land use within the District includes residential, commercial, and agricultural with some industrial and recreational properties. The majority of agricultural land lies outside of the City of Goleta limits.

2.1.5 Population Projections

GWD has an estimated current service area population of 85,000. Using population growth rate estimates for 2010 to 2040 developed by the Santa Barbara County Association of Governments (SBCAG), service area population was projected to 2040, as shown in **Table 2-1**. SBCAG determined two different growth rates that apply to GWD's service area, one for the City of Goleta (0.50%) and one for the unincorporated area surrounding Goleta and Santa Barbara (0.67%). The two growth rates were applied to their respective populations and then summed to determine the service area population for the years 2020 to 2040.

Table 2-1: Current and Projected Population

Population Served	2015	2020	2025	2030	2035	2040
Total Population Served	85,000	86,358	87,716	90,411	93,190	96,057

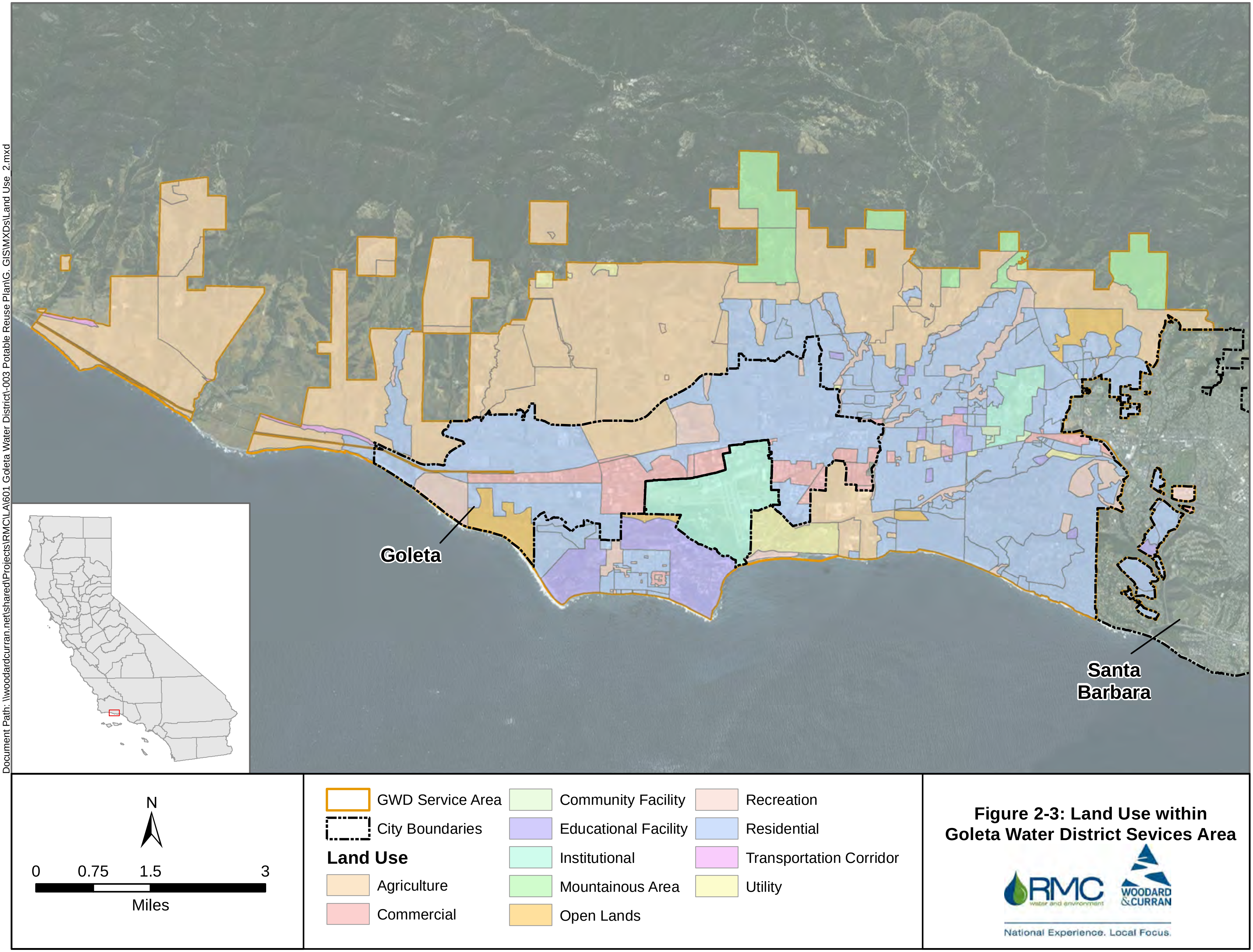

Figure 2-3: Land Use within Goleta Water District Sevices Area

2.2 Water Supply Characteristics and Facilities

2.2.1 Water Supplies

GWD's water supply portfolio consists of Cachuma Project water, State Water Project water, groundwater, and recycled water.

Cachuma Project

Under non-drought conditions, the majority of GWD's water supply is obtained from the Cachuma Project, which was constructed by the USBR on the Santa Ynez River in the early 1950's. The Cachuma Project consists of Bradbury Dam, Tecolote Tunnel, South Coast Conduit, Lake Cachuma, and various water conveyance facilities. Lake Cachuma has an estimated capacity of approximately 190,000 AF and is operated by the Cachuma Operation and Maintenance Board under contract with USBR. Cachuma Project water from Lake Cachuma is conveyed through the Tecolote Tunnel to the South Coast Conduit where it is delivered to the CDM WTP for treatment and use by GWD. When the level in Lake Cachuma rises to an elevation requiring discharge, the District may receive "spill water" in addition to its annual entitlement (9,322 AFY) without direct cost.

Historically, Cachuma Project water has been a reliable source of water. In the 1986-92 drought, Cachuma Project water deliveries were only reduced by 40% during the last year of the drought. During the current drought, Cachuma Project water deliveries were reduced by 55% and 100%, respectively, in water years 2014-2015 and 2015-2016. Given that Cachuma is normally GWD's principal source of supply, these reductions have had a significant effect on GWD's water supplies (GWD, 2017).

Over the past 20 years, circumstances surrounding the Cachuma Project have changed, including reduced reservoir capacity due to sedimentation, increased downstream releases required by the National Marine Fisheries Service under the 2000 Biological Opinion and implementation of the Settlement Agreement with downstream water rights interests. In addition, a draft revised Biological Opinion for Steelhead Trout is pending and the SWRCB recently issued its Draft Water Rights Order, providing further clarity on potential long-term reductions in Cachuma Project yield and potential effects on District entitlement. Given these changes, Santa Barbara County hydrologists are currently modeling the potential for new safe yields of the Cachuma Project in preparation for contract renewal negotiations ahead of 2020. While no currently published evidence supports a long-term reduction in Cachuma Project yield and reduction in entitlements, GWD is conservatively preparing to account for such potential reductions (GWD, 2017).

State Water Project

In 1991, customers within the GWD service area voted to purchase an annual water supply allotment of 4,500 AFY from the SWP. The SWP conveyance facilities to Lake Cachuma were completed in 1997 by the Central Coast Water Authority (CCWA). The CCWA is a California Joint Powers Agency formed by its nine public agency members, including GWD. CCWA was formed to construct the necessary facilities to deliver SWP to its members and now operates and maintains those facilities. SWP water deliveries through the CCWA system began in 1997. SWP supplies are commingled with Cachuma Project water in Lake Cachuma and are conveyed in the same manner as Lake Cachuma water to the CDM WTP for treatment and use by GWD.

Groundwater

The remainder of GWD's potable water supply consists of groundwater from the Goleta Groundwater Basin. GWD has a current adjudicated, appropriative right to extract and use up to 2,350 AFY of groundwater from the Basin under the terms of a court judgment, known as the Wright Judgment, that determined the relative rights to the groundwater in the Basin. The Wright Judgment provides GWD with the right to defer producing its annual groundwater entitlement and considers this water to be GWD stored water, which can be used during dry years, droughts, and emergencies.

The Wright Judgment also allows the District to inject treated water and claim it as the District's stored water, in addition to its annual entitlement. When Lake Cachuma spill water is available, the District uses that water for injection. The amount of water stored in the basin is reported annually by GWD.

The SAFE Water Supplies Ordinance (SAFE), approved by GWD voters in 1991 and amended in 1994, allows GWD to provide new service connections at a rate not to exceed one% of total potable water supply when certain conditions are met. SAFE directs how GWD manages groundwater and specifies under what conditions groundwater is either pumped or stored. In addition, SAFE established an Annual Storage Commitment – a groundwater recharge requirement when the Central subbasin of the Goleta Groundwater Basin drops below 1972 levels. The details of how both the Wright Judgment and SAFE affect groundwater use by GWD are contained in 2016 Groundwater Management Plan for the Goleta Groundwater Basin.

GWD currently has seven fully operational groundwater production wells located in the North and Central subbasins. Total well extraction and treatment capacity is presently about 500 AF per month. The same wells used for extracting groundwater can be used for injection. Until 2012, GWD had not pumped the majority of its Goleta Groundwater Basin rights under the judgement, which has resulted in significant carry over storage (over 45,000 AF as of 2015) within the Basin. Since 2012, GWD has increased groundwater production to offset the loss of surface and imported water. This has resulted in a drop in groundwater elevation below the 1972 benchmark, but groundwater modeling and monitoring indicate that the basin is not approaching historic lows. While some indicator wells demonstrate lower water levels in the Basin, others have not shown substantial drops in water levels.

Recycled Water

Recycled water is produced at the GSD WWTP and delivered to customers by the District’s dedicated recycled distribution system consisting of approximately 10 miles of pipelines, ranging in size from 2 inches to 18 inches in diameter. The largest recycled water users are UCSB and several golf courses. Approximately 1,100 AFY of recycled water is delivered to 35 customers, which are listed in Appendix A.

The existing recycled water system is discussed in detail in Section 2.4.

2.2.2 Water Supply Facilities

GWD’s potable water supply facilities are shown in **Figure 2-4**. The District’s distribution system includes over 270 miles of pipelines ranging in size from 2 inches to 42 inches in diameter. Water from Lake Cachuma and the SWP is treated at the CDM WTP which has a rated nominal capacity of 24 MGD and a peak capacity of 36 MGD. GWD maintains 8 reservoirs ranging in capacity from 0.3 million gallons (MG) to over 6 MG with a total combined capacity of approximately 21 MG. GWD currently has seven fully operational groundwater production wells with a total well extraction and treatment capacity of approximately 500 AF per month.

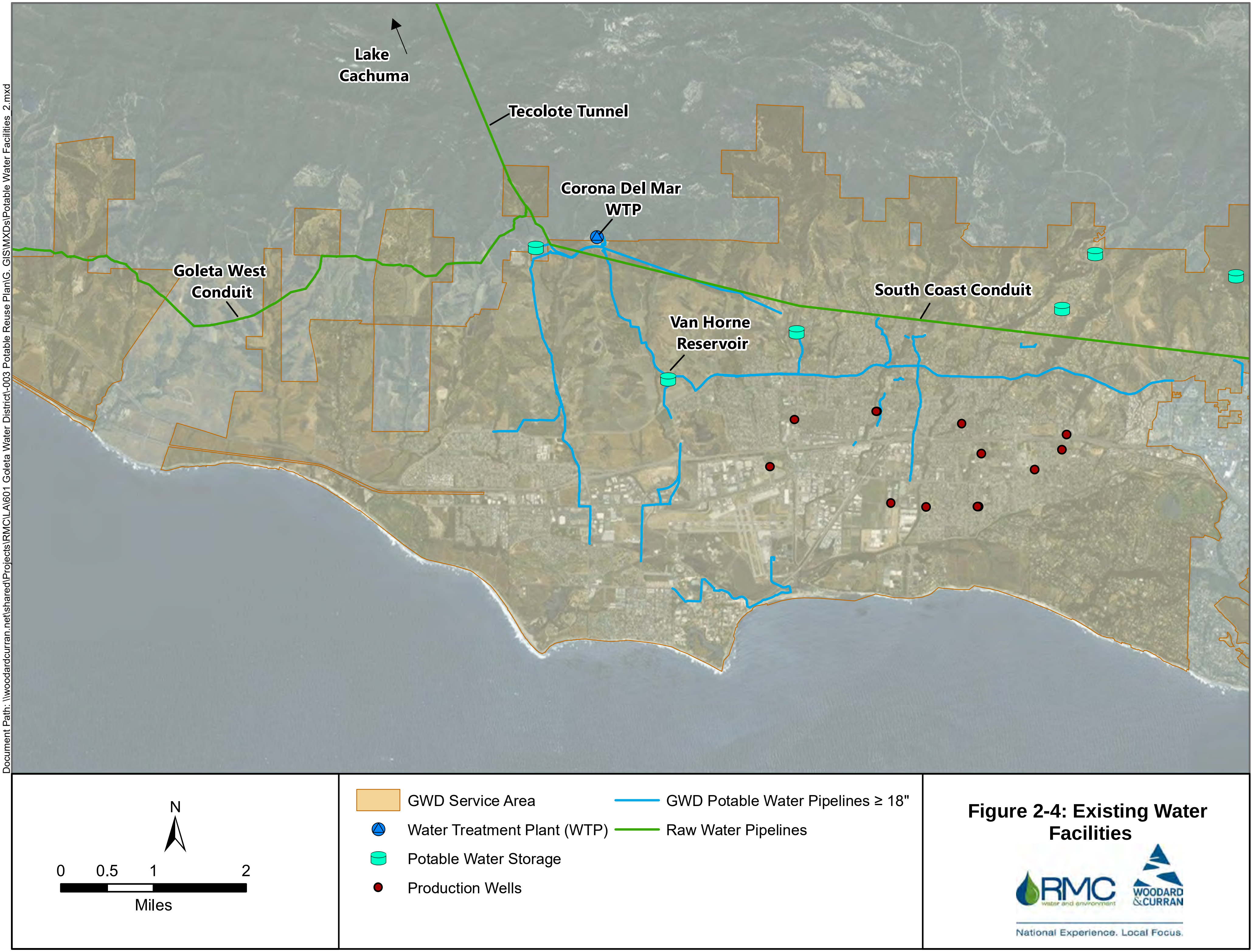

Figure 2-4: Existing Water Facilities

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2.2.3 Water Supply and Demand Projections

As part of the GWD's 2017 Water Supply Management Plan (WSMP) Update, water supplies in normal and dry year conditions were compared with water demand under current conditions and future (2035) conditions. Demand projections were developed as part of GWD's 2015 Urban Water Management Plan. The projections methodology used the average of the years 2011 to 2013 as a baseline since more recent years were subject to severe and extensive drought that resulted in significant demand reductions. Then, different projection methods were applied for each water use sector to determine future demand by sector – residential demand was estimated based on population growth estimates; commercial and institutional demands were estimated based on relevant planning documents; and landscape and agricultural irrigation were assumed to the stay the same.

Key supply projections assumptions include:

- **Cachuma Project:** Multiple dry year conditions assumed only 40% of the entitlement would be delivered and a range of scenarios were evaluated that assumed potential future reductions in Cachuma entitlements of 0%, 20%, 30%, and 40%.
- **State Water Project:** SWP projections were based on the Existing Conveyance High Outflow alternative in the DWR SWP Delivery Capability Report 2015, which is the most conservative alternative and results in average SWP reliability for the District of 39% (equates to an annual delivery of 2,905.5 AF under the District's 7,450 AF of contractual entitlement).
- **Groundwater:** The 2017 WSMP Update managed the groundwater basin within the constraints of the SAFE Ordinance with the perspective both from building an adequate drought buffer and from subsequent pumping of that drought buffer.

GWD's normal supplies (Cachuma Project entitlement, SWP Table A entitlement, groundwater right, and recycled water) can yield about 17,200 AFY with current infrastructure and entitlements, which exceeds demand projections. However, with the exception of recycled water, GWD's supplies are subject to reductions, particularly during droughts. GWD's supplies are likely not sufficient in the future to avoid significant and recurring demand reductions beyond regular conservation efforts.

The 2017 WSMP Update estimates that future supply shortfalls will occur during more than 50% of years without additional water supplies. In addition, potential future reductions in the Cachuma entitlement (currently 9,332 AFY) would reduce supplies and create larger shortfalls of several thousand AFY depending on the reduction.

Additional water supplies are required to reduce both the frequency and magnitude of the projected shortfalls. Purchasing supplemental imported water is the least expensive strategy; however, the quantity is limited by pipeline capacity so the additional water needed must be locally available (for example, Lake Cachuma, storm water capture, potable reuse). The 2017 WSMP Update estimates that 1,500 AFY of new, local supply is needed and that any potential future reductions in Cachuma entitlement would reduce supplies and create larger shortfalls. Potable reuse is an option to meet the new supply target and reduce both the frequency and magnitude of these shortfalls.

Table 2-2 and **Table 2-3** summarize supply projections for normal year, single dry year and multiple dry years for current supply / demand conditions and future (2035) supply / demand conditions, respectively. Normal supply is based on current infrastructure and entitlements and normal demand for recycled water. Dry year and multiple dry year supplies are based on the optimal water supply strategy identified in the 2017 WSMP Update.

Table 2-2: Water Supply / Demand Comparison, Current Conditions

Water Use	Normal Year	Single Dry Year	Multiple Dry Years
Cachuma Project (1)	9,811	9,322	3,884
State Water Project	1,942	2,427	3,380
Groundwater	1,160	1,923	5,751
Recycled Water	1,061	985	985
Total Supply	**13,974**	**14,657**	**14,000**
Demand Estimate	13,824	14,657	14,657
Surplus (Deficit)	**150**	**0**	**(657)** (2)

Source: 2017 Water Supply Management Plan Update
Notes:
1. Assumes no change to entitlement. The WSMP also evaluated scenarios where the entitlement is reduced.
2. Supply deficits would be addressed through additional conservation and/or supplemental water purchases.

Table 2-3: Water Supply / Demand Comparison, Future Conditions (2035)

Water Use	Normal Year	Single Dry Year	Multiple Dry Years
Cachuma Project (1)	9,849	9,322	3,884
State Water Project	2,828	3,197	1,519
Groundwater	2,449	3,839	7,022
Recycled Water	1,265	1,137	1,137
Supplemental Water			2,198
Total	**16,391**	**17,495**	**15,760**
Demand Estimate	16,391	17,495	17,640
Surplus (Deficit)	**0**	**0**	**(1,880)** (2)

Source: 2017 Water Supply Management Plan Update
Note:
1. Assumes no change to entitlement. The WSMP also evaluated scenarios where the entitlement is reduced.
2. Supply deficits would be addressed through additional conservation and/or supplemental water purchases.

2.2.4 Potable Water Rates

Potable water rates (effective July 1, 2016) for the District are summarized in **Table 2-4**. The District currently applies a drought surcharge to all potable water sales. Fixed monthly charges are also applied to individual services including meter and fire line charges.

Table 2-4: Potable Water Rates

Commodity Charges ($/HCF)	
Single Family Residential (First 6 HCF/Month)	$4.66
Single Family Residential (Next 10 HCF/Month)	$5.74
Single Family Residential (All additional HCF/Month)	$6.31
Urban and Recreational Irrigation	$5.41
Urban Agriculture	$1.86
Fixed Meter Charges / month	
5/8" & 3/4" Meters (based on individual month's water use)	
Ultra-Low Flow (6 HCF or less)	$14.57
Low Flow (7-16 HCF)	$30.08
All other 5/8" & 3/4" Meters	$45.74
1 – inch	$70.21
1 1/2 – inch	$131.40
2 – inch	$204.82
3 – inch	$437.32
4 – inch	$779.95
6 – inch	$1,722.21
8 – inch	$2,945.90
10 – inch	$4,659.09
Fire line	$9.73
Drought Surcharge (per HCF)	
Stage 3	$2.68

Source: http://www.goletawater.com/rates-bills-and-budget/water-rates-and-meter-charges/

2.3 Wastewater Characteristics and Facilities

2.3.1 Existing Facilities

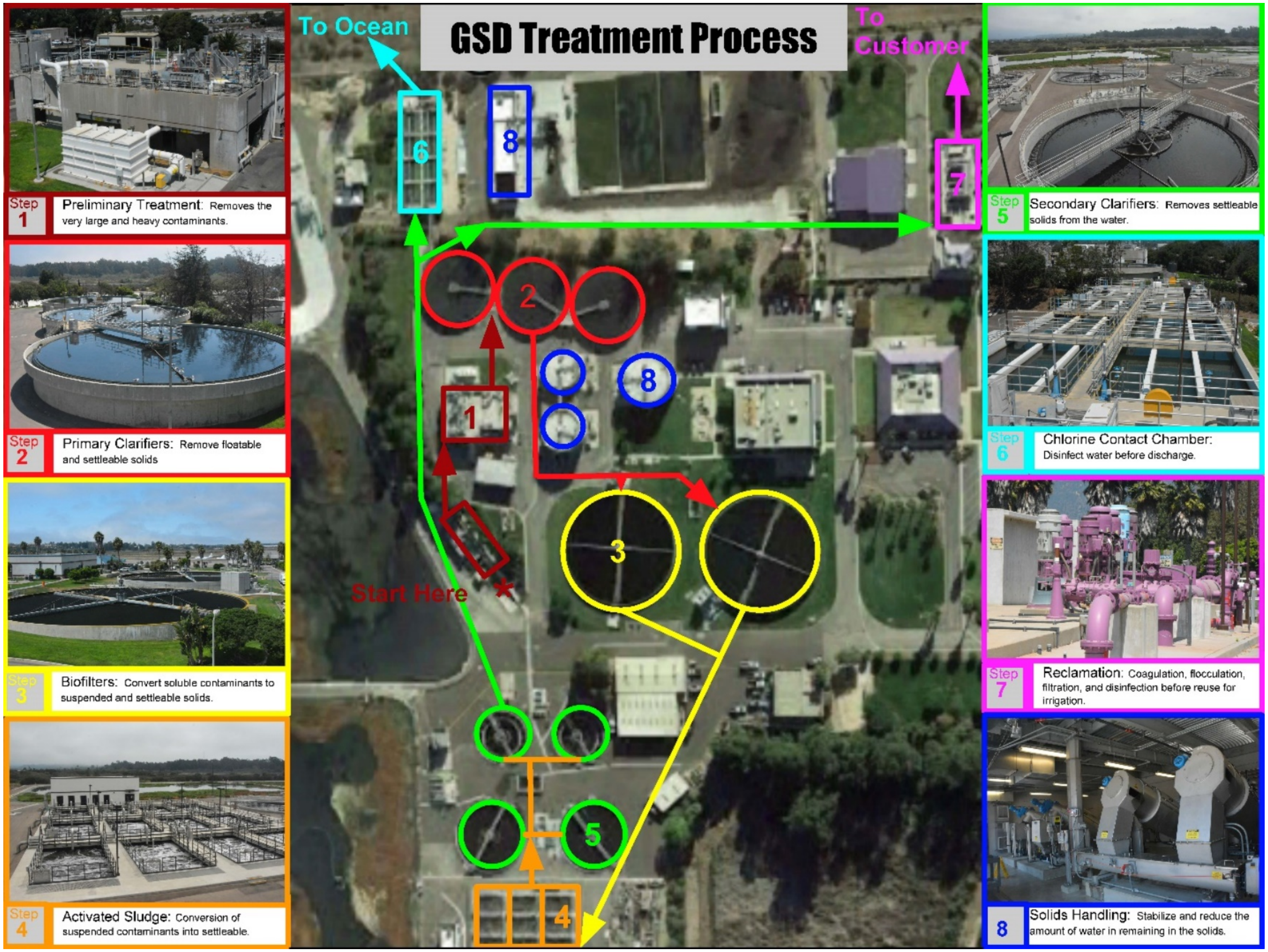
Both the Goleta West Sanitary District (GWSD) and GSD operate sanitary sewer collection systems within the GWD service area. Wastewater generated within the GWSD and the GSD flows almost entirely by gravity in over 190 miles of pipelines to the GSD Wastewater Treatment Plant (WWTP). The GSD WWTP is located adjacent to the Santa Barbara Airport, approximately 10 miles west of the City of Santa Barbara and near the Pacific Ocean. The facility is designed to treat a peak dry weather flow of 9 MGD.

The WWTP treatment process, shown in **Figure 2-5**, begins with bar screens to remove large debris and aerated grit tanks and two cyclone separators to remove grit and sand. Grit and debris is transported to the local landfill and air collected at the influent pump stations is scrubbed in activated carbon odor reduction towers. Wastewater then flows into three primary clarifiers and on to secondary treatment. Secondary treatment includes biofilters, an aeration basin, and secondary sedimentation tanks. GSD completed the installation of secondary treatment at the wastewater treatment plant in 2013 and has provided full secondary treatment to its effluent discharge since then.

A portion of the effluent from this process is sent to the water reclamation facilities for tertiary treatment, which consists of flash mixing tanks, flocculation tanks, anthracite filters, a chlorine contact tank, and storage tanks. The remainder is treated with sodium hypochlorite for disinfection and then dechlorinated with sodium bisulfite prior to ocean discharge.

From 2011 to 2015, WWTP influent flows averaged 4.7 MGD while an average of 3.7 MGD of treated effluent was discharged through the ocean outfall. The primary difference between the influent and effluent flows is due to non-potable reuse, which is discussed in Section 2.4. Average flows during 2015 fell to 4.25 MGD as a result of aggressive water conservation implemented due to the California drought.

Figure 2-5: Goleta Wastewater Treatment Plant Schematic



Source: http://www.goletasanitary.org/images/GSD%20Process%20Schematic.pdf

Wastewater influent flows decrease in the summer due to a lower college student population and increase slightly in the winter due to inflow and infiltration, as shown in **Figure 2-6**. The diurnal influent curve for the GSD WWTP, shown in **Figure 2-6,** is typical for a municipal WWTP.

Figure 2-6: Monthly Influent Flows to GSD WWTP (2011-2015)

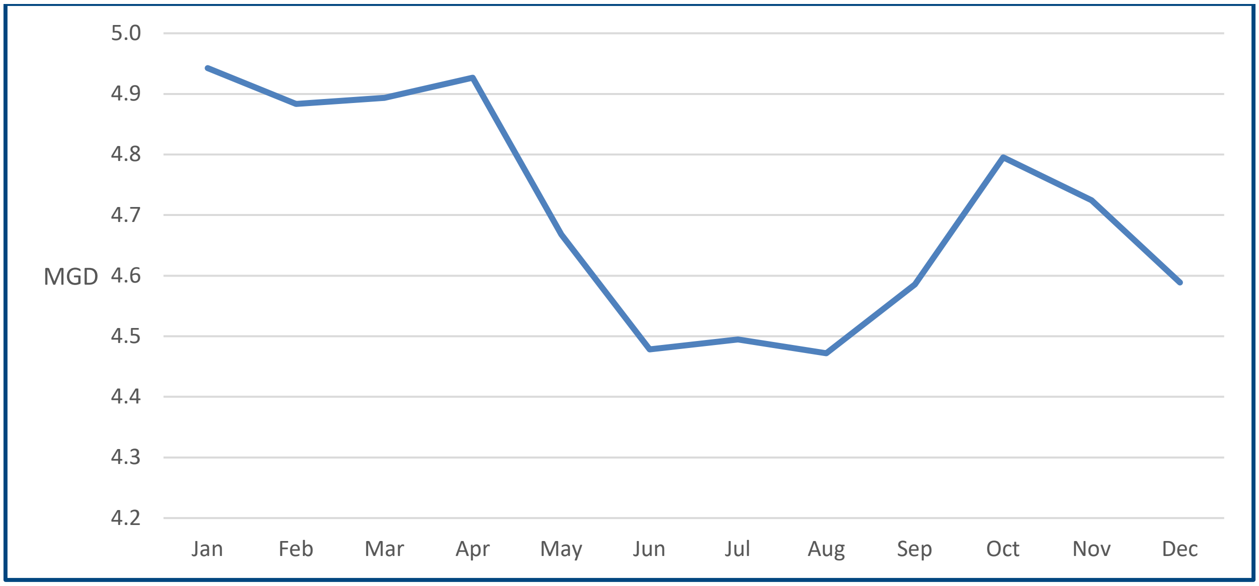
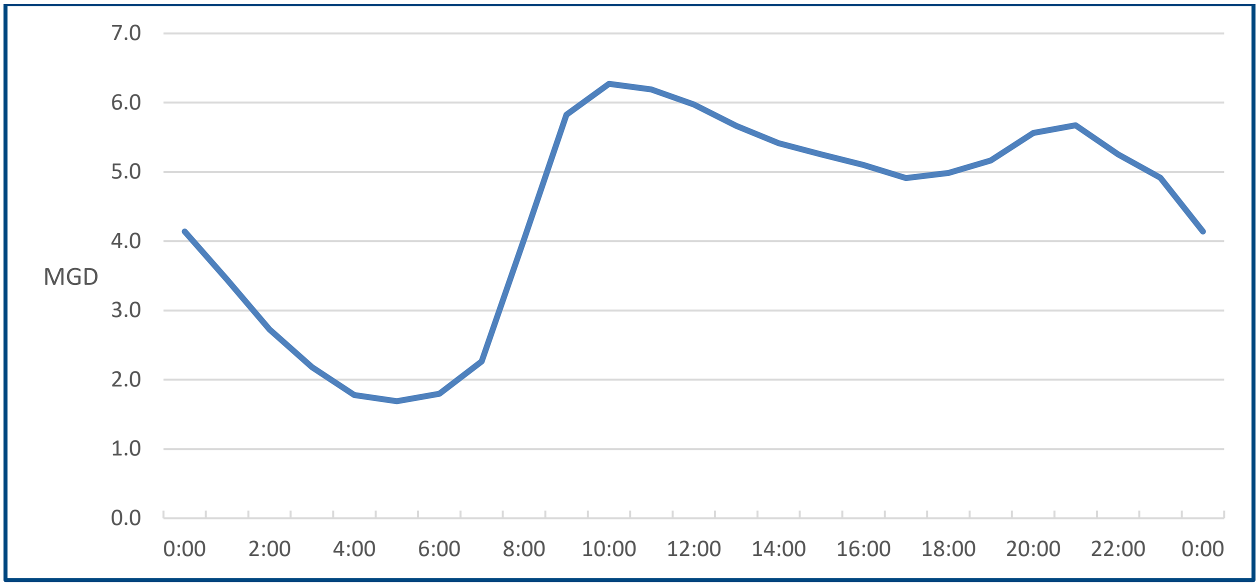


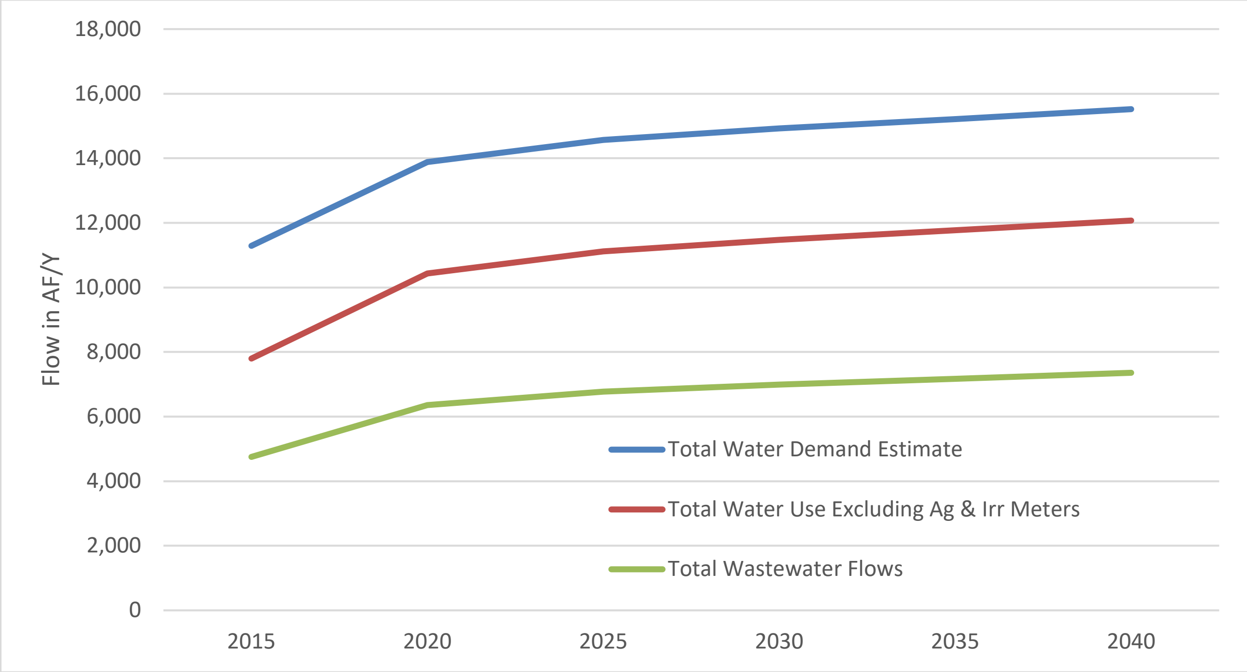
Figure 2-7: Diurnal Influent Flows to GSD WWTP



2.3.2 Wastewater Flow Projections

The projected influent flows to the WWTP through 2040 are shown in **Figure 2-7**. The projections were developed for this Facilities Plan by removing agriculture and irrigation meters from the potable water demand projections presented in **Figure 2-8** and applying a factor of 60% of remaining potable water for flows to the WWTP. The factor was based on the percentage of potable water use excluding agriculture and irrigation meters in 2015 that were measured as flows at the WWTP and represents indoor uses of potable water. Overall, total effluent is projected to increase from 4,750 AFY (4.25 MGD) today to 7,360 AFY (6.6 MGD) in 2040.

Figure 2-8: GSD WWTP Flow Projections Basis



2.3.3 Wastewater Discharge Requirements

GSD currently operates its WWTP under NPDES Permit No. CA0048160, Order No. R3-2010-0012 for discharges through an ocean outfall. The permit became effective on September 1, 2010 and was administratively extended after the GSD filed a Report of Waste Discharge on March 5, 2015. A new NPDES permit is anticipated to be issued within the next year.

GSD discharges treated wastewater from the WWTP to the Pacific Ocean. Existing and anticipated beneficial uses of the ocean waters in the vicinity of the discharge include industrial water supply, water contact and non-water contact recreation, navigation, commercial and sport fishing, mariculture, preservation of rare and endangered species, migration of aquatic organisms, fish spawning, marine habitat, and shellfish harvesting.

The NPDES permit contains two kinds of effluent limitations: technology-based effluent limitations and water quality-based effluent limitations. The permit’s technology-based effluent limitations include restrictions on biochemical oxygen demand (BOD), total suspended solids (TSS), settleable solids, turbidity, oil & grease, and pH. The limits for oil & grease, settleable solids, turbidity, and pH are based on Table 2 of the Water Quality Control Plan for the Central Coastal Basin. GSD expects that the current Permit limits for BOD and TSS, which are based on the District’s 301(h) waiver, will be replaced by the federal secondary treatment standards found in Title 40 of the Code of Federal Regulations, Part 133, which specifies a 30-day average of 30 mg/L and 7-day average of 45 mg/L. In addition to effluent limitations, the permit also contains receiving water limitations for bacteria, dissolved oxygen, pH, and other constituents that are based on the California Ocean Plan.

2.3.4 Effluent Rights

California Water Code Section 1210 states that the WWTP owner shall hold the exclusive right to the treated wastewater as against anyone who has supplied the water discharged into the waste water collection and treatment system, including a person using water under a water service contract, unless otherwise provided by agreement. The agreement between GWD and GSD to construction and operate the existing recycled water system[3] includes an option for GWD to acquire the right to receive all or part of the wastewater produced by the GSD WWTP in the future in addition to the current entitlement of 3.0 MGD.

To protect downstream water rights, California Water Code Section 1211 requires that before making a change in the point of discharge, place of use, or purpose of use of treated wastewater, the WWTP owner must seek approval from the SWRCB Division of Water Rights. However, this does not apply to ocean discharges.

2.4 Recycled Water System

2.4.1 Existing Facilities

Recycled water service in the Goleta Valley began in 1994 in response to drought conditions of the early 1990s and the Wright Judgement and resulting limitations on GWD groundwater pumping.

The tertiary treatment system consists of flash mixing tanks, flocculation tanks, anthracite filters, a chlorine contact tank, and storage tanks. The District's existing recycled water system, shown in **Figure 2-8**, includes 3.0 MG of recycled water storage at the GSD WWTP, which represents approximately two days of peak summer day demand, adjacent to the recycled water pump station at GSD WWTP as well as approximately 9.7 miles of distribution pipelines ranging from 6-inch diameter to 18-inch diameter pipe.

The on-site storage tanks allow for steady, efficient system operations regardless of daily fluctuations in recycled water demand. The existing recycled water system can produce up to 3.0 MGD (approximately 3,300 AFY) of tertiary effluent for reuse. However, the ability to fully use recycled water is limited by irrigation demand patterns, which are typically condensed into an 8-hour period rather than a 24-hour period; reuse is also limited by recycled water delivery capacity.

2.4.2 Recycled Water Rate

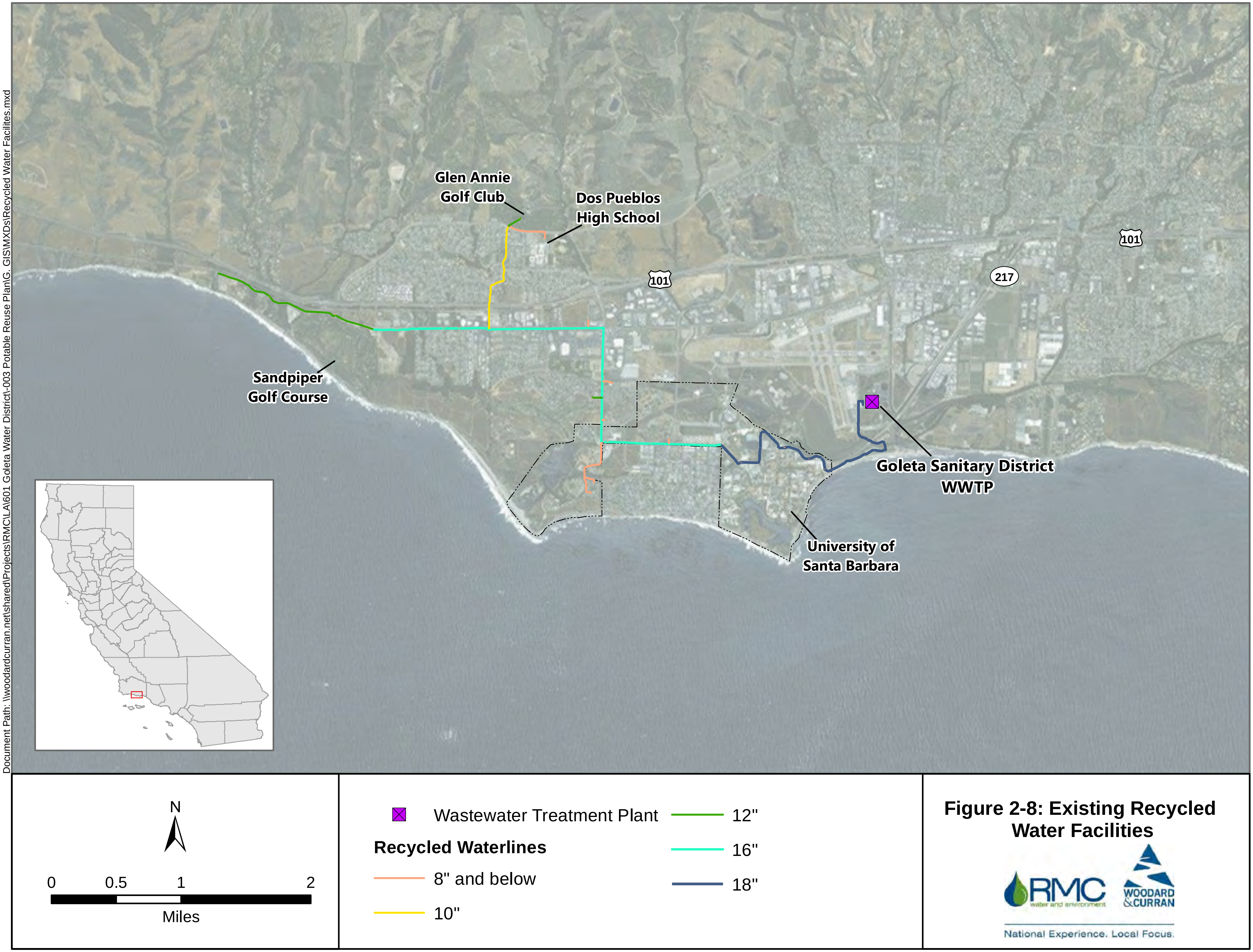
The current recycled water rate is $3.36/hcf, representing a 37% discount over the urban and recreational irrigation rate ($5.41/hcf). When the drought surcharge is added under a Stage III Water Shortage, recycled water is 58% cheaper than potable water. Fixed meter charges are the same, regardless of the water used.

2.4.3 Recycled Water Demand and Availability

Currently, GWD delivers approximately 1,100 AFY of recycled water for landscape irrigation uses as well as a minor amount for toilet flushing. Over the last 20 years, the amount of recycled water produced and delivered has remained relatively constant, with some variation due to rainfall. In years when the Goleta Valley receives higher than normal rainfall, demand for recycled water is low.

Based on known recycled water projects, demand for recycled water is expected to increase by approximately 130 AFY by 2030. Recycled water service inquiries from potential customers have significantly increased during the recent drought period; however, most are not economically viable to extend service, as discussed further in Section 2.5.1. **Table 2-5** presents projections of potential recycled water use by sector through 2040.

[3] "Agreement for Construction and Operation of Goleta Sanitary District / Goleta Water District Wastewater Reclamation Project" dated October 15, 1990



Wastewater Treatment Plant

Recycled Waterlines

8" and below	12"
10"	16"
	18"

Figure 2-8: Existing Recycled Water Facilities

National Experience. Local Focus.

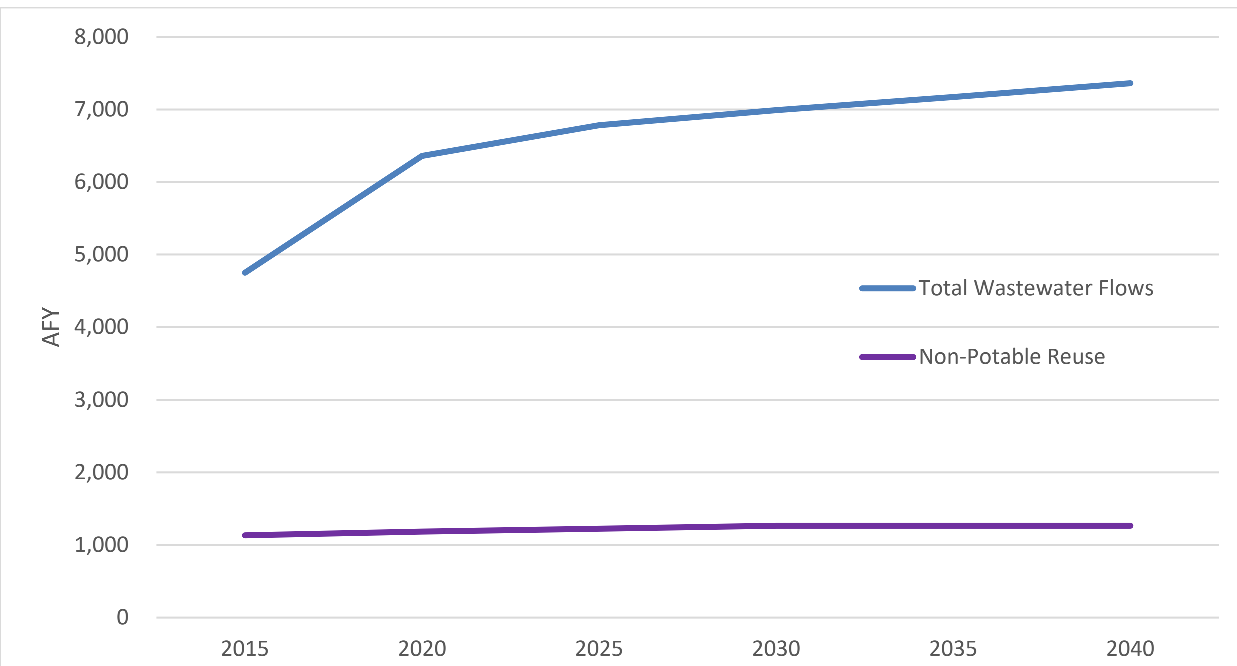
Table 2-5: Current and Projected Recycled Water Demand

Use Type	2015 (Actual)	2020	2025	2030	2035	2040
Landscape Irrigation (excludes golf courses)	494	540	580	620	620	620
Golf Course Irrigation	634	630	630	630	630	630
Toilet Flushing/ Cooling Towers	5	15	15	15	15	15
Total	**1,133**	**1,185**	**1,225**	**1,265**	**1,265**	**1,265**

Source: 2015 Urban Water Management Plan
Note: List of existing customers is in Appendix A.

As shown in **Figure 2-9**, current and projected GSD WWTP effluent flows far exceed current and projected recycled water demand. Total effluent is projected to increase from 4,750 AFY (4.25 MGD) today to 7,360 AFY (6.6 MGD) in 2040. Total available effluent after accounting for non-potable reuse is projected to increase from 3,620 AFY (3.2 MGD) today to 6,090 AFY (5.45 MGD) in 2040.

Figure 2-10: Recycled Water Supply Projections



2.4.4 Recycled Water Quality

The quality of the recycled water produced by GSD is monitored in accordance with their permit and summarized in their annual report. The water quality data for 2015 is shown in **Table 2-6**.

Table 2-6: Tertiary Effluent (Recycled Water) Quality (Average for 2015)

Turbidity		pH	Total Coliform	Chlorine Residual		TDS
Daily Max.	Daily Avg.			Min.	Max.	
NTU	NTU	S.U.	MPN/100ml	mg/l	mg/l	mg/l
0.6	0.3	6.9	1.3	8.5	13.2	1,293

Source: GSD 2015 Water Reclamation Annual Report

2.5 Sources of Additional Water Supplies

GWD plans to meet most new water demand through increased conservation and is exploring recycled water options as a strategy for meeting existing demand due to increasing unreliability of its surface water supplies and the related potential for water shortages in drought years. If a recycled water project is not implemented, GWD has limited opportunities to expand existing water supplies:

- Groundwater: GWD has adjudicated groundwater rights and long-term pumping above this amount (once storage is accounted for) would violate the Wright Judgement.
- Cachuma Project: The project is fully subscribed and yield has been decreasing due to reservoir siltation and increased requirements for environmental releases. Additional yield from the project is not a viable option.
- State Water Project: The District has existing rights; however, high supply variability, high water rights acquisition costs, delivery constraints, and projected delivery cost increases make further rights acquisition undesirable.

The 2017 WSMP Update identified that additional water supplies would likely be required to reduce both the frequency and magnitude of the projected supply shortfalls. Purchasing supplemental imported water is the least expensive strategy (roughly $500/AF based on recent purchases; though the cost will vary each year); however, the quantity is limited by SWP pipeline capacity so additional supply must be local. In addition to potable reuse, potential new water supplies include:

- Non-potable system expansion
- Stormwater capture

These two potential sources are discussed further in this section. In addition, GWD will continue to place a strong focus on demand management and achieving permanent conservation to meet future demand.

2.5.1 Non-Potable System Expansion

GWD has been serving recycled water since 1994. The recycled water production capacity is approximately 3,300 AFY (3.0 MGD). However, the ability to fully utilize recycled water is limited by recycled water use patterns, which are typically condensed into 8-hour periods and are driven by the irrigation season. While operational storage is available to address daily needs, seasonal storage is not available (or economically feasible) to address seasonal variability in irrigation demand.

GWD's existing recycled water system has a high need for maintenance and replacement of pipes and facilities due to the age of the system and corrosive soil conditions. GWD has identified several projects that are necessary to maintain and upgrade their current system. The 2015-2020 Infrastructure Improvement Plan (IIP) includes four recycled water system "critical need" projects that total $0.25 million and six projects "for future consideration" that total $9.2 million. The critical need projects are:

- Goleta Sanitary RW Pump Replacement
- Hollister Booster Station Pump Replacements
- RW Booster Station Process and Control Upgrades

- Hollister Booster Station Electrical Upgrades

The future consideration projects are:

- Recycled Water Hollister Booster Station Relocation Project
- Recycled Water 1 MG Reservoir Project
- RW Hollister Booster Station Pump Rebuild Project
- Recycled Waterline Preventative Maintenance Program
- Recycled Waterline in Fairview Road – Hollister Avenue
- Recycled Waterline at Goleta Beach
- Recycled Waterline Extensions

GWD has evaluated expansion of the existing recycled water system; however, further expansion was determined to be uneconomical, as discussed below.

The South Coast Recycled Water Development Plan (RMC, 2013) identified potential near-term and long-term recycled water customers. Near-term potential recycled water customers were identified as potential irrigation customers located near the existing recycled water distribution system that have expressed an interest to GWD in using recycled water. Seven potential near-term customers, with a total average annual demand of 27 AFY, were identified and have since been connected to the recycled water system.

Long-term potential recycled water customers are located farther away from the existing recycled water distribution system and require more effort and higher costs to convert to recycled water. In total, 33 potential long-term customers, with a total demand of 93 AFY, were identified. Six projects were defined to serve these potential customers and had a total capital cost $11.5 million. In general, the long-term projects' costs relative to their low yields – which translates to roughly $6,000/AF - indicate that the non-potable system is reaching diminishing returns on further investment and, therefore, are not currently planned for implementation.

Agricultural Reuse

The Goleta area has a large agricultural market, a portion of which could potentially utilize recycled water. However, there are obstacles to using recycled water for agricultural irrigation. Avocados and citrus are the dominant crops in the Goleta area, and these are sensitive to dissolved minerals found in recycled water. Avocados are extremely sensitive to total dissolved solids (TDS) requiring water with TDS of less than 500 mg/L. Currently the recycled water system produces water with TDS of approximately 1,250 mg/l. Delivery of recycled water to agriculture would require additional and perhaps costly advanced (reverse osmosis) treatment.

In addition, the cost of the recycled water would have to be subsidized these users as they currently rely on cheaper water sources. Therefore, agricultural reuse was not considered further at this time.

2.5.2 Stormwater Capture

GWD commenced work on developing a Stormwater Resources Plan (SRP) within the District service area in 2016. Due to recent legislation, preparation of an SRP is a precondition of receiving grant funds for stormwater and dry weather runoff capture projects. Specific to the District's service area, the SRP will quantify maximum stormwater capture potential to increase the beneficial use of stormwater as a water supply. It will focus on development of identified feasible centralized (i.e. spreading grounds, recharge basins) stormwater capture sites. GWD is currently analyzing various sites throughout the District for stormwater capture opportunities, including review of land use and geophysical properties, to determine where obstacles to infiltration exist and where infiltration and capture would be most desirable. A key part of the SRP planning effort is the identification of obstacles that hinder infiltration opportunities at particular sites, such as contaminant plumes, environmentally sensitive habitat, Superfund sites, dewatering permits, and heavy industrial land uses within the District. Areas of the District with these obstacles are unlikely to yield economically feasible projects.

GWD is also using available storm drain atlases to identify publicly owned parcels proximate to storm drains to help quantify the potential volume of stormwater that can be captured from particular concept projects. While the District will also explore stormwater capture potential from smaller scale projects such as curb cuts and permeable pavers, such smaller projects are not within the scope of this SRP due to the fact that the SRP is designed to identify options that will yield the most future supply and bring forth larger-scale, grant-eligible projects.

Supplies from potential stormwater projects may further enhance the GWD supply portfolio; however, as of the time this Facilities Plan was prepared, the estimated yield and cost of potential stormwater capture projects were not defined.

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Chapter 3 Regulatory, Permitting, and Legal Requirements

This chapter identifies the existing regulatory, permitting, and legal requirements for implementing recycled water projects, which entail non-potable reuse (e.g., landscape irrigation) and groundwater replenishment. Other potable reuse options, which currently do not have regulations, are discussed in Chapter 4. This chapter is organized into the following sections:

- Overview
- State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) regulations
- SWRCB policies
- Regional Water Quality Control Board (RWQCB) requirements
- Permitting recycled water projects

3.1 Overview

The SWRCB was created in 1967 to protect water resources throughout California by setting and enforcing statewide policies. Within the SWRCB, DDW regulates public drinking water systems and oversees water recycling projects. Regional Water Quality Control Boards (Regional Boards) oversee surface water, groundwater, and coastal waters.

The SWRCB divides the state into branches and regions to address local differences in climate, topography, geology and hydrology. The DDW consists of two Field Operations Branches (FOBs) which are further broken down into regions. Drinking water and recycled water in GWD’s service area are regulated by Region IV of DDW’s Southern FOB, which covers the counties of Los Angeles, Ventura, Santa Barbara, and San Luis Obispo. Surface water, groundwater, and coastal waters within GWD’s service area are regulated by the Central Coast RWQCB.

State statutes and regulations pertaining to the use of recycled water in California can be found in the California Water Code (CWC), California Code of Regulations (CCR), and California Health and Safety Code (H&SC). Water Quality Control Plans, which are prepared by each RWQCB, may also contain the recycled water use policy of individual region. **Table 3-1** provides a summary of key California statues for the protection of water quality and public health. A complete compendium of applicable statutes is available on the DDW website.

Table 3-1: Key California Statutes for Protection of Water Quality and Public Health

Code	Purpose
Water Rights	
CWC section 1210-1212	Requires that prior to making any change in the point of discharge, place of use, or purpose of treated wastewater, approval must be obtained from the SWRCB. New SWRCB guidance has clarified that a wastewater petition for change only needs to be filed with the SWRCB Division of Water Rights if the owner of the wastewater treatment plant decreases the amount of water in a stream or other waterway.
Recycled Water Definitions	
CWC sections 13050, 13512, 13576, 13577, 13350, and 13552-13554	Recycled water is defined in the CWC as water, which as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and therefore considered a valuable resource.
CWC sections 13561	Defines direct potable reuse and indirect potable reuse for GWR.
Water Quality	
CWC section 13170	Authorizes the SWRCB to adopt State policies for water quality control.

Code	Purpose
CWC sections 13240-42	Authorizes RWQCB to adopt Water Quality Control Plans (Basin Plans) that assign beneficial uses for surface waters and groundwaters, and contain numeric and narrative water quality objectives that must provide reasonable protection of the beneficial uses of the groundwater. One of the factors that must be considered when establishing water quality objectives is the need to develop and use recycled water. Basin Plans must include a program of implementation for achieving the water quality objectives. For the proposed project, the Los Angeles RWQCB's Basin Plan applies.
H&SC sections 116270 et seq.	This is the California Safe Drinking Water Act that authorizes primary and secondary maximum contaminant levels (MCLs) as included in the California Code of Regulations, Title 17 – Public Health, Chapter 5, Subchapter 1, Group 4 – Drinking Water Supplies, sections 7583 through 7630.
H&SC section 116455	Requires public water systems to take certain actions if drinking water exceeds Notification Levels (NLs). NLs are health-based advisory levels established by the DDW for chemicals in drinking water that lack MCLs. When chemicals are found at concentrations greater than their NLs, certain requirements and recommendations apply.
Recycled Water Permits	
CWC sections 13260, 13263, 13269, 13523.1	Dischargers proposing to discharge waste that could affect the quality of waters of the state must file a report of waste discharge (ROWD) to the RWQCB. After receiving this report, the RWQCB can issue specific or general Waste Discharge Requirements (WDRs) and/or Water Recycling Requirements (WRRs) that reasonably protect all beneficial uses and that implement any relevant water quality control plans and policies. The RWQCB can also issue a Master Reclamation Permit, which is a WDR that covers multiple non-potable reuse applications and requires periodic site inspections and adoption of rules and regulations for recycled water use. A RWQCB may require a discharger to provide monitoring program reports or conduct studies.
CWC section 13552.5	Authorizes the SWRCB to adopt General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water to streamline tertiary disinfected recycled water use. The General Permit was adopted in 2009; in 2014 the SWRCB adopted a new General Permit that supersedes the 2009 permit and covers all non-potable reuse applications.
H&SC section 116271	Effective July 1, 2014 transfers the CDPH Drinking Water Program to the SWRCB, including water reclamation and direct and indirect potable reuse; creates the Deputy Director of the new SWRCB DDW.
CWC section 13528.5	Effective July 1, 2014, the SWRCB may carry out the duties and authority granted to a RWQCB pursuant to Chapter 7 of the CWC (Water Reclamation sections 13500 – 13557, which include issuing potable reuse permits).
Recycled Water Regulations	
CWC sections 13500-13529.4; H&SC 116800 et seq.	Requires DDW to establish uniform statewide recycling criteria. DDW has developed these criteria for non-potable reuse and GWR and they are codified in Title 22 of the California Code of Regulations; regulations for cross connections are codified in Title 17.
CCR Title 17 and Title 22	DDW's regulations related to recycled water. Title 17 requires the protection of water systems through the use of backflow preventers. Title 22 contains criteria for recycled water quality based on usage, requirements for dual plumbed recycled water systems, and requirements for Groundwater Replenishment Reuse Projects (GRRPs) that qualify as indirect potable reuse via surface and subsurface application, including Nitrogen Compounds Control, Diluent Water, Recycled Water Contribution (RWC), Total Organic Carbon (TOC) and Soil-Aquifer Treatment (SAT), and Response Retention Times (RRT), including tracer studies.
CWC section 13540	Prohibits the use of any waste well that extends into a water-bearing stratum that is, or could be, used as a water supply for domestic purposes; injection wells or vadose zone wells used for recharge are part of this category (injection wells or vadose zone wells are considered waste wells under the CWC). An exception can be provided if (1) the RWQCB finds that water quality considerations do not preclude controlled recharge by direct injection, and (2) DDW finds, following a public hearing, that the proposed recharge will not degrade groundwater quality as a source of domestic

Code	Purpose
	water supply. This section of the CWC also allows DDW to make and enforce regulations pertaining to replenishment of recycled water using injection wells.
CWC sections 13522.5 and 13523	Requires any person who proposes to recycle or to use recycled water to file an Engineering Report with the RWQCB on the proposed use. After receiving the report, and consulting with and receiving recommendations from DDW, and any necessary evidentiary hearing, the RWQCB must issue a permit (WDRs and/or WRRs) for the use.
CWC sections 13562-13563	Requires DDW to adopt uniform water recycling criteria for GWR by June 30, 2014 as emergency regulations, and for surface water augmentation by December 31, 2016; and requires DDW to investigate the feasibility of developing criteria for direct potable reuse and to provide a final report on that investigation to the Legislature by December 31, 2016. By February 14, 2015, DDW must convene an expert panel to advise DDW on water recycling criteria for surface water augmentation and the feasibility of direct potable reuse.

3.2 DDW Regulations

Applicable DDW recycled water regulations are presented in the following sections:

- Non-potable reuse regulations
- Groundwater recharge regulations

3.2.1 Non-Potable Reuse Regulations

DDW sets forth water recycling criteria, including water quality standards, treatment process requirements, operational requirements, and treatment reliability requirements as part of the California Code of Regulations Title 22, Division 4, Chapter 3, Article 7 (Title 22). Recycled water meeting Title 22 disinfected tertiary treated requirements for unrestricted reuse can be used for the greatest variety of uses, including:

- Irrigation of golf courses, cemeteries, freeway landscaping, parks, playgrounds, school yards, and common area landscaping.
- Agricultural irrigation
- Process feedwater, such as industrial or commercial cooling or boilers
- Flushing toilets and urinals
- Groundwater recharge via surface spreading (Refer to Section 3.2.2 for further information).

GWD currently delivers Title 22 disinfected tertiary recycled water for landscape irrigation and toilet flushing.

3.2.2 Groundwater Recharge Regulations

The CWC defines groundwater recharge (GWR) as the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system. Since 1976, the California Department of Public Health (CDPH) issued numerous draft versions of more detailed GWR regulations that served as guidance for the seven permitted GWR projects in California. Final GWR regulations were adopted and went into effect June 18, 2014. The GWR regulations are organized by type of project: Surface application (surface spreading); and Subsurface application (injection or vadose zone wells). The key provisions of the GWR regulations are presented in **Table 3-2** for both surface and subsurface application projects.

Table 3-2: Title 22 Groundwater Replenishment Regulations

<table>
<tr><th></th><th>Surface Application</th><th>Subsurface Application</th></tr>
<tr><td>Source Control</td><td colspan="2">Must administer a comprehensive source control program to prevent undesirable chemicals from entering raw wastewater. The source control program must include: (1) an assessment of the fate of DDW and RWQCB-specified contaminants through the wastewater and recycled water treatment systems; (2) provisions for contaminant source investigations and contaminant monitoring that focus on DDW and RWQCB-specified contaminants; (3) an outreach program to industrial, commercial, and residential communities; and (4) an up-to-date inventory of contaminants.

Note: If the agency that administers the source control program is different than the agency producing or distributing the recycled water, DDW will require an agreement between the agencies to ensure the source control requirements are met.</td></tr>
<tr><td>Boundaries Restricting Construction of Drinking Water Wells</td><td colspan="2">Must establish (1) a “zone of controlled potable well construction,” which represents the greatest of the horizontal and vertical distances reflecting the retention times required for pathogen control or for response retention time; and (2) a “secondary boundary” representing a zone of potential controlled potable well construction that may be beyond the zone of controlled potable well construction thereby requiring additional study.

Note: Since it is not fully understood how the secondary boundary will be established, it is typically negotiated with DDW; this requirement may lead to more restrictions on well development and required studies and more impacts in areas with numerous production wells and/or the desire to develop new wells to capture recharge water.</td></tr>
<tr><td>Emergency Response Plan</td><td colspan="2">Must develop and be willing to implement a DDW-approved plan for an alternative source of potable water supply or treatment at a drinking water well if a GWR project causes the well to no longer be safe for drinking purposes.</td></tr>
<tr><td>Adequate Managerial and Technical Capability</td><td colspan="2">Must demonstrate adequate managerial and technical capability to comply with the regulations.

Note: DDW has indicated that project sponsors can use the drinking water Technical Managerial and Financial Assessment to demonstrate compliance with this requirement.</td></tr>
<tr><td>Pathogen Control</td><td>▪ Must meet Title 22 disinfected tertiary effluent requirements.
▪ The treatment system must achieve a 12-log enteric virus reduction, a 10-log Giardia cyst reduction, and a 10-log Cryptosporidium oocyst reduction using at least 3 treatment barriers.
▪ For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than 1.0-log reduction.
▪ Retention time[1] credit for virus of 1-log/month (up to 6-logs) can be counted; the retention time must be validated by an added or intrinsic tracer approved by DDW.

Giardia/Cryptosporidium Credit: If a project meets meet Title 22 disinfected tertiary effluent requirements <u>or</u> provides advanced treatment for the entire flow, <u>and</u> 6 months’ retention underground, a project will be credited with 10-log Giardia cyst reduction and 10-log Cryptosporidium oocyst reduction.

Note: Meeting Title 22 450 CT disinfected tertiary requirements does not guarantee a 5-log virus reduction credit; will require project sponsors to have further discussion or demonstration with DDW.</td><td>▪ The treatment system must achieve a 12-log enteric virus reduction, a 10-log Giardia cyst reduction, and a 10-log Cryptosporidium oocyst reduction using at least 3 treatment barriers.
▪ For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than 1.0-log reduction.
▪ Retention time[1] credit for virus of 1-log/month; must be validated by an added or intrinsic tracer approved by DDW.</td></tr>
<tr><td>Nitrogen (N) Control</td><td colspan="2">Total N must be less than 10 mg/L as N in recycled water or recharge water before or after application.

Note: The nitrogen requirements will be more stringent based on the RWQCB Basin Plan groundwater objectives.</td></tr>
</table>

<table>
<tr><th></th><th>Surface Application</th><th>Subsurface Application</th></tr>
<tr><td>Regulated Chemicals Control</td><td colspan="2">Recycled Water: Must meet all primary Maximum Contaminant Levels (MCLs), with the exception of nitrogen compounds; for disinfection byproducts, for surface application projects, compliance can be determined in the recycled water or the recharge water before or after surface application and for subsurface application projects in the recycled water or recharge water; for secondary MCLs, compliance can be determined in recycled water or recharge water.

Diluent Water: Must meet primary and secondary MCLs based on upper limit if not historically used for recharge (except for secondary MCLs for color, turbidity, and odor).

Note: For surface spreading projects, compliance with other secondary MCLs for some types of diluent water could be an issue in establishing credit; it may be possible to receive approval for compliance after surface application under the Alternatives Section, which would address this issue.</td></tr>
<tr><td>Notification Level (NL)</td><td colspan="2">Recycled Water: Regulatory action to be taken if NL is exceeded in the recycled water or recharge water after application (excluding the effects of dilution), including additional monitoring.

Diluent Water: Must ensure that diluent water does not exceed NL and have a plan in place prior to the operation of a project on actions to be taken if exceeded; diluent water must meet NLs.

Note: With regard to implementation, DDW has noted that the evaluation of NLs can occur in recharge water (after SAT); and the regulatory language is purposefully flexible in determining credits as part of a monitoring plan proposed by the project sponsor. A chronic exceedance of an NL would be an issue for establishing diluent water credit, while an occasional exceedance would not be an issue.</td></tr>
<tr><td>Total Organic Carbon (TOC)</td><td>Surface application: TOC_{max} = 0.5 mg/L ÷ RWC in undiluted recycled water prior to application or within the zone of percolation, diluted percolated recycled water with the value adjusted to negate diluent water, or the undiluted recycled water prior to application amended using a SAT factor.

Note: For surface application projects, treatment must consider the level of TOC to be achieved or a TOC alternative approved by DDW.</td><td>Recycled water TOC = 0.5 mg/L.

Note: All recycled water must undergo advanced treatment – see advanced treatment criteria.</td></tr>
<tr><td>Initial Recycled Municipal Wastewater Contribution (RWC)</td><td>▪ Up to 20% unless an alternative initial RWC is approved by DDW based on: (1) the review of the engineering report, (2) information obtained as a result of the public hearing, and (3) the project sponsor demonstrates that the treatment processes preceding SAT can reliably achieve a TOC 20-week running average no greater than 0.5 mg/L.
▪ The RWC averaging period is 120 months.
▪ TOC is sampled in undiluted recycled water after treatment or undiluted recycled water in the “zone of percolation.”

Note: A surface spreading project must start at a 20% RWC unless DDW has approved a higher RWC and advanced treatment is provided to meet a TOC concentration of 0.5 mg/L.</td><td>▪ To be determined by DDW (does not preclude starting at 100%).
▪ The RWC averaging period is 120 months.

Note: A subsurface application project has the possibility of starting at a 100% RWC if approved by DDW.</td></tr>
<tr><td>Increased Recycled Municipal Wastewater Contribution (RWC)</td><td>For projects starting at lower initial RWCs, sequential incremental increases ≥ 50% and ≥ 75% are allowed if:
▪ The TOC 20-week average for prior 52 weeks = 0.5 mg/L ÷ $RWC_{proposed\ max}$.
▪ The increase is approved by DDW and authorized in the project permit.</td><td>Increases allowed if:
▪ The TOC 20-week average for prior 52 weeks = 0.5 mg/L.
▪ The increase is approved by DDW and authorized in the project permit.</td></tr>
<tr><td>Advanced Treatment Criteria</td><td colspan="2">Reverse Osmosis:
▪ Each membrane element must achieve a minimum sodium chloride (NaCl) rejection ≥ 99.0% and an average (nominal) NaCl rejection ≥ 99.2% using ASTM Method D4194-03 (2008), using the following substitute test conditions: (1) tests are operated at a recovery ≥ 15%; (2) NaCl rejection is based on 3 or more successive measurements; (3) influent pH between 6.5 and 8.0; and (4) influent NaCl concentration ≤ 2,000 mg/L.
▪ During the 20 weeks of full-scale operation, the membrane produces a permeate having no more than 5% of the sample results having TOC > 0.25 mg/L based on weekly monitoring.</td></tr>
</table>

	Surface Application	Subsurface Application
	Advanced Oxidation Process: Two options: ▪ Option 1 - Conduct an occurrence study that identifies 9 indicators representing 9 functional groups, with 0.5-log removals for 7 of the indicators and 0.3-log removals for 2 of the indicators; establish at least one surrogate or operational parameter that reflects the removal of at least 5 of the 9 indicators (one of the surrogates must be monitored continuously); confirm the results using a study via challenge or spiking tests. ▪ Option 2 - Conduct testing that includes challenge or spiking tests to demonstrate that the AOP process removes 0.5-log of 1,4-dioxane; establish surrogate or operational parameters that reflect whether the 0.5-log reduction of 1,4-dioxane is attained, and one of the surrogates can be monitored continuously.	
Application of Advanced Treatment	Advanced treatment is only needed for that portion of recycled water needed to meet the TOC/RWC requirements desired by the project sponsor.	Advanced treatment must be applied to the full recycled water volume.
Soil Aquifer Treatment (SAT) Performance / CEC Monitoring	▪ Monitor recycled water or recharge water before and after recharge for 3 indicator constituents of emerging concern (CECs) with reductions < 90% triggering investigation. If a project sponsor demonstrates there are not 3 indicator compounds available and suitable for indicating a 90% reduction, a project sponsor may utilize an indicator compound that achieves a reduction less than 90% pending DDW approval of the compound and reduction criteria. ▪ Project sponsors must conduct a DDW approved CEC occurrence study prior to operation and then every 5 years.	None.
Response Retention Time (RRT)	▪ RRT is the time recycled water must be retained underground to identify treatment failure and implement actions so that inadequately treated recycled water does not enter a potable water system, including the plan to provide an alternative water supply or treatment. ▪ The minimum RRT is 2 months, but must be justified by the project sponsor. ▪ The RRT must be validated using an added tracer or a DDW approved intrinsic tracer.	
Project Planning	**Method used to estimate the retention time to the nearest downgradient drinking water well**	**Virus Log Reduction Credit per Month**
	Tracer study using added tracer[1]	1.0 log
	Tracer study utilizing an intrinsic tracer[1]	0.67 log
	Numerical modeling consisting of calibrated finite element or finite difference models using validated and verified computer codes used for simulating groundwater flow	0.50 log
	Analytical modeling using existing academically-accepted equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions	0.25 log
	Method used to estimate Retention Time to the nearest downgradient drinking water well	**Response Time Credit per Month**
	Tracer study using added tracer[2]	1 month
	Tracer study utilizing an intrinsic tracer[2]	0.67 months
	Numerical modeling consisting of calibrated finite element or finite difference models using validated and verified computer codes used for simulating groundwater flow.	0.5 months
	Analytical modeling using existing academically-accepted equations such as Darcy's Law to estimate groundwater flow conditions based on simplifying aquifer assumptions.	0.25 months
Alternatives	Allowed for all provisions in the regulations if: ▪ The project sponsor has demonstrated that the alternative provides the same level of public health protection. ▪ The alternative has been approved by DDW. ▪ If required by DDW or RWQCB, the project sponsor will conduct a public hearing. ▪ An expert panel must review the alternative unless otherwise specified by DDW.	
Engineering Report	The project sponsor must submit an Engineering Report to DDW and RWQCB that indicates how a GWR project will comply with all regulations and includes a contingency plan to ensure	

	Surface Application	Subsurface Application
	that no untreated or inadequately treated water will be used. The report must be approved by DDW.	

Notes:

1. The retention time represents the difference from when the water with the tracer is applied at the GRRP to when either 2% of the initially introduced tracer concentration has reached the downgradient monitoring point, or 10% of the peak tracer unit value is observed at the downgradient monitoring point. With DDW approval, an intrinsic tracer may be used in lieu of an added tracer with no more credit provided than 0.67-log per month.
2. The retention time shall be the time representing the difference from when the water with the tracer is applied at the GRRP to when either; two% (2%) of the initially introduced tracer concentration has reached the downgradient monitoring point, or ten% (10%) of the peak tracer unit value observed at the downgradient monitoring point reaches the monitoring point.

Some of the key issues that must be addressed include the following:

- Minimum treatment
- Recycled water contribution
- Underground retention time

Minimum Treatment

The minimum treatment requirements are substantively different depending on the type of application. For surface spreading, the minimum treatment is disinfected tertiary recycled water and nitrogen removal that produces a total nitrogen concentration less than 10 mg/L. For injection, the minimum treatment is reverse osmosis (RO) and advanced oxidation applied to the full volume of water recharged – a treatment combination referred to as “advanced water treatment”.

Recycled Water Contribution

The recycled water contribution (RWC) is defined as the portion recycled water applied at the GWR project after accounting for credited dilution water [Recycled Water / (Recycled Water + Diluent Water)]. The RWC is calculated initially after 30 months of project operations and as a rolling average over 120 months thereafter. It is determined as a function of total organic carbon (TOC) concentration in the recycled water. For surface spreading projects, an initial RWC of 20% (or 4:1) is applied unless an alternative RWC is approved based on additional treatment prior to recharge or through soil aquifer treatment (SAT)[4]. Application of RO to all effluent would ultimately eliminate the need for any dilution water while application of RO to a portion of the effluent could decrease the dilution requirement by removing more TOC. Also, monitoring of TOC removal can be used to demonstrate SAT proficiency and can allow for an increased maximum RWC. RWC scenarios are summarized in **Table 3-3**.

[4] SAT describes the natural attenuation of contaminants as water travels through the vadose zone and then underground. Removal mechanisms include photolysis (by the sun while in the recharge basin), biodegradation, and adsorption onto soil particles. SAT is effective at removing viruses, bacteria, TOC, nutrients, and contaminants of concern to various degrees. Removal is site specific and column studies must be conducted to obtain accurate estimates of potential performance.

Table 3-3: Recycled Water Contribution / Diluent Water Requirements

GWR Method	Surface Spreading		Well Injection	
Treatment Level	Initial RWC	Ultimate RWC	Initial RWC	Ultimate RWC
Tertiary Only	20% (1)	20% to 50% (1)	N/A	N/A
Partial RO	20% to 50%(1)	50% to 75% (1)	N/A	N/A
AWT	100%	100%	100%	100%

RWC = Recycled Water Contribution = Portion that recycled water makes up of total recharge

1. Initial RWC is dependent on TOC concentration in recycled water and ultimate RWC is dependent on TOC concentration after soil aquifer treatment. The process to justify an increase of the RWC over time is outlined in the GWR regulations and would be included in the GWR permit.

Retention Time

The regulations include two requirements that relate to retention time: 1) Pathogen control; and 2) Response retention time (RRT). For pathogen control for surface spreading projects, the recycled water must meet Title 22 disinfected tertiary effluent requirements. The treatment system must achieve a 12-log enteric virus reduction, 10- log Giardia cyst reduction, and 10-log Cryptosporidium oocyst reduction using at least 3 treatment barriers. For each pathogen, a separate treatment process can only be credited up to a 6-log reduction and at least 3 processes must each achieve no less than a 1.0-log reduction. Log removal credit is allowed for virus (only) of 1-log/month of retention time.

RRT is the time recycled water must be retained underground to identify any treatment failure and implement actions so that inadequately treated recycled water does not enter a potable water system, including the time to provide an alternative water supply or treatment. The minimum RRT is 2 months, and it must be justified by the project sponsor(s). For planning purposes, RRT is assumed to be 6 months.

The largest of the retention times required (Pathogen Control or RRT) is used to establish the zone within which drinking water wells cannot be constructed (this effectively establishes a boundary between potable and non-potable use of the groundwater basin).

For planning purposes, the regulations allow use of groundwater modeling to estimate residence times for project facility siting. A project sponsor must validate retention time using an added or intrinsic tracer within the first three months of operation.

3.3 State Water Resources Control Board Policies

Two types of policies have particular importance with respect to recycled water projects for protection of water quality and human health:

- Anti-degradation Policies
- Recycled Water Policy

3.3.1 Anti-degradation Policies

California's anti-degradation policies are found in Resolution 68-16, Policy with Respect to Maintaining Higher Quality Waters in California and Resolution 88-63, Sources of Drinking Water Policy. These resolutions are binding on all State agencies. They apply to both surface water and groundwater, protect both existing and potential uses, and are incorporated into RWQCB Basin Plans.

3.3.2 Recycled Water Policy

The Recycled Water Policy was adopted by the SWRCB in 2009 and amended in 2013. The Policy was a critical step in creating uniformity in how RWQCBs were individually interpreting and implementing

Resolution 68-16 for water recycling projects. The critical provisions in the Policy related to landscape irrigation and GWR projects include:

- Development of Salt and Nutrient Management Plans (SNMP)
- Requirements for landscape irrigation projects
- RWQCB GWR requirements
- Anti-degradation and assimilative capacity
- CECs

Salt and Nutrient Management Plans

The Recycled Water Policy requires the development of SNMPs for every groundwater basin/sub-basin by May 2014 (May 2016 with a RWQCB-approved extension). The SNMP must identify salt and nutrient sources, identify basin/sub-basin assimilative capacity and loading estimates (including estimates for GWR and landscape irrigation projects that use recycled water), and evaluate the fate and transport of salts and nutrients. The SNMP must include implementation measures to manage salt and nutrient loadings in the basin on a sustainable basis as well as an anti-degradation analysis demonstrating that all recycling projects identified in the plan will collectively satisfy the requirements of Resolution No. 68-16. The SNMP must also include an appropriate cost-effective network of monitoring locations to determine whether salts, nutrients, and other constituents (as identified in the SNMPs) are consistent with applicable water quality objectives.

In 2016, GWD developed an SNMP for the Goleta Groundwater Basin as part of the Groundwater Management Plan. The SNMP has been submitted to and accepted by the Central Coast RWQCB.

RWQCB Groundwater Requirements

The Recycled Water Policy does not limit the authority of a RWQCB to include more stringent requirements for GWR projects to protect designated beneficial uses of groundwater, provided that any proposed limitations for the protection of public health may only be imposed following consultation with DDW. In addition, the Recycled Water Policy does not limit the authority of a RWQCB to impose additional requirements for a proposed GWR project that has a substantial adverse effect on the fate and transport of a contaminant plume (for example, those caused by industrial contamination or gas stations), or changes the geochemistry of an aquifer thereby causing the dissolution of naturally occurring constituents, such as arsenic, from the geologic formation into groundwater.

Anti-degradation and Assimilative Capacity

Assimilative capacity is typically defined as the difference between the ambient groundwater concentration and the concomitant groundwater quality objective. In accordance with the Recycled Water Policy, two assimilative capacity thresholds were established for GWR projects in light of the type of assimilative capacity that must be conducted. A GWR project that uses less than 10% of the available assimilative capacity in a groundwater basin/sub-basin (or multiple projects utilizing less than 20% of the available assimilative capacity in a groundwater basin/sub-basin) must conduct an anti-degradation analysis verifying the use of the assimilative capacity. In the event that a project or multiple projects utilize more than the designated fractions of assimilative capacity (e.g., 10% or 20%), the project proponent must conduct a RWQCB-deemed acceptable anti-degradation analysis. Some SNMPs use these assimilative capacity values as thresholds for evaluating impacts of salt and nutrient loadings and implementation measures.

A landscape irrigation project that meets the Recycled Water Policy streamlining criteria, and which is also within a groundwater basin with an approved SNMP, may be approved by a RWQCB without further anti-degradation analysis if the project is consistent with the SNMP. A landscape irrigation project that meets the streamlining criteria, which is within a groundwater basin preparing an SNMP, may be approved by a RWQCB by using a salt/nutrient mass balance or equivalent analysis to demonstrate that the project uses less than 10% of the available assimilative capacity or less than 20% of the available assimilative capacity for multiple projects.

CECs

As part of the Recycled Water Policy, a Science Advisory Panel was formed to identify a list of CECs (e.g., endocrine disrupters, personal care products, or pharmaceuticals) for monitoring in recycled water used for GWR and landscape irrigation. The Panel recommended monitoring selected health-based and treatment performance indicator CECs and surrogates for GWR projects. The Panel concluded that CEC monitoring was unnecessary for landscape irrigation. The GWR monitoring recommendations were directed at surface spreading using tertiary recycled water and injection projects using advanced water treatment. The purpose of monitoring performance indicator CECs and surrogates is to assess the effectiveness of unit processes to remove CECs.

The Recycled Water Policy was amended in 2013 to include the CEC monitoring program. The Amendment provides the final list of specific CECs and monitoring frequencies for GWR projects and procedures for both evaluating the data and responding to the results. These requirements will be incorporated into the permits for existing GWR projects and will be included as requirements for all future projects. As part of the 2014 GWR regulations, additional CEC requirements and monitoring locations must be met in addition to the Recycled Water Policy requirements. The next update of CEC monitoring by a SWRCB expert panel will occur in 2017-2018.

3.4 Central Coast RWQCB Requirements

The Central Coast RWQCB is responsible for regulating water discharges to surface water and groundwater, which are subject to State water quality regulations and statutes. The Central Coast RWQCB provides local implementation of SWRCB policies and regulations and develops and implements the 2016 Water Quality Control Plan for the Central Coastal Basin (Basin Plan) to protect surface water and groundwater quality and beneficial uses. The Basin Plan identifies groundwater objectives for the Goleta Groundwater Basin that are intended to serve as a water quality baseline for evaluating water quality management in the basin. The median values for groundwater objectives are shown in **Table 3-4**.

Table 3-4: Goleta Groundwater Basin Median Groundwater Objectives (mg/L)

TDS	Chloride	Sulfate	Boron	Sodium	Nitrogen
1000	150	250	0.2	150	5 (as N)

Source: Water Quality Control Plan for the Central Coast Basin (Central Coast RWQCB, 2016), Table 3-8
Note: Objectives shown are median values based on data averages; objectives are based on preservation of existing quality or water quality enhancement believed attainable following control of point sources.

A GWR project will need to consider the assimilative capacity of the groundwater basin for specific constituents to conform to the State Anti-Degradation Policy (Resolution 68-16), SWRCB 2009 Recycled Water Policy, and local SNMP.

3.5 Permitting Recycled Water Projects

The process for permitting non-potable and groundwater projects is described in this section. Chapter 4 discusses potential regulations and permitting other types of potable reuse projects.

3.5.1 SWRCB General Permit

The Water Reclamation Requirements for Recycled Water Use (General Order), adopted on June 7, 2016, replaced the existing statewide Waste Discharge Requirements for Recycled Water Use (2014-0090-DWQ) and established standard conditions for recycled water for non-potable uses such as landscape irrigation, crop irrigation, dust control, industrial/commercial cooling, decorative fountains, etc. Potable reuse activities are not authorized under the General Order.

To obtain coverage under the General Order, an applicant must have an approved Engineering Report and submit a Notice of Intent to the RWQCB within its jurisdiction. Producers, distributors, or users of recycled water covered under existing permits may elect to continue or expand coverage under the existing permits or apply for coverage under the General Order.

3.5.2 Individual Non-Potable Reuse Project Permits

The DDW, as part of the SWRCB, has the statutory authority to issue WDRs and WRRs. Under the current permitting framework where the RWQCB issues the WDR/WRR permit project sponsors are required to submit an Engineering Report to DDW and RWQCB, as well as a Report of Waste Discharge to the RWQCB. In issuing the permit, the RWQCB is required to consult with DDW. Any reclamation requirements included in a permit must conform to Title 22. The RWQCBs have the option of issuing a Master Reclamation Permit in lieu of individual WRRs for a project involving multiple uses. The master permit can be issued to a recycled water supplier or distributor, or both.

3.5.3 Groundwater Recharge Projects

The process for project approval and permitting of GWR projects is similar to individual non-potable reuse project permits; however, the Engineering Report prepared for DDW has a more prominent role in review and approval of the project. The RWQCB would issue the permit based on requirements consistent with the GWR Regulations, Basin Plans, SNMPs, and State policies. The type of permit (WDR and/or WRR) issued depends on how and where the recycled water is “discharged”.

A recent example of the process is the Pure Water Monterey Advanced Water Purification Project, which applies advanced treatment technologies to wastewater prior to recharge of the local groundwater basin via injection wells. In January 2016, the Central Coast RWQCB approved a WDR/WRR for the project, which is first GWR project approved under the 2014 GWR regulations.

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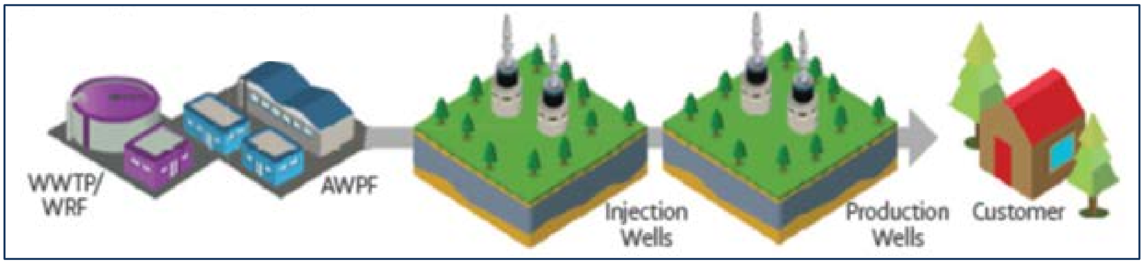
Chapter 4 Potable Reuse Background

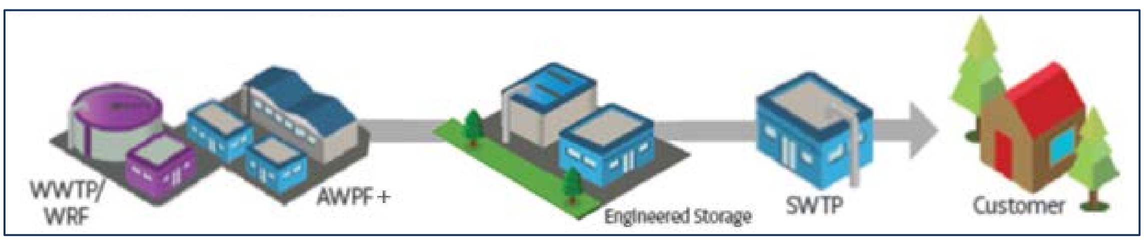
There are two types of potable reuse: Indirect Potable Reuse (IPR) and Direct Potable Reuse (DPR). IPR involves the blending of recycled water in a groundwater basin or surface water reservoir where it mixes with water *prior to* treatment and delivery. DPR removes the environmental barrier (e.g., groundwater basin or surface water reservoir) and involves delivering purified recycled water directly into a potable water system or raw water system upstream of a water treatment plant. See Section 4.2 of this Plan for further discussion. The range of potable reuse[5] concepts can be further grouped into four general categories:

Groundwater Augmentation (GWA) (IPR): Purified water percolated or injected into the groundwater basin

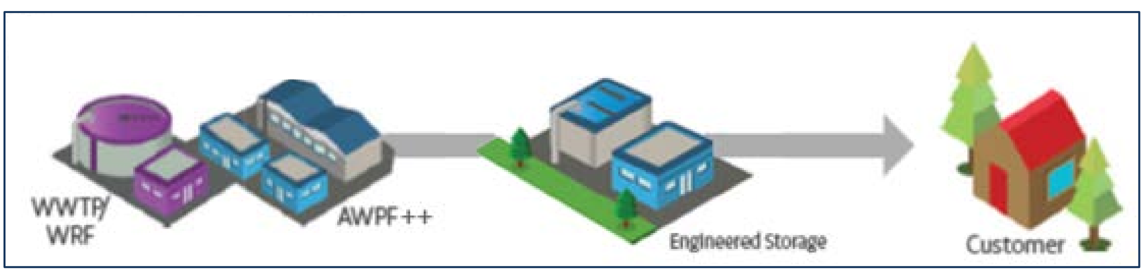


Reservoir Augmentation (RA) (IPR): Purified water discharged to a reservoir with a combination of minimum detention time and dilution required prior to treatment at a conventional surface water treatment plant.

Raw Water Augmentation (RWA) (DPR): Purified water introduced directly to a surface water treatment plant.



Treated Water Augmentation (TWA) (DPR): Finished drinking water, which also meets the requirements of the Surface Water Treatment Rule, introduced directly to the potable water distribution system.



[5] Common terminology for potable reuse concepts is included in Appendix B.

DDW has established regulations for groundwater augmentation and is expected to issues regulations for reservoir augmentation in 2017 but has only recently begun investigating raw water augmentation and treated water augmentation. Raw and treated water augmentation remove the environmental barrier, such as the groundwater basin, between the recycled water and potable water use so these project types focus on engineered measures to replace the environmental barrier, such as:

- More robust treatment barriers
- Additional treatment barriers (redundancy)
- Enhanced monitoring for chemicals, pathogens, or surrogates
- High frequency monitoring capability
- Storage of product water to provide time (engineered storage buffer)
- Means to quickly respond to “off-spec” water (time to respond)

4.1 Background

In 2010, the California Legislature enacted Senate Bill (SB) 918 directing CDPH (now DDW) to investigate the feasibility of developing uniform water recycling criteria for direct potable reuse (DPR) by December 2016. SB 918 also included the requirements to convene an Expert Panel. In 2013, the Legislature enacted SB 322 which required an Advisory Group be convened to advise the Expert Panel and DDW in the development of the DPR criteria feasibility report. DDW issued the final *Investigation on the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse* in December 2016.[6]

4.2 Expert Panel Key Findings

The Expert Panel determined that “it is feasible to develop uniform water recycling criteria for DPR that would incorporate a level of public health protection as good as or better than what is currently provided in California by conventional drinking water supplies...” The panel noted that the functionality provided by the environmental buffer (i.e., storage, attenuation, and response time) in an indirect potable reuse (IPR) project must be addressed by other means for DPR. The panel also noted that any project that cannot obtain two months of retention in the environmental buffer should be classified as DPR.

Given the lack of an environmental buffer, the Expert Panel stressed that reliability would be the overarching goal for a DPR option to consistently achieve the desired water quality in the product water. The Panel defined a reliable system as redundant, robust and resilient where:

1. “Redundancy” is the use of multiple barriers for the same contaminant, so that risks can be properly managed even in the event of an upset or failure in a unit;
2. “Robustness” is the use of a combination of treatment technologies to address a broad variety of contaminants and changes in concentration in source water; and
3. “Resilience” is a combination of protocols and strategies to address failures and bring systems back on-line, such as real-time monitoring.

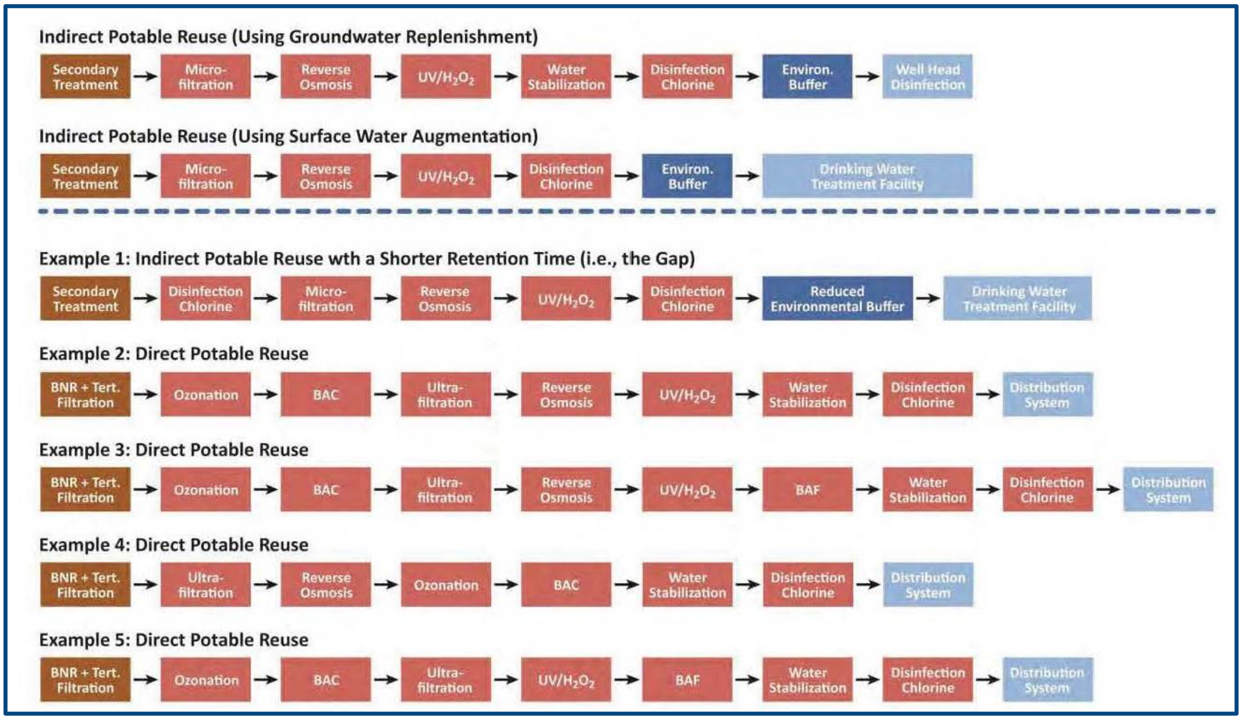
The panel suggested that DPR regulations must provide reliability by:

1. Providing multiple, independent treatment barriers;
2. Incorporating the frequent monitoring of surrogate parameters at each step to ensure treatment processes are performing properly; and
3. Developing and implementing rigorous response protocols (such as a formal Hazard Analysis Critical Control Point system).

[6] http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/rw_dpr_criteria.shtml

The Expert Panel Report provides a number of example treatment trains for the range of potable reuse projects, as shown in **Figure 4-1**. The two trains above the dashed line represent groundwater augmentation and reservoir augmentation, respectively. The trains below the dashed line represents different potential treatment trains for potable reuse.

Figure 4-1: Example Potable Reuse Treatment Trains



Source: Expert Panel Final Report: Evaluation of the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse (Olivieri et. al., 2016). Figure 8-1.

While the Expert Panel determined that no additional research needs to be conducted to establish criteria, they recommended supplemental research be conducted concurrently to enhance the understanding and acceptability of DPR and further ensure that DPR is protective of public health. The six research recommendations are summarized as follows:

- Continue to improve on source control and final water quality monitoring, carry out an ongoing literature review to identify new compounds that may pose health risks particularly to fetuses and children from short term exposures
- Implement a probabilistic method (Quantitative Microbial Risk Assessment, QMRA) to confirm the necessary removal values for viruses, *Cryptosporidium* and *Giardia*, based on a literature review and new pathogen data collected, and apply this method to evaluate the performance and reliability of DPR treatment trains.
- Require monitoring of pathogens in raw wastewater to develop better empirical data on concentrations and variability.
- Investigate the feasibility of collecting raw wastewater pathogen concentration data associated with community outbreaks of disease, and implement where possible.
- Identify suitable options for final treatment processes that can provide some "averaging" with respect to potential chemical peaks particularly for chemicals that have the potential to persist through advanced water treatment.

- Develop more comprehensive analytical methods to identify unknown contaminants, particularly low molecular weight compounds potentially in wastewater that may not be removed by advanced treatment and are not presently detectable by current regulatory monitoring approaches.

The Expert Panel states that while the results of the research could be used by the SWRCB to inform the development of DPR criteria, the absence of better information is not a barrier to establishing uniform regulatory criteria for DPR. DDW has offered a different interpretation, stating that the development of regulations can begin but should not be finalized until the research is complete.

4.3 DDW Report Key Findings

After reviewing the recommendations of Expert Panel Report and Advisory Group Report, DDW concluded that it is feasible to begin the process of developing DPR regulations. However, DDW believes the additional research and knowledge gaps identified in the Expert Panel and Advisory Group reports must be addressed prior to the adoption of criteria. DDW acknowledged that there are at least three possible types of DPR projects that will have different risk profiles:

1. **Small Reservoir Augmentation:** A project delivering recycled water to a surface water reservoir, with the reservoir providing some benefits, but lacking the full complement of benefits provided by reservoir augmentation, such as meeting minimum retention time.
2. **Raw Water Augmentation:** A project delivering recycled water directly to a surface water treatment plant or a surface water reservoir, with the reservoir providing no benefits.
3. **Treated Water Augmentation:** A project delivering finished water to a public water system's distribution system.

DDW confirmed that each DPR project will have a unique set of criteria but that a common framework across the various types of DPR will help to avoid discontinuities in the risk assessment and risk management approach to public health protection. The framework would address:

- Complexity of the proposed treatment;
- High degree of reliability required;
- Short time period to detect and respond to failures; and
- Lack of experience operating advanced treatment facilities in California.

The report acknowledges that much of the research identified by the Expert Panel and program enhancements listed above are currently underway, but much will still be ongoing beyond 2018.

4.4 Key Considerations for DPR Concepts

Although criteria have yet to be established, the DDW Report to the Legislature and associated appendices provide guidance on key considerations for a potential DPR project. **Table 4-1** illustrates how the DDW Report can be interpreted to provide guidance in the formulation of DPR concepts for further consideration.

Chief among these considerations is the requirement for enhanced monitoring and response strategies given the lack of substantive environmental buffer. Regardless of the type, DPR projects will need to link emerging monitoring techniques (such as TRASAR for RO systems) with engineered storage and a response protocol that provides assurance that any treatment failures can be identified and controlled prior to off-specification water entering the water supply system.

Additional background on monitoring / response time, CECs, and source control are discussed in the subsequent sections.

Table 4-1: Example Potable Reuse Criteria

Category	Small Reservoir or Raw Water Augmentation	Treated Water Augmentation
Source Control		
Industrial Pretreatment	Enhanced programs above IPR requirements	Enhanced programs above IPR requirements and collection system "monitoring"
Enhanced commercial/residential programs		
Wastewater Treatment Plant Optimization		
Biological Nutrient Removal	Preferred	Required
Flow Equalization		
Pathogen Control		
Independent, diverse treatment barriers that meet performance standards in excess of public health goals	Required	Required
Log Removal Values (LRV) for Enteric Virus –- *Cryptosporidium* – *Giardia*	9 – 9 - 8[1]	12 – 10 – 10 plus supplemental based on AWT performance reliability analysis
Chemical Control		
Multiple, redundant barriers with rigorous monitoring protocols	RO-AOP plus chemical barrier benefit provided by SWTP	Supplemental treatment barrier to be determined
Water quality "averaging" (to protect against illicit short-term chemical discharges to sewer system)	Achieved through blending prior to and within SWTP	Requires supplemental treatment or flow equalization (prior to or after AWT)
Monitoring and Control		
Frequent monitoring of surrogate parameters (including insuring pathogen LRV's are met) for each treatment process	State of the Art technologies and Engineered Storage associated with Monitoring and Response Plan timeline.	State of the Art technologies and Engineered Storage associated with Monitoring and Response Plan timeline.
Rigorous response protocols (HACCP)	Preferred	Required
Drinking water system Implications		
Ensure microbial/chemical stability maintained in drinking water system	Need to consider implication on SWTP operation	Conditioning required to "align" DPR water with SWTP water

Note:

1. Compliance point is prior to surface water treatment plant (SWTP); therefore, SWTP credit of 4-3-2 not included in requirement. Targets include 1 LRV addition for each pathogen category due to precedent set by pending SWA allowance for reduced blending. Enhanced monitoring and engineered storage could potentially mitigate the 1 LRV addition.

Monitoring / Response Time

The following information is excerpted from the recently published Potable Reuse Research Compilation: Synthesis of Findings (WRRF-15-01; Mosher et. al., 2016).

Treatment technologies are available that are capable of providing the necessary treatment to be protective of public health in DPR applications; however, because treatment processes do degrade and may fail, the operation, maintenance, and monitoring of these processes are of critical importance. Both end-of-pipe compliance monitoring and performance-based monitoring have been used to ensure that an AWTF produces water that is protective of public health.

The critical control point (CCP) approach is a systematic way to mitigate the risk to human health through monitoring and control strategies related to physical locations within the treatment process. The CCP approach focuses on the monitoring and control of treatment processes for acute health risks and operational parameters.

Because online monitoring is not 100% accurate or precise, engineered storage provides an opportunity to decouple treatment processes from one another and a critical opportunity for monitoring systems to “catch up” with the water that is being treated. It is especially important for water quality concerns related to acute risks, such as those presented by pathogens and selected chemicals. The engineered storage is a storage volume that provides sufficient time to monitor for and respond to water quality concerns representing acute risks. Engineered storage relies on the definition of failure response time, which is composed of the time it takes to obtain critical monitoring data (from a CCP), understand the data, identify a potential failure, and take corrective action.

Constituents of Emerging Concern (CECs)

The following information is excerpted from the recently published Potable Reuse Research Compilation: Synthesis of Findings (WRRF-15-01; Mosher et. al., 2016).

CECs in drinking water and sources of drinking water are of concern to the public and water industry. Depending on the level of treatment, a wide variety of anthropogenic contaminants have been found in treated wastewater, including pharmaceuticals, ingredients in personal care products, industrial chemicals, and others. Over 400 non-regulated organic compounds have been identified in secondary-treated waters in the United States. CECs, their metabolites, and unregulated oxidation/disinfection byproducts are present in secondary- and tertiary-treated wastewater effluents throughout California, the United States, and other industrialized nations. Due to continuing advances in analytical chemistry in water monitoring, more CECs will be identified in the future, new CECs will emerge, and previously identified CECs may disappear, based on the use of specific chemicals by society.

No single treatment process (or combination of treatment processes) exists that is capable of removing all CECs from water. Various unit treatment processes used in conventional drinking water treatment, wastewater treatment, and advanced treatment for reuse have different efficacies in removing CECs. Nevertheless, advanced water treatment involving RO has been shown to remove the majority of known CECs to below the very low detection limit ranges of ng/L to sub-ng/L.

CECs have not been detected in advanced treated water from AWTFs using RO at concentrations above the risk-based criteria used in studies that have evaluated the potential health effects of CECs (such as WRRF-06-004 and WRRF-11-02). The risks associated with CECs likely will come from very few contaminants, as reported in prior risk assessment studies that evaluated a wide range of CECs and ultimately concluded only a limited number of CECs require monitoring. For certain California communities, public perception of the risks associated with CECs is greater than the actual risk, as indicated by public surveys conducted before and after education about the (low) risk of being exposed to or consuming advanced treated water. Public outreach is addressed in Chapter 7.

Source Control

The following information is excerpted from the recently published Potable Reuse Research Compilation: Synthesis of Findings (WRRF-15-01; Mosher et. al., 2016).

Keeping constituents of concern out of the wastewater system through a robust source control program can be the most beneficial, efficient, and cost-effective strategy for managing and treating industrial, commercial, and other contributions to the wastewater supply; therefore, when pursuing and planning for DPR, it is crucial to implement a rigorous source control program in conjunction with other applicable programs to eliminate or control the discharge of constituents that might affect the production of advanced treated water (Mosher et. al., 2016).

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Chapter 5 Potable Reuse Project Components

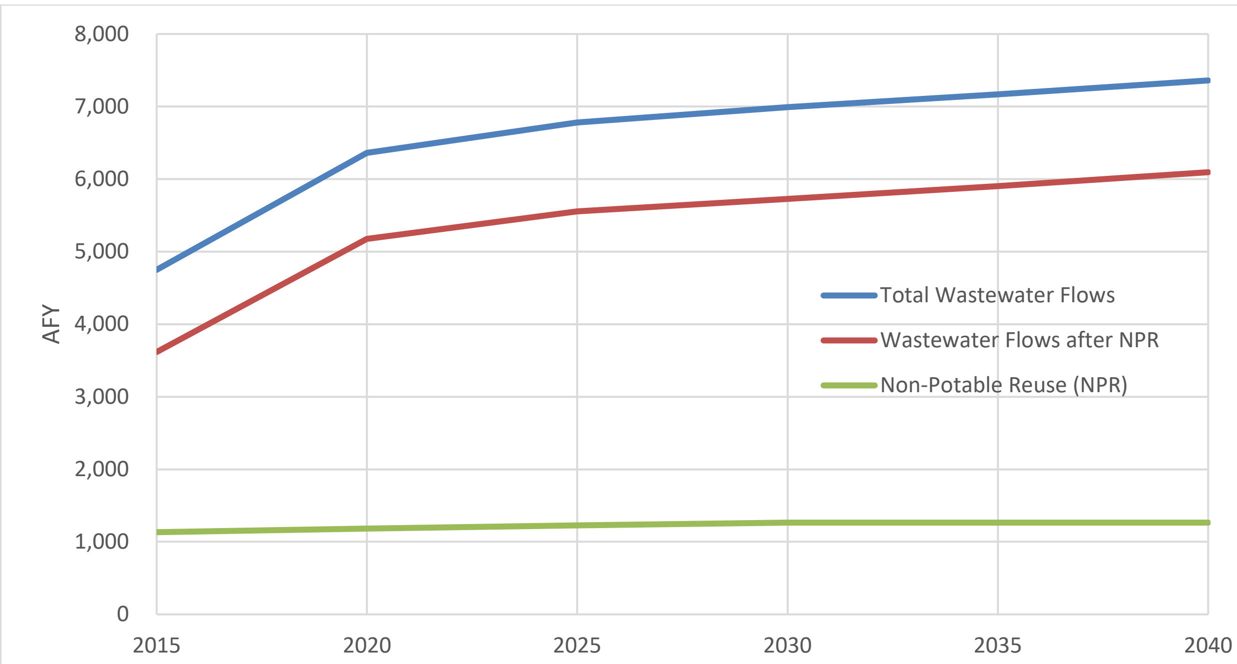
This chapter identifies potable reuse project components and conducts preliminary screening prior to developing project alternatives in Chapter 6. First, the design criteria for facilities development are presented.

5.1 Design Criteria

5.1.1 Potential Potable Reuse Volume

The available supply for the potable reuse project is dependent upon whether operation of the existing non-potable reuse system is continued along with the proposed potable reuse system (i.e., production of two qualities of recycled water). Discontinuation of deliveries through the non-potable system would make that supply available for use in the potable reuse system. A total of 1,113 AF of recycled water was produced for the non-potable system in 2015 and is projected to increase to 1,265 AFY by 2030. Projected wastewater flows are through 2040 are shown in **Figure 5-1**. (Refer to Section 2.3.2 for the wastewater flow projections basis and Section 2.4.3 for the recycled water projections basis).

Figure 5-1: Potable Reuse Supply Projections

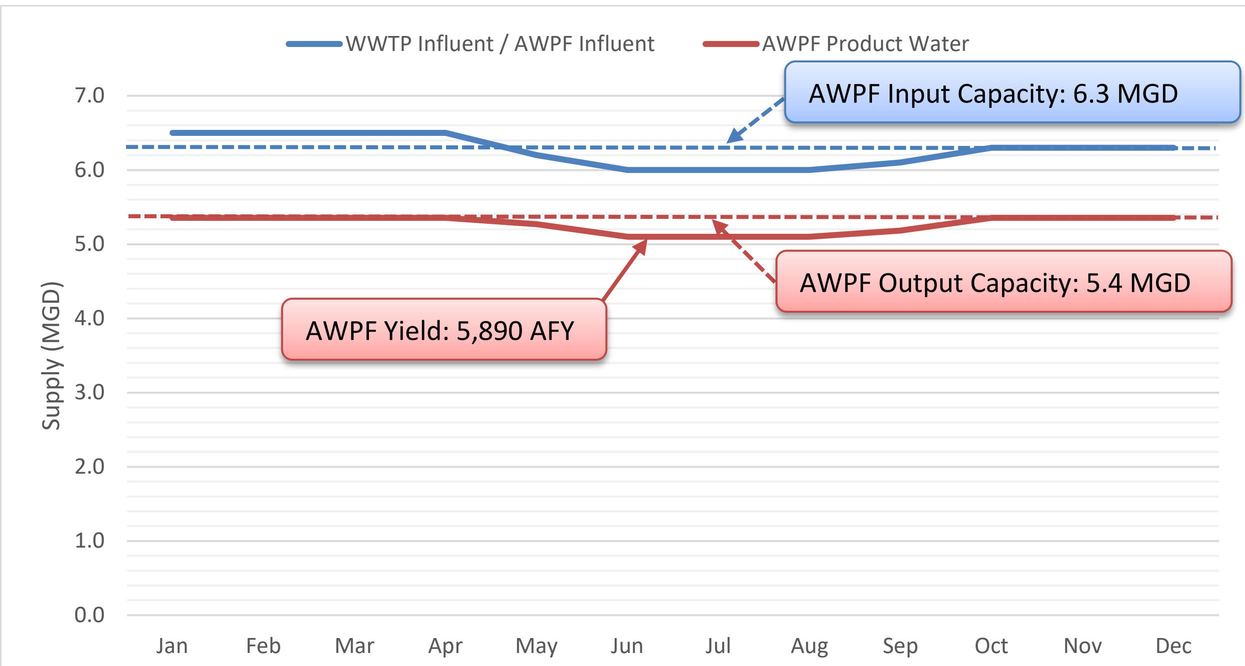


Two potable reuse supply scenarios are considered for wastewater flows an advanced water purification facility (AWPF): 1) One scenario – "AWPF without NPR" – assumes that the operation of the existing non-potable system is ended and all available wastewater is treated for eventual potable use; and 2) the second scenario – "AWPF with NPR" – assumes continued operation of the existing non-potable system. Both scenarios assume 85% RO recovery and sized facilities for alternatives comparison based on projected supplies in 2030. Flows in 2030 are selected for alternatives comparison to account for projected flow increases that have higher levels of confidence. The flow selected for design of a potable reuse project should consider potential flows beyond 2030 when sizing components that cannot be readily expanded once constructed, such as pipelines.

In 2030, approximately 6,990 AFY (6.3 MGD) of wastewater flows are projected based on estimated water demand growth (refer to Section 2.3.2). An assumption of 85% RO recovery results in approximately 5,940 AFY (5.3 MGD) of AWPF product water. After accounting for non-potable reuse of 1,270 AFY, wastewater flows are reduced to 5,720 AFY (5.1 MGD) and result in approximately 4,900 AFY (4.4 MGD) of AWPF product water.

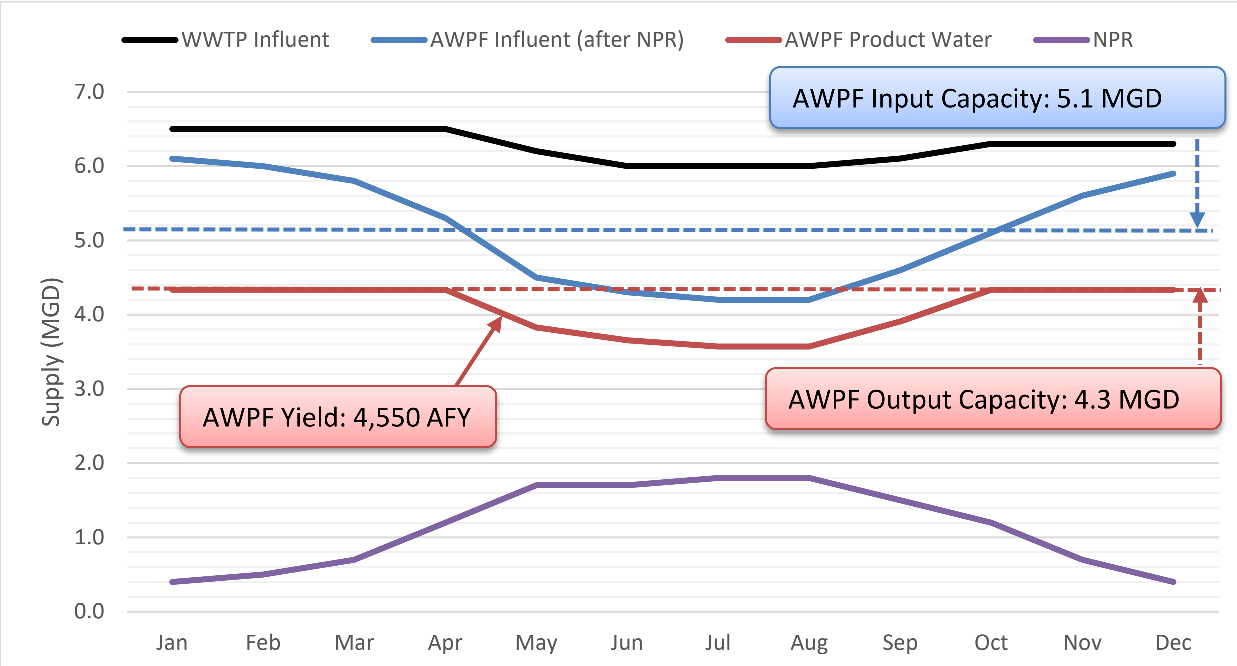
Monthly wastewater production must be considered in addition to annual availability. Historical (2011 to 2015) monthly influent records were used to create a monthly production profile that was applied to projected 2030 annual average flows (6.3 MGD). As shown in **Figure 5-2**, WWTP influent flows are lower during the summer / dry season (roughly 6.0 MGD) than during the winter / wet season (6.3 to 6.5 MGD). Assuming an AWPF input capacity of 6.3 MGD (based on average flows throughout the year) results in an average treatment of 6.2 MGD due to lower summer / dry season influent flows. Applying an RO recovery of 85% to the monthly production values results in average annual yield of 5.3 MGD (5,890 AFY).

Figure 5-2: Monthly Potable Reuse Supply Estimates (2030), Scenario 1: AWPF without NPR



As shown in **Figure 5-3**, including monthly NPR demand (1,270 AFY; 1.1 MGD in 2030) results in a notable drop in AWPF product water flow during the summer to 4.2 MGD from a high monthly flow of 6.1 MGD in the winter. Treating all available effluent in this scenario would require an AWPF with 6.1 MGD influent capacity that would only operate at that capacity for one month a year while treating an average of 5.1 MGD, which is 85% of AWPF capacity, while paying the capital costs to install the full AWPF capacity. Therefore, an influent capacity of 5.1 MGD (based on average flows through the year) was assumed to optimize AWPF use to 95% of AWPF capacity (an average of 4.8 MGD). Applying an RO recovery of 85% to the monthly production values results in an average annual yield of 4.1 MGD (4,550 AFY).

Figure 5-3: Monthly Potable Reuse Supply Estimates (2030), Scenario 2: AWPF with NPR



In addition, AWPF sizing will need to consider the impact of future water conservation / reduction on wastewater flows. GSD wastewater flows have declined approximately 20% since 2013 due to reduced indoor water use from drought awareness and GWD water use restrictions and incentives. GWD water demand projections (and the associated wastewater flows) anticipate some increases from water use in 2015 and 2016 if drought restrictions are eased but most of the future increases are from new demand. Lower wastewater flows would reduce the maximum available supply for an AWPF. This can be addressed by constructing the initial AWPF phase for existing flows and adding capacity as wastewater flows increase.

5.1.2 Pipeline Design Criteria

The pipeline design criteria used to develop the alternatives in this report are presented in **Table 5-1.**

Table 5-1: Pipeline Design Criteria

Criteria	Value, Comments
Design Flow	Peak hour conditions
Material	Ductile Iron or Steel (for high pressure or close to potable)
Pressure Class (Minimum)	Class 200 (psi)
Max Velocity	8 fps
Min Velocity	1 fps
Goal	3 to 5 fps
Max Head Loss	10 ft per 1,000 ft
Pipeline C factor	120 Ductile iron

5.2 Potential Potable Reuse Receptors

Four potential recycled water receptors were identified for a conceptual potable reuse project.

- Groundwater Augmentation: Goleta Groundwater Basin (via surface spreading or injection)
- Reservoir Augmentation: Lake Cachuma
- Raw Water Augmentation: CDM WTP
- Treated Water Augmentation: Potable Water Distribution System (Van Horne Reservoir)

These potential receptors generally fall into three "strategy" categories: (1) raw water body, (2) raw water infrastructure, and (3) potable water infrastructure as shown in **Figure 5-4**. The locations of the five potential receptor sites are shown on **Figure 5-5**.

Figure 5-4: Schematic of Potable Reuse Receptors

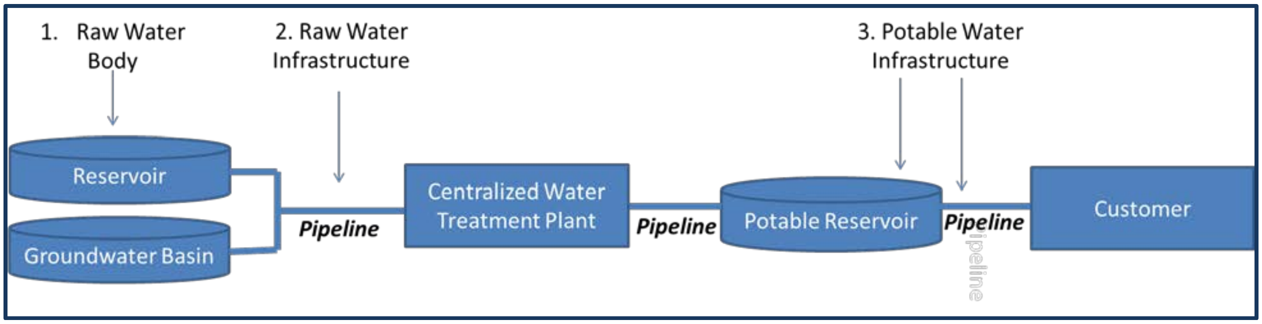
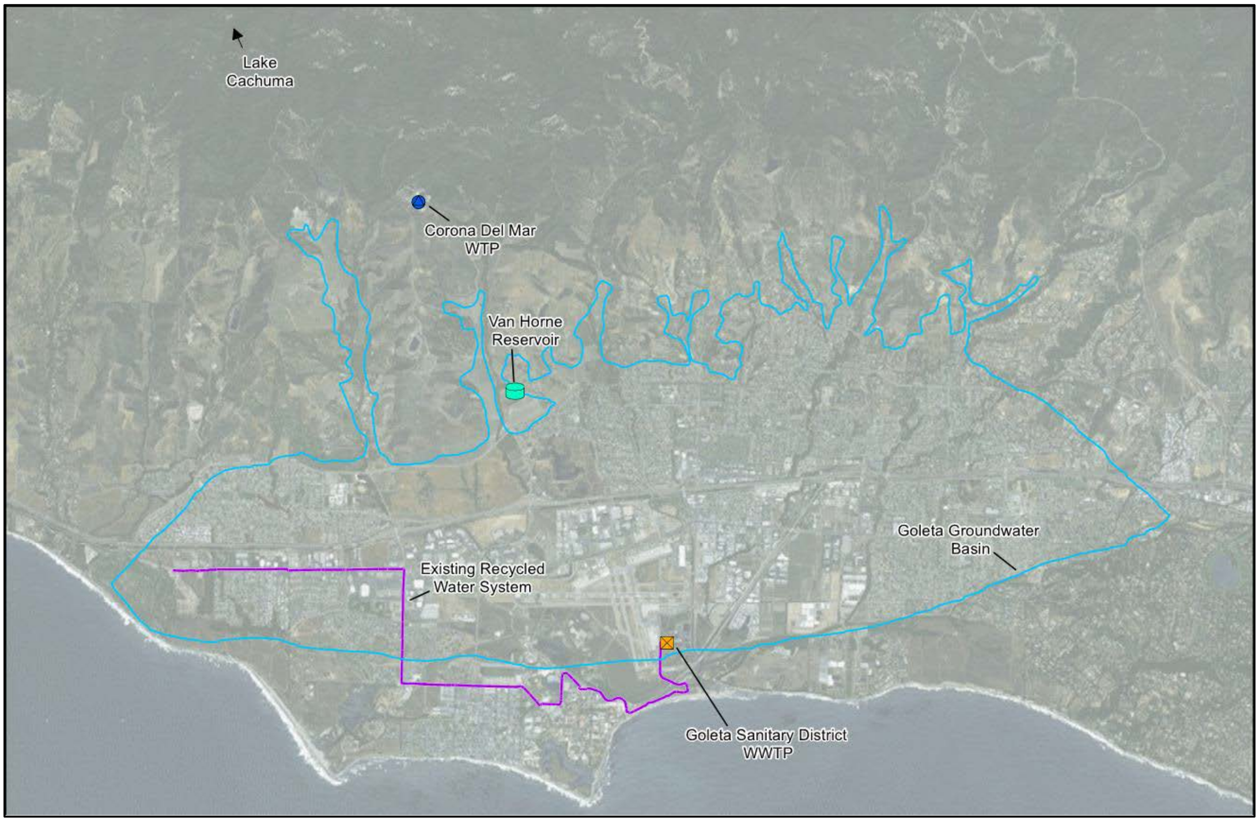


Figure 5-5: Potential Potable Reuse Receptor Locations



5.2.1 Raw Water Body

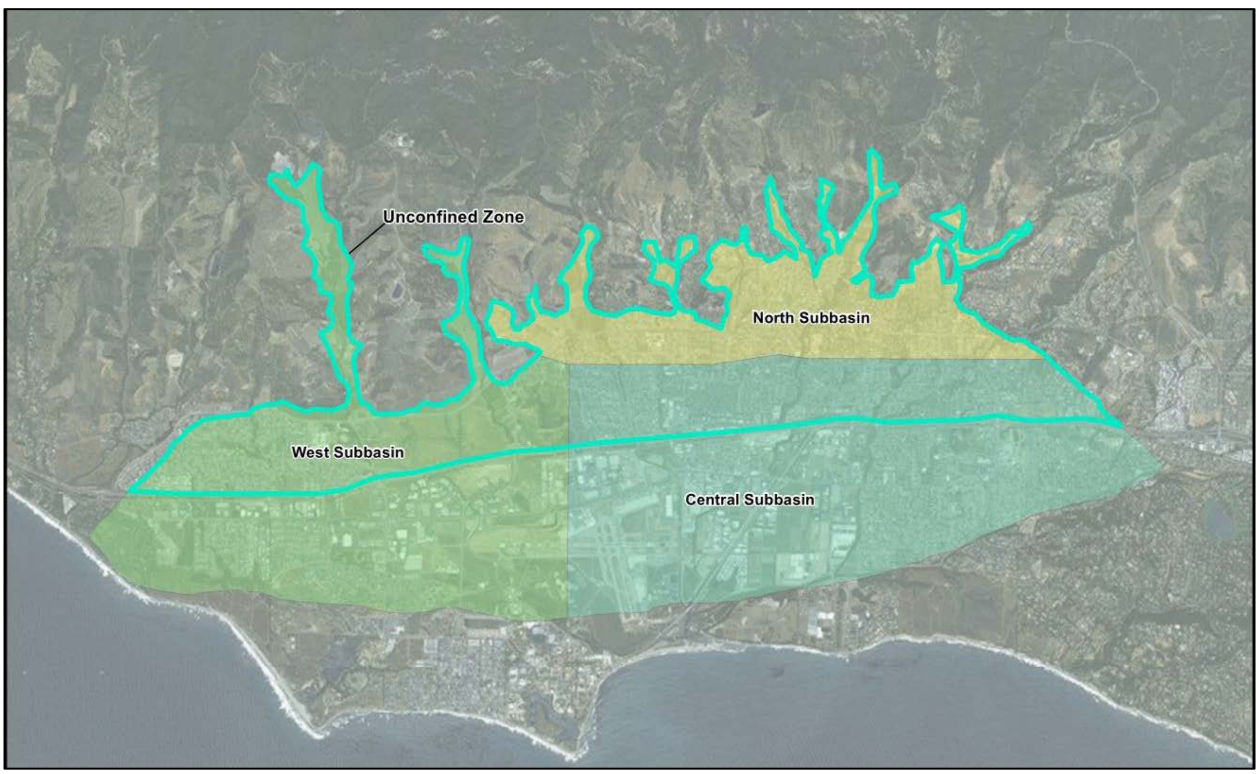
A "raw water body" is defined as a surface reservoir or groundwater basin that could be used to store purified recycled water, with the intent to provide subsequent additional treatment and distribution to customers through the potable water system. The various pathways for introduction of recycled water into a raw water body are described below.

Groundwater Augmentation via Surface Spreading

Groundwater augmentation via surface spreading is most efficient where recharge basins can be located above an unconfined aquifer and, where sediments between the ground surface and the water table are highly permeable and able to transmit water downward. As shown in **Figure 5-6**, this condition exists in the North Subbasin, as well as a portion of the Central Subbasin and the West Subbasin; however, insufficient open space exists to construct recharge basins. For example, approximately 40 acres of recharge basins would be required to recharge 5,890 AFY, assuming maximum month supply is 5.4 MGD, infiltration rate of 0.5 feet per day, and an additional 20% of acreage is needed beyond acreage dedicated for recharge area for berms, setbacks, maintenance, etc.

Therefore, groundwater augmentation via surface spreading is not feasible due to a lack of available open space in the optimum recharge areas and the confining layers in areas where open space is available and this option was removed from further evaluation.

Figure 5-6: Potential Surface Recharge Areas



Groundwater Augmentation via Injection

The Goleta Groundwater Basin is a potential potable reuse receptor by injection into the Basin. The District has historically injected surplus water from Lake Cachuma after treatment at CDM WTP and, in 2015, the District investigated potential injection well locations to expand this program. These potential injection well sites identified during that investigation were assumed to be suitable for injection of purified water too since they are also located in areas that would promote recovery of the basin following extended pumping periods.

GSI (2017) completed an initial analysis of travel times under two injection scenarios – 3,000 AFY and 6,000 AFY. The analysis is included in Appendix C. Both scenarios assumed a similar volume of injected water would be pumped in addition to baseline pumping of 1,200 AFY to be conservative from a travel time estimate perspective. The 3,000 AFY scenario assumed six injection wells at 0.5 MGD per well and the 6,000 AFY scenario assumed 11 injection wells at 0.5 MGD.

The GWR regulations specify a minimum response retention time of 2 months verified by a tracer test and of 4 months when using a groundwater model. The preliminary modeling for both scenarios found that no GWD wells or active La Cumbre Mutual Water Company potable supply wells are located within 4 months of response retention time relative to the simulated injection wells. Recycled water travel distances in the subsurface over 4 months were estimated to be approximately 600-700 feet under the conditions simulated.

Surface Water Augmentation

The surface water reservoir considered as a potential potable reuse receptor is Lake Cachuma. Lake Cachuma is located north of Goleta on the Santa Ynez River and provides potable water supply to the District, as described in Chapter 2. Delivering recycled water to Lake Cachuma would require almost 80,000 ft of pipeline to reach the reservoir through the Tecolote Tunnel.

This option was removed from further consideration due to the following:

- High capital cost of the pipeline required to reach Lake Cachuma
- Uncertainty regarding permits required to install a new pipeline within the Tecolote Tunnel
- Institutionally complicated water rights exchanges/agreements involving Lake Cachuma parties

5.2.2 Raw Water Infrastructure

"Raw water infrastructure" is defined as an engineered conduit for untreated surface water that supplies an existing (or planned) surface water treatment plant. The CDM WTP currently treats water from Lake Cachuma and the SWP. The option considered in this report would introduce purified water from the AWPF directly upstream of the CDM WTP.

Purified water is assumed to be limited to no more than 50% of source water to the CDM WTP at any point in time due to concerns regarding impacts to WTP operations and DDW may not issue full log removal credit for the WTP (presented in Table 4-1).

5.2.3 Potable Water Infrastructure

"Potable water infrastructure" is defined as a reservoir or distribution pipeline that already contains treated, potable water intended for direct delivery to customers. The option considered in this report is a potable reuse project that introduces purified recycled water directly into the distribution system via the Van Horne Reservoir shown in Figure 5-4. Purified water from the AWPF would be conveyed by pipeline to the Van Horne Reservoir where it would be mixed with other treated water from the CDM WTP before entering the distribution system. This option has the advantage of mixing high quality purified water with high quality treated water from the CDM WTP and avoids the potential operational issues of combining different qualities of source waters at the CDM WTP.

5.3 Potable Reuse Treatment Alternatives

Typically, the selection of treatment processes is driven by several common regulatory requirements: (1) low bulk organic limits (e.g., TOC, COD); (2) requirements for pathogen log reduction; and (3) the use of multiple treatment barriers to control pathogens and chemicals, including trace organics (Mosher et. al., 2016). The common advanced treatment train consists of microfiltration (MF) or ultrafiltration (UF), reverse osmosis (RO), and an advanced oxidation process (AOP) and is designed to meet DDW 12/10/10 (enteric viruses/cryptosporidium/giardia) log removal requirements. MF or UF removes residual particulate matter, RO demineralizes and removes chemical constituents, and AOP is used to destroy or alter chemical constituents that are not oxidized completely by conventional biological treatment processes or removed by filtration; AOP also provides disinfection benefits (Tchobanoglous et. al. 2015). AOP most commonly includes ultraviolet (UV) disinfection with hydrogen peroxide or may include ozonation or chlorination.

In addition to MF/RO/AOP, the example potable reuse treatment trains in Figure 4-1 include several additional unit processes:

- **Biological Nutrient Removal (BNR)** for removal of nitrogen and phosphorus and decreased fouling rates for MF or UF membranes. Denitrification also has the added benefit of reducing the degree of nitrate removal that must be achieved in the AWPF (Tchobanoglous et. al. 2015).
- **Tertiary Filtration** can be used to reduce a measure of complexity and the effects of close-coupled processes in DPR systems. For example, a biological process upset that increases the suspended solids and turbidity of secondary effluent will negatively affect downstream membrane performance, but the impact will be reduced with the use of tertiary filtration to capture and reduce the particle load (Tchobanoglous et. al. 2015).
- **Disinfection** of secondary or tertiary filtered effluent can add a redundant disinfection barrier to the subsequent AWPF, with the level of redundancy and a possible measure of robustness depending upon the disinfection technology (Tchobanoglous et. al. 2015).
- **Ozone** in DPR trains may be used for the pretreatment of MF/UF for flux improvement, oxidation of organic matter including trace organics, and disinfection of pathogens. Ozone can form significant concentrations of NDMA, although the use of downstream biological activated carbon (**BAC**) has been shown to effectively remove NDMA that has formed (Mosher et. al., 2016).

Blending Assumptions

Raw water augmentation assumes purified water is limited to no more than 50% of source water to the CDM WTP at any point in time due to concerns regarding impacts to WTP operations and DDW may not issue full log removal credit for the WTP. The blending assumption could limit use of purified water during times of extreme drought when Cachuma and SWP supplies are extremely limited, such as 2015/2016 winter conditions.

Treated water augmentation blending requirements are also assumed to be limited to no more than 50%; however, there has been little regulatory discussion on the topic to date. Groundwater augmentation does not have blending requirements but does include minimum retention time of 2 months.

5.3.2 Treatment Trains

Assumed minimum levels of treatment were developed for raw water augmentation and treated water augmentation based on the key considerations described in Section 4.4. The assumptions herein attempt to balance the anticipated conservative nature of forthcoming potable reuse regulations with treatment trains proposed by agencies considering potable reuse based on the DPR Expert Panel recommendations. The treatment train is assumed to include secondary wastewater treatment followed by an AWPF (MF/RO/AOP), as currently required for groundwater augmentation via injection. Treatment also includes other treatment processes and critical control point monitoring to provide a reliable system that is redundant (multiple barriers), robust (combination of technologies), and resilient (combination of protocols and strategies) (Pecson et. al., 2015).

A raw water augmentation treatment train builds upon the AWPF for groundwater augmentation with BNR and a redundant disinfection step in addition to ultimately being treated at a conventional drinking water treatment facility that meets surface water treatment rules. Extra processes include biological nutrient removal added to secondary treatment and a second chlorine (Cl) disinfection step added to the AWPF. The assumed raw water augmentation treatment train is referred to as “AWPF+” in this report.

Treated water augmentation may require additional barriers to address acutely toxic constituents. Full tertiary treatment following secondary treatment with BNR precedes the AWPF, which includes a redundant disinfection process (chlorine disinfection) and redundant organics removal process (ozone (O_3) followed by biological activated carbon (BAC)) was assumed. The assumed treated water augmentation treatment train is referred to as “AWPF++” in this report.

In summary, the following treatment trains are assumed for each potable reuse receptor:

- Groundwater Augmentation:
    - Secondary wastewater treatment
    - “AWPF” (MF/RO/AOP)
- Raw Water Augmentation:
    - Biological nutrient removal
    - “AWPF+” (UF/RO/AOP + Cl)
- Treated Water Augmentation:
    - Biological nutrient removal
    - Tertiary filtration
    - “AWPF++” (UF/RO/AOP + Cl + O_3/BAC)

It should be noted that the minimum treatment, storage, and monitoring requirements for the potable reuse options without regulations (raw water augmentation and treated water augmentation) are based on an interpretation of the ongoing DPR regulatory discussion. These requirements will be subject to change once regulations are finalized for each type of potable reuse. Future regulations could be more or less conservative than the assumptions in this report.

Also, developing regulations for treated water augmentation will require a better understanding of DPR issues. Many of these issues are expected to be better understood as data are collected from operating raw water augmentation projects.

5.4 GSD WWTP Considerations

5.4.1 Ocean Outfall Impact

Increased reuse will reduce the volume and quality of effluent discharged to the ocean outfall and, under certain conditions, all effluent could be RO brine. Lower effluent flows and increased density impacts the performance of the outfall since the outfall diffuser ports require a minimum velocity to be maintained to prevent sedimentation and ensure proper initial dilution. Also, minimum effluent velocities may be required to prevent sedimentation in outfall pipelines with shallow slopes.

The potential impact of reduced effluent volumes and quality should be evaluated along with potential mitigation measures. The evaluation must consider that all WWTP effluent may be discharged at certain times while only RO brine may be discharged at other times. A potential solution to low flows is to install “duckbill” diffusers that close when there is no flow so sediment is prevented from entering and minimum pressure is needed to open the diffuser.

The evaluation requires consideration of multiple variables and scenarios that is beyond the scope of this effort but is recommended as a next step in Section 8.8.3.

5.4.2 NPDES Permit Impact

Discharge that is strictly RO brine could impact compliance with GSD's existing NPDES permit so a preliminarily assessment was conducted to compare existing NPDES permit numerical limits with projected effluent quality.

GSD completed the installation of secondary treatment at the wastewater treatment plant in December 2013, and it has provided full secondary treatment to its effluent discharge since then. For the purpose of this analysis, only data collected after the plant upgrades is used (from January 2014 - April 2016 data). Only constituents that were detected at least once during the analysis period are included in the analysis.

Treatment of the full influent WWTP capacity (9.0 MGD) was analyzed to conservatively estimate impacts to the WWTP's effluent caused by a potable reuse project with AWPF. This represents a "high loading" scenario because it considers the effects of 100% of the waste stream being treated with an AWPF, therefore adding the maximum amount of brine to the WWTP's effluent. The calculations assume the AWPF (including RO) has an 85% recovery rate (i.e., ratio of product water to feed water) and, consequently, brine has constituent concentrations approximately 6.67 times that of the secondary effluent feed water. Based on these assumptions, the scenario provides AWPF facilities to treat a total of 9.0 MGD of influent capacity, yielding 7.65 MGD of product water and 1.35 MGD of brine.

Tables 5-2, 5-3, and 5-4 provide a summary of conventional and toxic constituents with the anticipated effluent limits, typical concentration values for those constituents in the current effluent, and projected values for a future scenario where the AWPF alternative is implemented and the brine concentrate becomes the only flow stream through the ocean outfall. The calculations assume a permitted average dry weather flow of 9.0 MGD and that the values for non-detect (ND) results set at the detection limit. Concentration values of potential concern are shown in red in the two tables.

For the conventional pollutants, it should be noted that the effluent concentration limits in NPDES permits are typically based on daily loadings (in pounds per day). The loadings would not significantly change with discharge of RO brine, so it may be possible to recalculate the effluent concentrations and adjust the NPDES water quality-based limits based on the reduced effluent flow rates (and increased concentrations) that would be experienced with the implementation of an AWPF process.

In addition, many of the conventional pollutants would be removed by filtration prior to the RO process. As long as the backwash from this filtration process is returned to the headworks of the WWTP, they will not be concentrated in the brine. If the AWPF is located at CDM WTP, additional loading from MF backwash would need to be considered in this analysis.

Finally, for total chlorine residual, it is reasonable to assume that chlorine application procedures would change as a result of implementing AWPF.

Table 5-2: NPDES Toxic Pollutants for Protection of Human Health, Projected Effluent Quality

Constituent	Units	Current Effluent Water Quality[1]		Multi-plier[2]	Projected Effluent Water Quality (to ocean outfall)		NPDES Limits[3]
		Avg	High		Avg	High	Avg Monthly
Antimony	mg/L	0.00104	0.00131	6.67	0.00695	0.00874	134
Toluene	g/L	1.06×10^{-6}	1.28×10^{-6}	6.67	7.05×10^{-6}	8.54×10^{-6}	9.52
Thallium	mg/L	0.000015	0.000016	6.67	0.00010	0.00011	0.224
Dibromochloromethane	mg/L	0.0257	0.0301	6.67	0.171	0.201	0.962
Chloroform	mg/L	0.0594	0.0713	6.67	0.396	0.476	14.6
Dichlorobromomethane	µg/L	44.1	51.2	6.67	294	342	694
Halomethanes	mg/L	0.00286	0.00362	6.67	0.0191	0.0241	14.6

Notes:
1. Based on effluent water quality data for January 2014 – April 2016.
2. Based on assumed 85% recovery rate of the advanced water treatment process.
3. Estimated limits for reissued GSD WWTP NPDES permit with a higher permitted discharge flow rate of 9.0 MGD. Current limits are higher than those shown in table.

Table 5-3: NPDES Conventional Pollutants, Projected Effluent Quality

Constituent	Units	Current Effluent Water Quality[1]		Multi-plier[2]	Projected Effluent Water Quality (to ocean outfall)		NPDES Limits[3]		
		Avg.	High[4]		Avg.	High	Avg. Monthly	Avg. Weekly	Max. Daily[5]
Biochemical Oxygen Demand[6]	mg/L	4.4	21	6.67	30	140 [7]	30	45	90
Total Suspended Solids[6]	mg/L	6.1	20	6.67	41 [7]	133 [7]	30	45	90
Oil and Grease	mg/L	3.5	13.8	6.67	23	92 [7]	25	40	75
Settleable Solids	mg/L	0.2	0.4	6.67	1.1 [7]	2.7 [7]	1	1.5	3
Turbidity	NTU	2.3	8.4	6.67	15	56	75	100	225
Total Coliform	MPN/100 mL	34	70	6.67	225	467	1,000	--	10,000
Fecal Coliform	MPN/100 mL	4.7	6.8	6.67	31	45	200	--	400
Enterococcus	MPN/100 mL	1.8	2	6.67	12	13	35	--	104

Notes:
1. Based on effluent water quality data for January 2014 – April 2016.
2. Based on assumed 85% recovery rate of the advanced water treatment process.
3. Limits based on California Ocean Plan except where noted.
4. For total coliform, fecal coliform, and enterococcus, the 90^{th}%ile was used.
5. For total coliform, fecal coliform, and enterococcus, the maximum daily limits were used for comparison.
6. Limits based on secondary treatment standard, as found in 40 CFR Part 133.
7. For the conventional pollutants, effluent concentration limits in NPDES permits are typically based on daily loadings. The loadings would not significantly change with discharge of RO brine so it may be possible to recalculate the effluent concentrations and adjust the NPDES water quality-based limits based on the

reduced effluent flow rates (and increased concentrations) that would be experienced with the implementation of an AWPF. In addition, many of the conventional pollutants would be removed by filtration prior to the RO process. As long as the backwash from this filtration process is returned to the headworks of the WWTP, they will not be concentrated in the brine.

Table 5-4: NPDES Toxic Pollutants, Projected Effluent Quality

Constituent	Units	Current Effluent Water Quality[1]		Multi-plier[2]	Projected Effluent Water Quality (to ocean outfall)		NPDES Limits[3]		
		Avg.[4]	High		Avg.	High	6-month median	Daily Max.	Inst. Max
Arsenic	µg/L	1.15	8.16	6.67	7.70	54.43	563	3251	8627
Cadmium	µg/L	0.035	0.065	6.67	0.232	0.434	112	448	1120
Chromium, Hexavalent[5]	µg/L	0.811	3.23	6.67	5.41	21.54	224	899	2240
Copper	µg/L	6.67	11.2	6.67	44.5	74.7	114	1122	3138
Lead	µg/L	0.956	13.4	6.67	6.38	89.4	224	899	2240
Mercury	µg/L	0.0135	0.0799	6.67	0.0904	0.533	4.46	18.2	44.6
Nickel	µg/L	4.08	6.20	6.67	27.2	41.4	560	2240	5600
Selenium	µg/L	1.15	1.16	6.67	7.67	7.74	1680	6691	16800
Silver	µg/L	0.16	1.0	6.67	1.0	6.7	61	296	766
Zinc	µg/L	40.2	81.6	6.67	268	544	1351	8071	21511
Cyanide	µg/L	1.43	1.86	6.67	9.54	12.4	112	448	1120
Total Chlorine Residual	µg/L	101	300	6.67	673 [6]	2001 [6]	224	896	6720
Total Ammonia (as N)	mg/L	0.89	1	6.67	5.9	6.7	67	269	672
Acute Toxicity	TUa	0	0.41	6.67	0	2.7	--	3.6	--
Chronic Toxicity	TUc	3.4	5.6	6.67	23	37	--	112	--
Radio-activity	pCi/L	9.5	11.3	6.67	63	75	Not Assessed		

Notes:

1. Based on effluent water quality data for January 2014 – April 2016.
2. Based on assumed 85% recovery rate of the advanced water treatment process.
3. Estimated limits for reissued GSD WWTP NPDES permit with a higher permitted discharge flow rate of 9.0 MGD. Current limits are higher than those shown in table.
4. For acute toxicity and chronic toxicity, the median was used.
5. Reported water quality data from GSD were for total chromium.
6. For total chlorine residual, it is reasonable to assume that chlorine application procedures would change as a result of implementing AWPF.

5.5 AWPF Siting / Conveyance Alternatives

5.5.1 AWPF Site

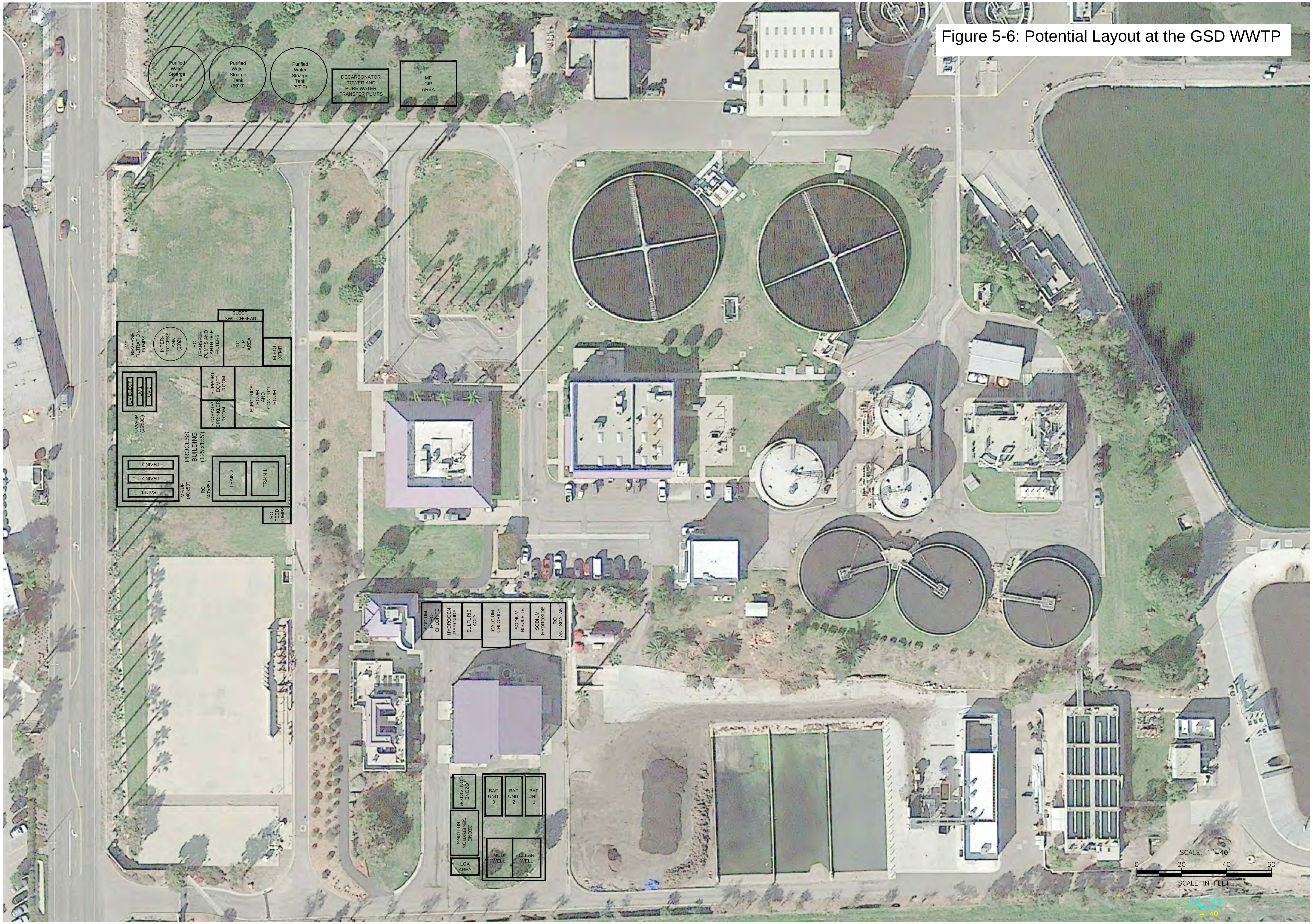
Two AWPF sites were considered: 1) GSD WWTP; and 2) CDM WTP. Proposed facilities layouts for siting all “AWPF++” facilities at the GSD WWTP is shown in **Figure 5-7** and at CDM WTP in **Figure 5-8**. There is sufficient space for all AWPF++ facilities at this site. Siting the AWPF at the GSD WWTP has the benefits of only having to pump finished water (85% of the total) to its ultimate entry into the water system and ease of brine disposal, due to its proximity to the ocean outfall.

Sufficient space is available at CDM WTP for the facilities and this option has the benefit of institutional simplicity by keeping all potable treatment facilities in one location. The drawback however, is an additional pipeline that must be constructed to convey the RO concentrate from CDM WTP to the ocean outfall at the GSD WWTP. Installation of a zero liquid discharge facility could eliminate this drawback, but would increase capital and operations costs. Also, this siting option is only feasible with raw water augmentation due to the distance from CDM WTP to the other potential receptors (groundwater injection wells and Van Horne Reservoir).

5.5.2 Conveyance

Two options were considered for conveyance from GSD WWTP to CDM WTP (**Figure 5-9**). The first option considered is construction of an entirely new pipeline along the proposed alignment. The second option is to use the existing non-potable system to convey water a portion of the distance to CDM WTP and construct a new pipeline from the existing non-potable system to CDM WTP. The benefit of this alternative is a reduction in capital cost by avoiding 19,000 LF of new pipeline. Existing non-potable customers would then receive purified water or be disconnected from the recycled water system. The considerations of impacts to existing non-potable customers from using the existing system is discussed in Section 6.3.1.

Figure 5-6: Potential Layout at the GSD WWTP



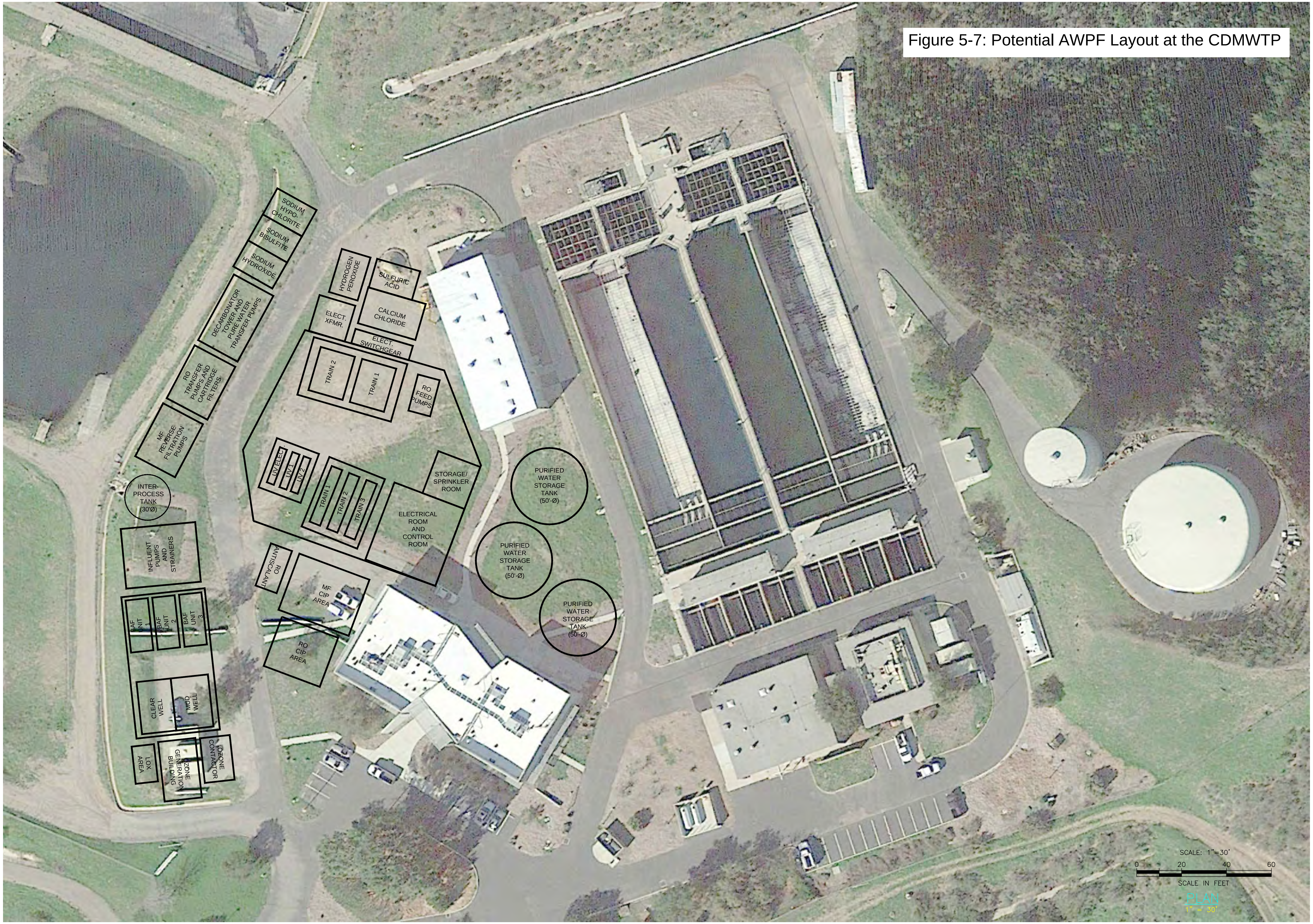
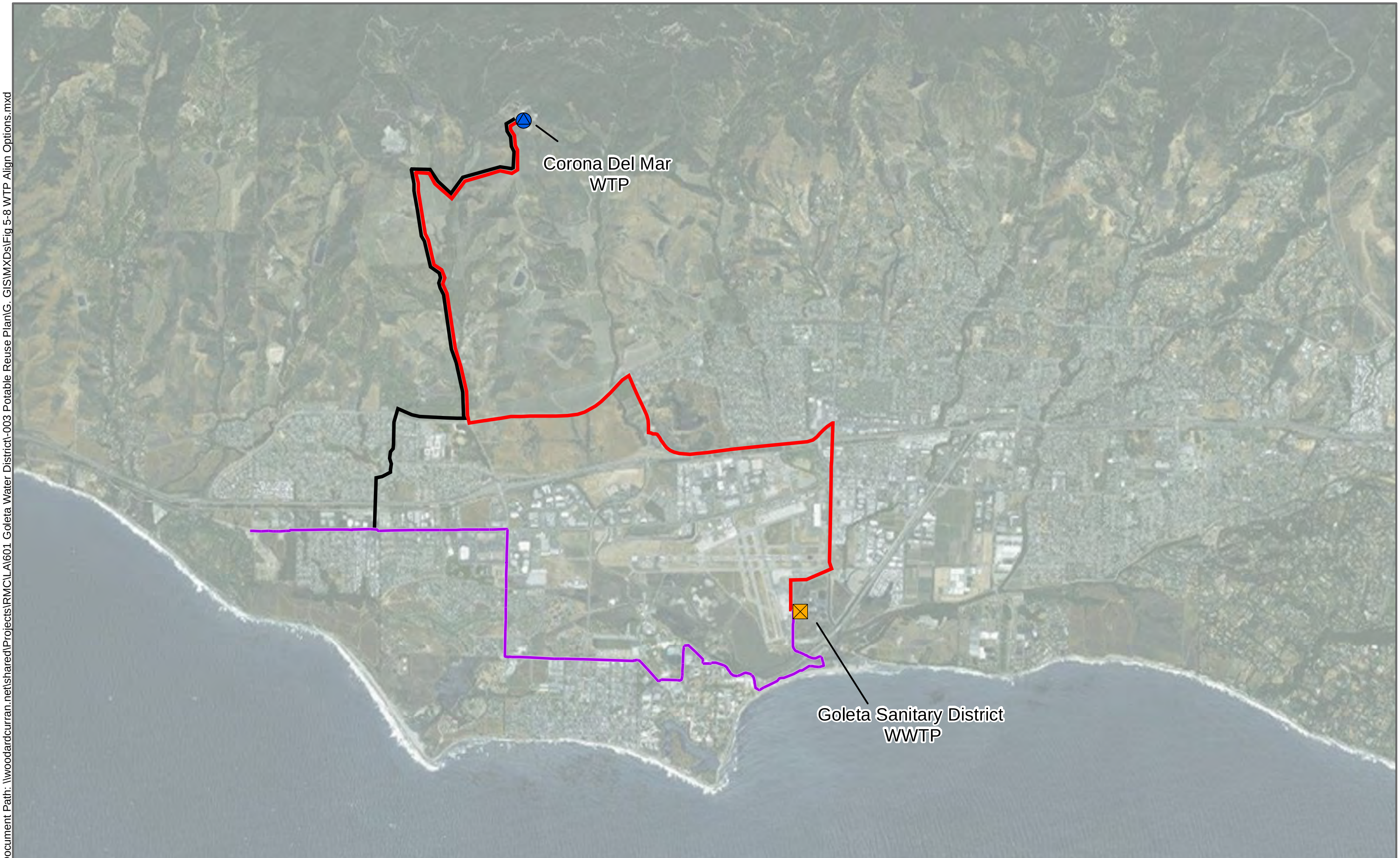


Figure 5-7: Potential AWPF Layout at the CDMWTP



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Existing Facilities

- Wastewater Treatment Plant
- Water Treatment Plant
- Existing RW Pipeline

CDM WTP Alignment Options

- Option 1
- Option 2

Figure 5-8: CDM WTP Alignment Options

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Chapter 6 Project Alternatives Analysis

6.1 Alternatives Description

Nine alternatives were developed for three receptor options, as summarized in this section:

- Groundwater (Goleta Groundwater Basin)
- Raw Water (CDM WTP)
- Treated Water (Van Horne Reservoir)

These nine alternatives were divided into two main groups: “A” and “B”. “A” alternatives assume the existing non-potable system would be terminated to apply all available wastewater for potable reuse, resulting in a maximum project yield of 5,890 AFY. “B” alternatives assume continued operation of the existing non-potable system, which limits project yield to 4,550 AFY. (Refer to Section 5.1.1 for discussion of project yield). Each alternative includes the following components, which were discussed in Chapter 5:

- **Treatment Processes:** A minimum of AWPF treatment (MF/RO/AOP) is assumed. Raw water augmentation alternatives include extra treatment, storage, and monitoring while treated water augmentation alternatives include additional, expanded treatment.
- **Treatment Upgrades:** Both raw water augmentation and treated water augmentation alternatives assume full biological nutrient removal (BNR) upgrades at the GSD WWTP. Treated water augmentation alternatives assume expansion of tertiary treatment to treat all flows to the AWPF.
- **Treatment Location:** The AWPF is located at the GSD WWTP for groundwater and treated water augmentation alternatives. For raw water augmentation, the AWPF is located at either the GSD WWTP or the CDM WTP.
- **Pump Station:** Each alternative includes a new pump station at GSD WWTP and the raw water augmentation alternatives include a second pump station to boost purified water supplies to the CDM WTP.
- **Pipelines:** Each alternative includes a transmission main ranging from 18 inches to 24 inches in diameter. The groundwater augmentation alternatives include 6-inch diameter distribution mains to each injection well. Alt A2a includes the use of the existing non-potable distribution system to convey the water a portion of the distance to the CDM WTP. Also, the raw water and treated water augmentation alternatives include a trenchless crossing of Highway 101.
- **Engineered Storage:** The raw water augmentation alternatives include three tanks with at least two hours of storage while the treated water augmentation alternatives include three tanks with at least six hours of storage. The raw water augmentation alternatives with the AWPF located at GSD WWTP also include 2 to 4 hours of travel time in the conveyance pipeline. Groundwater augmentation alternatives do not include engineered storage but does include minimum retention time of 2 months.
- **Blending:** Raw water augmentation assumes purified water is limited to no more than 50% of source water to the CDM WTP at any point in time due to concerns regarding effects on WTP operations and DDW may not issue full log removal credit for the WTP. Treated water augmentation blending requirements are also assumed to be limited to no more than 50%; however, there has been little regulatory discussion on the topic to date. Groundwater augmentation does not have requirements but does include minimum retention time of 2 months.
- **Monitoring:** The raw water augmentation alternatives include a $1 million lump sum for additional system monitoring while the treated water augmentation alternatives include a $5 million lump sum. Potential critical control point monitoring requirements are not defined well enough at this time for further definition.

- **Injection Wells:** The groundwater augmentation alternatives include a sufficient number of injection wells to recharge the product water at a rate of 0.5 MGD per well, which is based on previous injection studies completed by the District, along with an additional backup well. The cost of a monitoring well is also included with each injection well as part of a future compliance monitoring network.
- **Ocean Outfall Modification:** A lump sum cost of $500,000 is included as a placeholder for potential modifications required to the existing ocean outfall to mitigate periods with low effluent flows predominantly consisting of RO brine. An evaluation is required to determine the impacts of changes to effluent as well as the potential mitigation measures. The evaluation is included as a next step in Section 8.8.3.
- **Avoided NPR System Costs:** The "A" alternatives avoid the need to invest approximately $9.2 million in estimated non-potable reuse (NPR) system capital projects to improve reliability, such as a pipe to loop the currently linear system, and O&M costs of roughly $800,000 per year. Alternative A2a would avoid much of the capital cost but would still require the planned upgrades to the portions of the system proposed for use as part of the alternative.

It should be noted that the minimum treatment, storage, and monitoring requirements for the raw water augmentation and treated water augmentation alternatives are based on an interpretation of the ongoing DPR regulatory discussion. These requirements will be subject to change once regulations are finalized for each type of potable reuse.

The alternatives are described in detail below and are summarized in **Table 6-1** and **Figure 6-1**.

6.1.1 "A" Alternatives

The five group "A" alternatives assume the existing non-potable system would be abandoned to apply all available wastewater for potable reuse with a 5.4 MGD (product water) treatment system, resulting in maximum purified water production of 5,890 AFY. Since existing non-potable demand becomes potable demand if the non-potable system is discontinued, roughly 1,270 AFY of non-potable demand (in 2030) must be accounted for, which reduces the potable reuse project yield by 1,270 AFY to a net yield of 4,620 AFY. As noted above, avoided capital and O&M costs associated with the NPR system are included in the "A" alternative cost estimates

Alternative A1: Groundwater Augmentation

For this alternative, purified water from a new AWPF located at the GSD WWTP will be conveyed to injection wells for groundwater augmentation. Alternative A1 facilities include:

- 5.4 MGD AWPF (MF/RO/AOP; located at GSD WWTP)
- Pump station (450 hp; located at GSD WWTP)
- Transmission main (18-inch @ 9,800 LF and 12-inch @ 13,200 LF; from AWPF to injection well areas)
- 6-inch diameter distribution mains (13,500 LF; from transmission main to each injection well)
- New injection wells (12); includes one redundant well
- No engineered storage

Alternative A2: Raw Water Augmentation, AWPF at GSD WWTP

For this alternative, purified water from a new AWPF located at GSD WWTP will be conveyed to the CDM WTP intakes. Alternative A2 facilities include:

- 5.4 MGD AWPF+ treatment facilities (UF/RO/AOP + Cl; located at GSD WWTP)
- GSD WWTP upgraded to full BNR

- 3 x 0.5 MG of engineered storage
- Pump Stations (450 hp at GSD WWTP; 650 hp along the pipeline route for boost to CDM WTP)
- 24-inch diameter transmission main (40,000 LF; from AWPF at GSD WWTP to CDM WTP)

Alternative A2a: Raw Water Augmentation, AWPF at GSD WWTP, Alternate Alignment

This alternative is similar to A2 with the exception that the existing non-potable system would be used to convey purified water from the AWPF sited at the GSD WWTP part of the distance to the CDM WTP. A new transmission main would be constructed at the point where the existing system reduces from a 16-inch diameter pipe to a 12-inch diameter pipe. Alternative A2a facilities include:

- 5.4 MGD AWPF+ (UF/RO/AOP + Cl; located at GSD WWTP)
- GSD WWTP upgraded to full BNR
- 3 x 0.5 MG of engineered storage
- Pump Stations (700 hp at GSD WWTP and 700 hp along the pipeline route for boost to CDM WTP)
- 18-inch diameter transmission main (21,000 ft; from existing NPR system to CDM WTP)

Note that, compared with Alternative A2, the pump stations have higher horsepower requirements since the existing non-potable system pipeline diameters (18-inch and 16-inch) are smaller than is optimal for the required flow rates. This results in higher head losses for Alternative A2a.

Alternative A3: Raw Water Augmentation, AWPF at CDM WTP

For this alternative, secondary effluent from the GSD WWTP would be conveyed via pipeline to a new AWPF sited at the CDM WTP site. In addition to a secondary effluent transmission main, a brine pipeline is required to send RO concentrate from the AWPF to the GSD WWTP. Alternative A3 facilities include:

- 5.4 MGD AWPF+ (UF/RO/AOP + Cl; located at CDM WTP)
- GSD WWTP upgraded to full BNR
- 3 x 0.5 MG of engineered storage
- Pump Stations (550 hp at GSD WWTP and 750 hp along the pipeline route for boost to CDM WTP)
- 24-inch diameter transmission main (40,000 LF; from GSD WWTP to AWPF at CDM WTP)
- 6-inch diameter brine/waste pipeline (40,000 LF; from CDM WTP to GSD WWTP)

Alternative A4: Treated Water Augmentation

This alternative would convey purified water from new AWPF at the GSD WWTP to the Van Horne Reservoir. The absence of an environmental buffer (as in groundwater augmentation) or additional treatment (as in raw water augmentation) requires additional treatment and monitoring. Alternative A4 facilities include:

- 5.4 MGD AWPF++ (UF/RO/AOP + Cl + Ozone/BAC; located at GSD WWTP)
- GSD WWTP upgraded to full BNR
- 3.3 MGD additional tertiary treatment at GSD WWTP
- 3 x 1.4 MG of engineered storage
- Pump Station (550 hp; located at GSD WWTP)
- 18-inch diameter transmission main (19,800 LF; from GSD WWTP to Van Horne Reservoir)

6.1.2 "B" Alternatives

The four group "B" alternatives assume continued operation of the non-potable system, which limits project yield to 4,550 AFY. Each alternative includes a 4.3 MGD AWPF.

Alternative B1: Groundwater Augmentation

This alternative is similar to Alternative A1 with the exception that a smaller project yield results in fewer injection wells and distribution mains. Alternative B1 facilities include:

- 4.3 MGD AWPF (MF/RO/AOP; located at GSD WWTP)
- Pump station (350 hp; located at GSD WWTP)
- Transmission main (18-inch @ 9,800 LF and 12-inch @ 7,000 LF; from AWPF to injection well areas)
- 6-inch diameter distribution mains (11,600 LF; from transmission main to each injection well)
- New injection wells (10); includes one redundant well
- No engineered storage

Alternative B2: Raw Water Augmentation, AWPF at GSD WWTP

This alternative is similar to Alternative A2 with the exception that a smaller project yield results in smaller facilities. Alternative B2 facilities include:

- 4.3 MGD AWPF+ (UF/RO/AOP + Cl; located at GSD WWTP)
- GSD WWTP upgraded to full BNR
- 3 x 0.4 MG engineered storage
- Pump Stations (450 hp at GSD WWTP and 550 hp along the pipeline route for boost to CDM WTP)
- 24-inch diameter transmission main (40,000 LF; from AWPF at GSD WWTP to CDM WTP)

Alternative B3: Raw Water Augmentation, AWPF at CDM WTP

This alternative is similar to Alternative A3 with the exception that a smaller project yield results in smaller facilities. Alternative B3 facilities include:

- 4.3 MGD AWPF+ (UF/RO/AOP + Cl; located at CDM WTP)
- GSD WWTP upgraded to full BNR
- 3 x 0.4 MG engineered storage
- Pump Stations (450 hp at GSD WWTP and 600 hp along the pipeline route for boost to CDM WTP)
- 24-inch diameter transmission main (40,000 LF; from GSD WWTP to AWPF at CDM WTP)
- 6-inch diameter brine/waste pipeline (40,000 LF; from CDM WTP to GSD WWTP)

Alternative B4: Treated Water Augmentation

This alternative is similar to Alternative A4 with the exception that a smaller project yield results in smaller facilities. Alternative B4 facilities include:

- 4.3 MGD AWPF++ (UF/RO/AOP + Cl + Ozone/BAC; located at GSD WWTP)
- GSD WWTP upgraded to full BNR
- 2.1 MGD additional tertiary treatment at GSD WWTP
- 3 x 1.1 MG engineered storage
- Pump Station (400 hp; located at GSD WWTP)
- 18-inch diameter transmission main (19,800 LF; from GSD WWTP to Van Horne Reservoir)

Table 6-1: Summary of Potable Reuse Alternatives

Alt.	Receptor	Net Yield (AFY) (1)	Advanced Treatment		GSD WWTP		Non-Treatment Facilities			
			Process(2)	Location	Full BNR Upgrade	Tertiary Expansion	Conveyance (3)	Pump Station(s)	Engineered Storage (4)	Other (5,6)
A1	Ground-water	4,620	AWPF	GSD WWTP	No	None	9,800 LF (18" dia.) 13,200 LF (12" dia.) 13,500 LF (6" dia.)	450 hp	None	12 Injection Wells
B1	Ground-water	4,550	AWPF	GSD WWTP	No	None	9,800 LF (18" dia.) 7,000 LF (12" dia.) 11,600 LF (6" dia.)	350 hp	None	10 Injection Wells
A2	Raw Water CDM WTP	4,620	AWPF+	GSD WWTP	Yes	None	40,000 LF (24" dia.)	450 hp 650 hp	3 x 0.5 MG	Additional Monitoring
A2a	Raw Water CDM WTP	4,620	AWPF+	GSD WWTP	Yes	None	21,000 LF (18" dia.)	2 x 700 hp	3 x 0.5 MG	Additional Monitoring
B2	Raw Water CDM WTP	4,550	AWPF+	GSD WWTP	Yes	None	40,000 LF (24" dia.)	450 hp 550 hp	3 x 0.4 MG	Additional Monitoring
A3	Raw Water CDM WTP	4,620	AWPF+	CDM WTP	Yes	None	40,000 LF (24" dia.) 40,000 LF (6" dia.)(7)	550 hp 750 hp	3 x 0.5 MG	Additional Monitoring
B3	Raw Water CDM WTP	4,550	AWPF+	CDM WTP	Yes	None	40,000 LF (24" dia.) 40,000 LF (6" dia.)(7)	450 hp 600 hp	3 x 0.4 MG	Additional Monitoring
A4	Treated Water Van Horne Reservoir	4,620	AWPF++	GSD WWTP	Yes	3.3 MGD	19,800 LF (18" dia.)	550 hp	3 x 1.4 MG	Additional Monitoring
B4	Treated Water Van Horne Reservoir	4,550	AWPF++	GSD WWTP	Yes	2.1 MGD	19,800 LF (18" dia.)	400 hp	3 x 1.1 MG	Additional Monitoring

Notes:

1. Net yield for "A" alternatives is 4,620 AFY after the 5,890 AFY of product water is reduced by 1,270 AFY to account for non-potable demand that must now be met with purified or potable water when the non-potable system flows are used for potable reuse.
2. "AWPF" = MF/RO/AOP; "AWPF+" = UF/RO/AOP + Cl; "AWPF++" = UF/RO/AOP + Cl + BAC/O_3
3. All alternatives except for B1 include a trenchless crossing of Highway 101.
4. The raw water augmentation alternatives include three tanks with at least two hours of storage while the treated water augmentation alternatives include three tanks with at least six hours of storage. Groundwater augmentation does not require engineered storage.
5. Injection Wells: The groundwater augmentation alternatives include enough injection wells to recharge the produced water at a rate of 0.5 MGD per well, which is based on previous injection studies completed by the District, along with an additional backup well.
6. Monitoring: The raw water augmentation alternatives include a $1 M lump sum for additional system monitoring while the treated water augmentation alternatives include a $5 M lump sum since critical control point monitoring requirements are not defined well enough at this time to include in this analysis.
7. The 6-inch diameter brine line from the CDM WTP to the GSD WWTP is assumed to be located in the same trench as the 24-inch diameter pipeline conveying secondary effluent to the CDM WTP.

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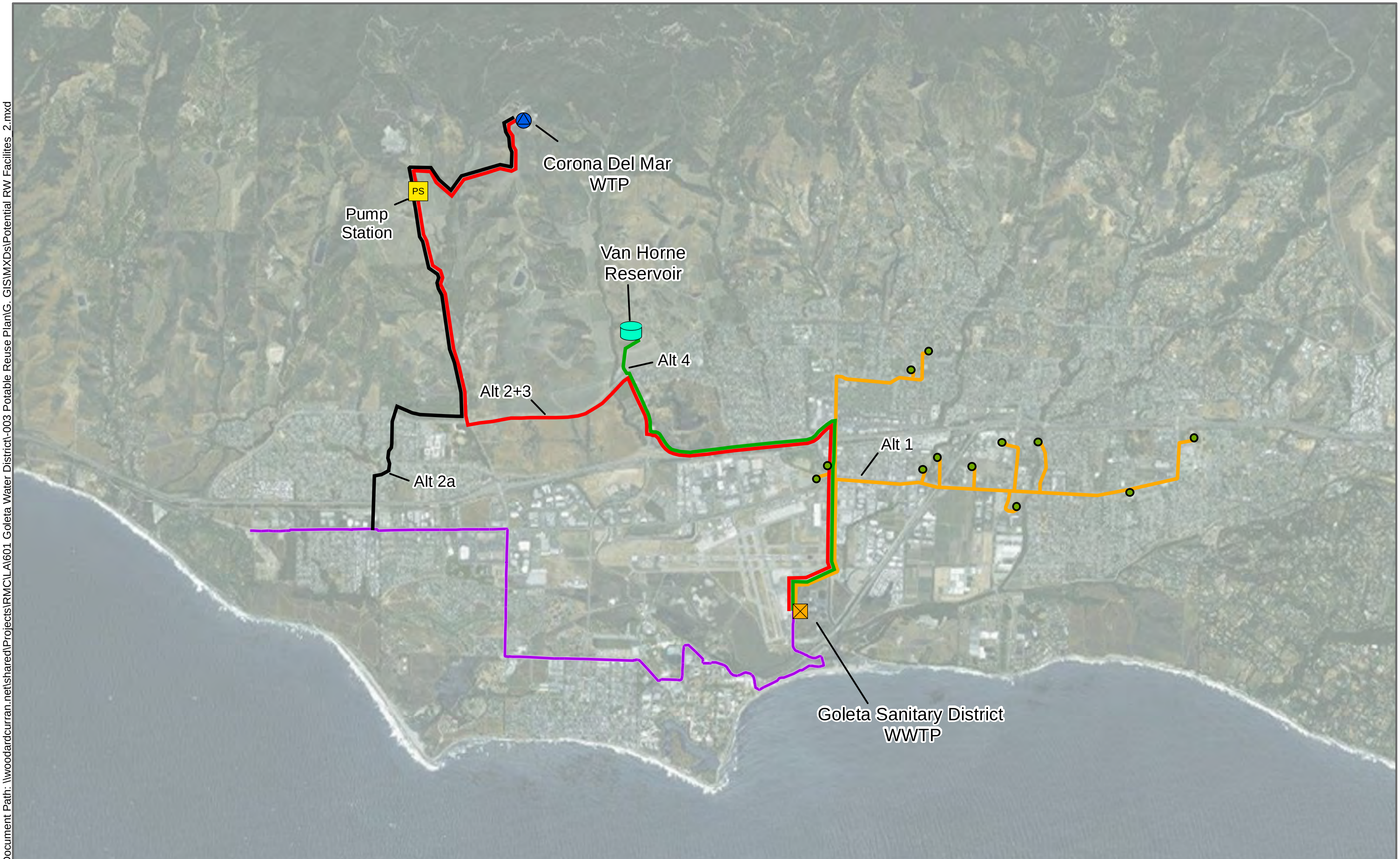

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Existing Facilities

- Existing RW Pipeline
- Water Treatment Plant
- Wastewater Treatment Plant
- Potable Water Storage

Potential Facilities

- Injection Wells
- PS Pump Station
- Alt 1: Groundwater Injection
- Alt 2a: RWA Substitute Alignment
- Alt 2,3: RWA
- Alt 4: Flange to Flange

Figure 6-1: Potential Recycled Water Facilites

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6.2 Cost Estimate

6.2.1 Cost Estimate Basis

The Association for Advancement of Cost Estimating International's (AACE) cost estimate classification system includes five classes of project cost estimates. Cost estimates in this report fall within Class 4 estimates, which have an expected accuracy of +50% to -30%. Per AACE (2011): "Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams for main process systems, and preliminary engineered process and utility equipment lists."

Reference Unit Costs

Various unit cost data and estimating methods have been used to develop the conceptual level construction cost estimate. A summary of these unit costs is contained in **Table 6-2**.

Table 6-2: Unit Costs

Facilities	Construction Cost (1)	Annual O&M Cost	Useful Life (2)
Electricity	--	$0.13/kWh	
Treatment Facilities (3)			
"AWPF" (UF/RO/AOP)	$6.6 M - $7.2 M per MGD	$0.7 M per MGD (capacity)	Concrete structures: 50 years Mechanical and electrical: 20 years
"AWPF+" (UF/RO/AOP + Cl)	$6.9 M - $7.4 M per MGD	$0.75 M per MGD (capacity)	
"AWPF++" (UF/RO/AOP + Cl + BAC/O3)	$8.9 M - $9.2 M per MGD	$0.9 M per MGD (capacity)	
BNR at GSD WWTP	$4.8 M	$0.1 M	
Tertiary Filtration Expansion	$2.0 M per MGD	$0.1 M	
Distribution System Facilities			
Storage	$1.5 / gal	5% of capital cost	65 years
Product Water Pump Station (4)	$6,500 / hp	5% of capital cost	Concrete structures: 50 years Mechanical and electrical: 15 years
Pipelines	6" ($120/LF), 12" ($180/LF), 18" ($270/LF), 24" ($360/LF)	1% of capital cost	80 years
Injection Wells	$1.0 M	5% of capital cost	
Monitoring Wells	$0.2 M	5% of capital cost	
Groundwater Pumping	--	$120 / AF	

Notes:

1. Contingencies and implementation factor presented below the table are added to the unit construction costs.
2. Source: Failure to Act: The Economic Impact of Current Investment Trends in Water and Wastewater Treatment Infrastructure (ASCE, 2011).
3. AWPF cost estimates developed using Treatment Train Toolbox from WRRF-11-02: Equivalency of Advanced Treatment Trains for Potable Reuse (Trussell et. al., 2015).
4. Pump station size based on peak flow and 75% pump / motor efficiency.

Total Capital Cost Factors

Construction contingency and implementation factors are added to the raw construction costs derived from the unit costs in the previous section.

Construction contingencies are defined as unknown or unforeseen costs. In general, higher contingencies should be applied to projects of high risk or with significant unknown or uncertain conditions. Unknowns and risk conditions for construction cost estimates could include project scope, level of project definition, occurrence of groundwater and associated dewatering uncertainties, unknown soil conditions, unknown utility conflicts, etc. A 30% contingency will be applied to construction cost estimates based on the methodology for Class 4 estimates.

Implementation factors are included to try to capture the capital costs associated with the implementation of the project in addition to construction costs. While these costs can vary greatly from project to project and from component to component, it is most common to assume a standard factor applied to the estimated construction costs across all projects and project types when analyzing alternatives and project options. Implementation factors are used to account for the following activities:

- Planning, environmental documentation, and permits
- Engineering services (pre-construction)
- Property acquisition (excluding cost of property)
- Engineering services during construction
- Construction management and inspection
- Legal and administrative services

For this study, 30% of the estimated project construction costs are used to account for these additional services.

Present Worth

The various alternatives will be compared using the present worth method, which adds the total capital cost to the present value of annual O&M costs such that both the initial capital and ongoing annual costs are considered. The economic factors used to analyze the estimated costs for each of the alternatives are:

- **Cost Basis:** Costs are benchmarked to the Engineering News Record's (ENR) Construction Cost Index (CCI) 20 Cities Average, January 2017 (10531.68) and adjusted for the Santa Barbara location factor (105.9%). Where historic unit cost data have been applied, those unit costs have been escalated to January 2017 dollars using the index and location factor.
- **Project Financing:** Interest Rate & Payback Period: 3% over 30 years. Based on State Revolving Fund (SRF) loans which have a lower rate than loans available from the open market (and are further discussed in Section 8.6.

6.2.2 Alternatives Costs

The cost estimates for each of the nine alternatives were developed in accordance with the parameters described in Section 6.2.1. A summary of the estimated capital, O&M, and unit costs for the group "A" and group "B" alternatives is presented in **Table 6-3** while more details for each group are provided in **Table**

6-4 and **Table 6-5**. A detailed breakdown of the cost estimates is contained in Appendix D. Several conclusions can be drawn from a comparison of the costs for each alternative:

- Unit costs increase from groundwater augmentation alternatives to raw water augmentation alternatives to treated water augmentation alternatives primarily as a result of increasing treatment and reliability requirements (i.e., BNR, tertiary filtration, advanced monitoring, engineered storage).
- Unit costs for the group "B" alternatives are roughly 10% lower than the group "A" alternatives because the net yield for "A" alternatives is 4,620 AFY after the 5,890 AFY of product water is reduced by 1,270 AFY to account for non-potable demand that must now be met with purified or potable water.
- Alternatives A2 and A2a, which used different conveyance pipelines, have similar unit costs. Alternative 2a saved roughly $6.8 M in capital cost from using the existing non-potable system, but the undersized pipes caused higher head losses that resulted in approximately an additional $170,000 per year in electrical costs. The capital cost savings and higher O&M costs appear to roughly offset each other.
- Unit costs for Alternatives A3/B3, which located the AWPF at the CDM WTP rather than the GSD WWTP, are roughly 5% higher than for Alternatives A2/B2. The additional cost is primarily due to a larger transmission main to the CDM WTP and inclusion of a brine pipeline back to the GSD WWTP.

Table 6-3: Summary of Costs for Group "A" and Group "B" Alternatives

Item	A1	A2	A2a	A3	A4	B1	B2	B3	B4
	GWA	RWA	RWA	RWA	TWA	GWA	RWA	RWA	TWA
Total Capital Costs ($M)	$99.7	$110.8	$103.9	$118.4	$131.1	$83.6	$95.0	$107.0	$112.9
Annualized Capital Cost ($M)	$5.09	$5.65	$5.30	$6.04	$6.69	$4.27	$4.85	$5.46	$5.76
Annual O&M Cost ($M)	$4.04	$5.21	$5.38	$5.35	$6.36	$3.80	$4.13	$4.15	$5.10
Total Annual Cost ($M)	**$9.09**	**$10.02**	**$9.84**	**$10.55**	**$12.20**	**$8.02**	**$8.93**	**$9.57**	**$10.81**
Project Yield (AFY)	4,620	4,620	4,620	4,620	4,620	4,550	4,550	4,550	4,550
Unit Cost ($/AF)	**$1,980**	**$2,180**	**$2,140**	**$2,300**	**$2,660**	**$1,780**	**$1,980**	**$2,120**	**$2,390**

Figure 6-2: Unit Cost Summary for Group "A" and Group "B" Alternatives

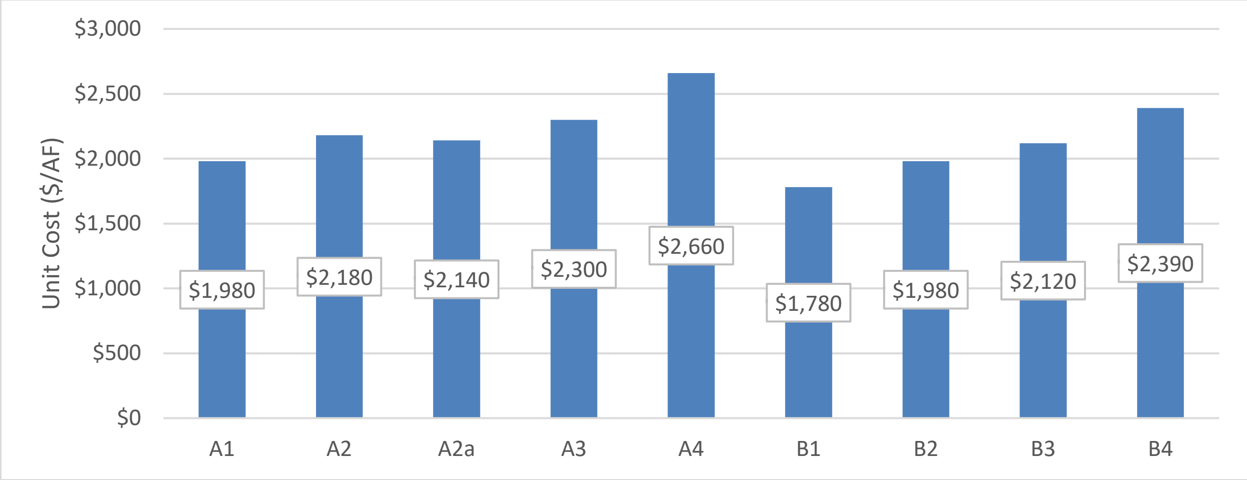


Table 6-4: Costs for Group "A" Alternatives

Item	Alt A1 GWA	Alt A2 RWA	Alt A2a RWA, Alt Alignment	Alt A3 RWA, AWPF @ CDM WTP	Alt A4 TWA
Capital Costs ($ M)					
Treatment	$39.5	$48.4	$48.4	$48.4	$73.1
Conveyance	$7.6	$15.4	$6.7	$18.6	$6.3
Pump Station	$2.9	$7.2	$9.1	$8.5	$3.6
Injection Wells	$14.4	$0.0	$0.0	$0.0	$0.0
Construction Subtotal	**$64.5**	**$71.0**	**$64.2**	**$75.5**	**$83.0**
Construction Contingency (30%)	$19.3	$21.3	$19.3	$22.7	$24.9
Construction Total	**$83.8**	**$92.3**	**$83.5**	**$98.1**	**$107.9**
Implementation Costs (30%)	$25.1	$27.7	$25.0	$29.4	$32.4
Avoided NPR System Costs	($9.2)	($9.2)	($4.6)	($9.2)	($9.2)
Total Capital Costs	**$99.7**	**$110.8**	**$103.9**	**$118.4**	**$131.1**
O&M Costs ($ M)					
Treatment	$3.90	$3.99	$3.99	$3.99	$4.99
Testing / Monitoring	$0.10	$0.50	$0.50	$0.50	$1.00
Pumping	$0.84	$0.72	$0.89	$0.86	$0.37
Avoided NPR System Costs	($0.80)	($0.80)	($0.80)	($0.80)	($0.80)
Total O&M Costs	**$4.04**	**$5.21**	**$5.38**	**$5.35**	**$6.36**
Unit Costs					
Annualized Capital Cost ($ M)	$5.09	$5.65	$5.30	$6.04	$6.69
Annual O&M Cost ($ M)	$4.04	$5.21	$5.38	$5.35	$6.36
Total Annual Cost ($ M)	**$9.13**	**$10.06**	**$9.89**	**$10.59**	**$12.24**
Project Yield (AFY)	4,620	4,620	4,620	4,620	4,620
Unit Cost (per AF)	**$1,980**	**$2,180**	**$2,140**	**$2,300**	**$2,660**

Note: Pumping costs include the cost of groundwater pumping for GWA alternatives.

Table 6-5: Costs for Group "B" Alternatives

Item	Alt B1	Alt B2	Alt B3	Alt B4
	GWA	RWA	RWA, AWPF @ CDM WTP	TWA
Capital Costs ($ M)				
Treatment	$29.9	$37.9	$37.9	$57.8
Conveyance	$5.3	$11.8	$18.6	$6.3
Pump Station	$2.3	$6.5	$6.8	$2.6
Injection Wells	$12.0	$0.0	$0.0	$0.0
Construction Subtotal	**$49.5**	**$56.2**	**$63.3**	**$66.8**
Construction Contingency (30%)	$14.8	$16.9	$19.0	$20.0
Construction Total	**$64.3**	**$73.0**	**$82.3**	**$86.8**
Implementation Costs (30%)	$19.3	$21.9	$24.7	$26.0
Total Capital Costs	**$83.6**	**$95.0**	**$107.0**	**$112.9**
O&M Costs ($ M)				
Treatment	$2.94	$2.98	$2.98	$3.84
Testing / Monitoring	$0.10	$0.50	$0.50	$1.00
Pumping	$0.76	$0.65	$0.67	$0.26
Total O&M Costs	**$3.80**	**$4.13**	**$4.15**	**$5.10**
Unit Costs				
Annualized Capital Cost ($ M)	$4.27	$4.85	$5.46	$5.76
Annual O&M Cost ($ M)	$3.80	$4.13	$4.15	$5.10
Total Annual Cost ($ M)	**$8.06**	**$8.97**	**$9.61**	**$10.86**
Project Yield (AFY)	4,550	4,550	4,550	4,550
Unit Cost ($ / AF)	**$1,780**	**$1,980**	**$2,120**	**$2,390**

Note: Pumping costs include the cost of groundwater pumping for GWA alternatives.

6.3 Initial Alternatives Evaluation

Evaluating the alternatives requires a decision on the fate of the existing non-potable system ("A" alternatives versus "B" alternatives) and the preferred AWPF site (Alternatives A2/B2 versus A3/B3). The non-potable system fate will determine whether group "A" alternatives should be considered further. Then, qualitative differences between the alternatives that are not captured by cost estimates should be considered.

6.3.1 Non-Potable System Fate

The yield of the group "A" alternatives assumes existing non-potable deliveries end and the recycled water is purified for potable reuse. This assumption has several substantial implications:

- Requires delivery of purified water to non-potable customers, for mostly irrigation purposes, which is a much higher quality then needed. This delivery could be accomplished via the existing non-potable distribution system or through the potable water system to these customers, which may have costs for potable conversion and customer rate implications.

- Existing customers are likely to object after investing in non-potable systems, such as dual plumbing, and due to the potential to pay higher potable water rates (and tiers) rather than lower recycled water rates.
- The public may object because irrigation of public green spaces, which is typically reduced in drought conditions (unless recycled water is being used), promotes wellness. Ending recycled water deliveries to parks and schools or other public green spaces may result in reduced irrigation and an increased number of brown spaces during drought periods.

Notably, the existing system has a high need for maintenance and replacement of pipes and facilities due to the age of the system and corrosive soil conditions. The 2015-2020 Infrastructure Improvement Plan (IIP) includes 10 recycled water system projects that total $9.5 million to address existing deficiencies and improve reliability of service, such as by installing a pipe to loop the distribution system. In addition, annual system O&M costs (excludes debt service) total roughly $800,000 per year. These avoided costs for the "A" alternatives were accounted for as credits in their cost estimates.

The "B" alternatives still had lower unit costs than the "A" alternatives after accounting for avoided NPR system costs and adjusting the "A" alternatives' yield to account for non-potable system demand that now must be met. On the whole, the analysis indicates that the negatives of terminating the non-potable system appear to outweigh the positives. **Therefore, the "A" alternatives are not considered further.**

6.3.2 AWPF Site Preference

The GSD WWTP has several significant advantages over the CDM WTP as the AWPF site, including lower cost, potable reuse type flexibility, and layout flexibility, as described further:

- The lower cost of the GSD WWTP site results from avoiding conveying AWPF influent volume to CDM WTP and then conveying brine back to the GSD WWTP ocean outfall.
- The GSD WWTP site allows for implementation of groundwater, raw water, or treated water augmentation while use of the CDM WTP site limits potable reuse options to raw water augmentation at CDM WTP
- The GSD WWTP has more potentially available space compared to CDM WTP and, thus, more flexibility to layout the AWPF

Siting the AWPF at the CDM WTP separates the water purification processes from the wastewater treatment processes and GWD would presumably own and operate the AWPF. Assuming GWD ultimately pays for AWPF O&M, the separation avoids the existing non-potable system situation (as an example) where GSD bills GWD for O&M associated with recycled water production control. Also, separation of purification and wastewater can provide public perception benefits by physically separating the potable water production from wastewater treatment.

The benefits of siting the AWPF at the CDM WTP do not overcome the disadvantages (higher cost, limited to raw water augmentation) so **the GSD WWTP is the preferred AWPF site over the CDM WTP.**

6.3.3 Qualitative Evaluation

Based on the recommendation to keep the non-potable system (and eliminate the "A" alternatives) and to site the AWPF at GSD WWTP, three alternatives remain:

- Alternative B1: Groundwater Augmentation
- Alternative B2: Raw Water Augmentation
- Alternative B4: Treated Water Augmentation

Groundwater augmentation is the lowest cost alternative. However, qualitative considerations could support the other alternatives. The primary qualitative differences between the alternatives include the following:

- Cost risk associated with the effect of future regulations on facility and operational requirements, which primarily effects project costs.
- Schedule risk associated with the absence of existing regulations for raw water augmentation and treated water augmentation that could delay implementation until regulations are in place (or proceed with a higher risk from assumed regulatory requirements)
- Implementation flexibility regarding the ability to implement projects phases to meet near-term supply shortfalls or provide public and regulatory support
- Potable system operations will be impacted by the location where new water is introduced into the system, which can increase system operational costs and complexity
- Public acceptance of the various forms of potable reuse considered is essential for project implementation

Cost Risk

The scope of the regulatory requirements will impact project costs as treatment, monitoring, and engineered storage are defined. We have assumed higher levels of treatment, monitoring, and storage for treated water augmentation versus raw water augmentation versus groundwater augmentation that resulted in higher costs for the respective projects. Future regulations could be less conservative than the assumptions in this report, which would reduce projects costs; however, raw water augmentation will still require additional conveyance infrastructure (pump stations and pipelines) due to the more distant CDM WTP location.

Schedule Risk

The timing of establishing new regulatory requirements will determine the point in the future at which a project can be implemented. Raw water augmentation projects will likely be possible from a regulatory standpoint sooner than treated water augmentation in California due to current interest from water suppliers. As of the date of this report, DDW has not committed to a timeline to complete new regulations so the timing of the District’s new water supply needs is an important consideration.

Implementation Flexibility

Similarly, the ability to implement a project in phases is beneficial from a rate impact perspective. The pipeline is the primary facility that must be installed for the ultimate capacity initially; whereas, treatment and pumping can be designed for future expansion. Raw water augmentation has the least flexibility due to the need for significant (40,000 LF) pipeline installation. Groundwater augmentation offers the most since it has the shortest transmission pipeline and has regulations in place for implementation.

Potable System Operations

The existing potable water system is primarily a gravity-fed system from the CDM WTP when surface water supplies (Cachuma and SWP) are the primary supply source, whereas groundwater must be pumped through the distribution system to customers. A groundwater augmentation project would increase normal groundwater pumping from 1,000 to 2,000 AFY by up to 4,550 AFY. Extraction of the injected water would result in new groundwater supplies entering the potable system at individual wells with independent pumps results in a more complex system. In comparison, raw water augmentation results in continued system operations as today and treated water augmentation would be similarly gravity fed from Van Horne Reservoir. Also, groundwater augmentation and treated water augmentation supply the lower zone of the potable system and would require additional boosting to supply the upper zone of the potable system, which has relatively low demand but is fed by gravity from CDM WTP.

Public Acceptance

Groundwater augmentation has gained broader public acceptance over the past decade as successful projects, such as Orange County Water District's Groundwater Replenishment System, and is supported by the fact that over 20 groundwater augmentation projects are in various stages of development across California. Public acceptance of recycled water as a non-potable supply has increased within Santa Barbara County, however, it is evident from previous and parallel planning efforts that explore options for potable use of recycled water that there is some opposition to its use. (Note that public outreach recommendations are discussed in Chapter 8.2).

Raw water augmentation is assumed have a higher risk of public opposition due lack of existing projects and treated water augmentation is assumed to have an even higher risk of public opposition.

Qualitative Summary

Table 6-6 summarizes the qualitative discussion in this section.

Table 6-6: Summary of Qualitative Analysis

Alternative	B1	B3	B4
Item	Groundwater Augmentation	Raw Water Augmentation	Treated Water Augmentation
Cost Risk	✓	✗	✗
Schedule Risk	✓	○	✗
Implementation Flexibility	✓	✗	✗
Potable System Operations	✗	✓	✓
Public Acceptance	✓	✗	✗

✓ Positive Attribute
○ Neutral Attribute
✗ Negative Attribute

6.3.4 Initial Alternatives Evaluation Findings

Based on the cost and qualitative information, Alternative B1 (groundwater augmentation) is preferred over the other alternatives since it has the lowest unit cost, most defined regulatory pathway most implementation flexibility, and highest likelihood of public acceptance. However, the potable system capacity to handle significant increased use of groundwater and increased operational complexity is recommended for further investigation. In addition, prior to and during project implementation, the District would need to further evaluate the ability to integrate injection of 4,550 AFY of purified water into groundwater basin management plans that coordinate with other water supplies. Finally, only approximately 3,000 AFY is available today for potable reuse (assuming the non-potable system continues to operate) and construction of the full (4,550 AFY) project requires significant capital costs. Therefore, four phased alternatives were developed for comparison and are discussed in the next section.

6.4 Phased Alternatives Description

Four new phased alternatives were defined - two groundwater augmentation (GWA) alternatives with smaller yields than Alternative B1 and two hybrid alternatives that combine an initial GWA phase with either raw water augmentation (RWA) or treated water augmentation (TWA).

- **GWA Phase 1 Alternative:** Groundwater Augmentation (1,500 AFY)
- **GWA Phase 2 Alternative:** Groundwater Augmentation (3,000 AFY)

- **GWA/RWA Alternative:** Groundwater Augmentation (up to 3,000 AFY) & Raw Water Augmentation (up to 3,000 AFY) (total of 4,550 AFY)
- **GWA/TWA Alternative:** Groundwater Augmentation (up to 3,000 AFY) & Treated Water Augmentation (up to 3,000 AFY) (total of 4,550 AFY)

In addition, three "B" series alternatives are being carried forward for evaluation:

- **GWA Phase 3 Alternative** (formerly Alternative B1)**:** Groundwater Augmentation (4,550 AFY)
- **RWA Alternative** (formerly Alternative B2)**:** Raw Water Augmentation (4,550 AFY)
- **TWA Alternative** (formerly Alternative B4)**:** Treated Water Augmentation (4,550 AFY)

6.4.1 Alternatives Descriptions

The four new alternatives are defined below. The three phases of groundwater augmentation (GWA 1, GWA 2, and GWA 3) are shown on **Figure 6-3**.

GWA 1: Groundwater Augmentation (1,500 AFY)

- 1.5 MGD AWPF (MF/RO/AOP; located at GSD WWTP)
- Pump station (100 hp; located at GSD WWTP)
- Transmission main (18-inch @ 9,800 LF; from AWPF to injection well areas)
- 6-inch diameter distribution mains (2,900 LF; from transmission main to each injection well)
- New injection wells (4); includes one redundant well
- No engineered storage

GWA 2: Groundwater Augmentation (3,000 AFY)

- 3.0 MGD AWPF (MF/RO/AOP; located at GSD WWTP)
- Pump station (100 hp; located at GSD WWTP)
- Transmission main (18-inch @ 9,800 LF and 12-inch @ 2,800 LF; from AWPF to injection well areas)
- 6-inch diameter distribution mains (6,000 LF; from transmission main to each injection well)
- New injection wells (7); includes one redundant well
- No engineered storage

GWA/RWA: Groundwater Augmentation & Raw Water Augmentation (4,550 AFY)

This alternative combines GWA 2 (as an initial phase) with RWA but limits RWA to roughly 3.0 MGD. The initial phase of GWA/RWA is the GWA 2 facilities listed above. The ultimate phase of GWA/RWA facilities includes:

- Expand AWPF from 3.0 MGD to 4.3 MGD (UF/RO/AOP)
- 4.3 MGD of chlorine treatment
- GSD WWTP upgraded to full BNR
- 3 x 0.3 MG engineered storage
- Pump Stations (Expand GSD WWTP PS to 400 hp and new 500 hp along the pipeline route for boost to CDM WTP)
- 18-inch diameter transmission main (34,000 LF; from GWA 2 terminus to CDM WTP)

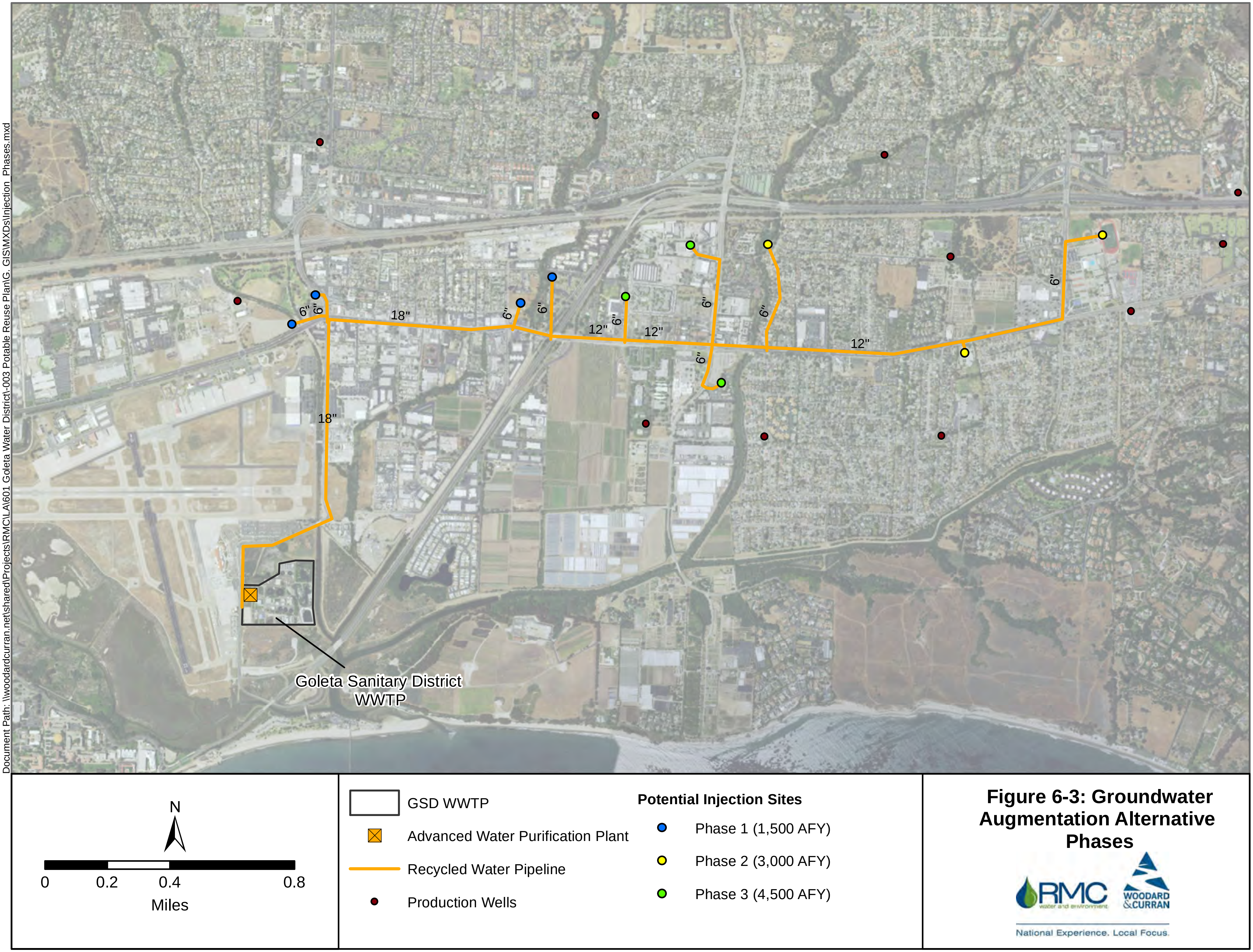


Figure 6-3: Groundwater Augmentation Alternative Phases

National Experience. Local Focus.

GWA/TWA: Groundwater Augmentation & Treated Water Augmentation (4,550 AFY)

This alternative combines GWA 2 (as an initial phase) with TWA but limits TWA to roughly 3.0 MGD. The initial phase of GWA/RWA is the GWA 2 facilities listed above. The ultimate phase of GWA/TWA facilities includes:

- Expand AWPF from 3.0 MGD to 4.3 MGD (UF/RO/AOP)
- 4.3 MGD of chlorine treatment and Ozone/BAC
- GSD WWTP upgraded to full BNR
- 2.1 MGD additional tertiary treatment at GSD WWTP
- 3 x 0.8 MG engineered storage
- Pump Station (350 hp; located at GSD WWTP)
- 18-inch diameter transmission main (13,600 LF; from GWA 2 terminus to Van Horne Reservoir)

6.4.2 Phased Alternatives Costs

Cost estimates for each of the four new alternatives are presented in **Table 6-7** and costs for the remaining seven alternatives are summarized in **Table 6-8**. Capital costs and unit costs for each alternative are graphically shown on **Figure 6-4** and **Figure 6-5**, respectively. As shown in Table 6-8, unit costs are higher for GWA Phase 1 (1,500 AFY) and GWA Phase 2 (3,000 AFY) than GWA phase 3 (4,550 AFY), primarily due to oversizing the transmission pipeline for ultimately implementing a 4,550 AFY project.

The hybrid alternatives (GWA/RWA and GWA/TWA) unit costs are roughly 10% higher compared with the RWA or TWA only alternatives and roughly 20% higher than GWA Phase 3 (which is GWA only). Based on these results, the hybrid alternatives are not attractive from a cost perspective compared with GWA only but the unit costs could become closer once potable system impacts are better understood for GWA 3 (which could increase its cost) and regulations better define facility requirements for RWA or TWA (which could decrease or increase their costs).

Table 6-7: Cost Estimates for Phased Alternatives

Item	GWA 1	GWA 2	GWA/RWA	GWA/TWA
Capital Costs ($ M)				
Treatment	$10.3	$19.9	$37.9	$57.8
Conveyance	$3.0	$3.9	$14.1	$8.5
Pump Station	$0.7	$1.3	$5.5	$2.6
Injection Wells	$4.8	$8.4	$8.4	$8.4
Construction Subtotal	**$18.7**	**$33.5**	**$65.9**	**$77.4**
Construction Contingency (30%)	$5.6	$10.0	$19.8	$23.2
Construction Total	**$24.4**	**$43.5**	**$85.6**	**$100.6**
Implementation Costs (30%)	$7.3	$13.1	$25.7	$30.2
Total Capital Costs	**$31.7**	**$56.6**	**$111.3**	**$130.8**
O&M Costs ($ M)				
Treatment	$1.03	$1.99	$2.98	$3.84
Testing / Monitoring	$0.10	$0.10	$0.50	$1.00
Pumping	$0.39	$0.49	$0.54	$0.26
Total O&M Costs	**$1.52**	**$2.58**	**$4.02**	**$5.10**
Unit Costs				
Annualized Capital Cost ($ M)	$1.62	$2.89	$5.68	$6.67
Annual O&M Cost ($ M)	$1.52	$2.58	$4.02	$5.10
Total Annual Cost ($ M)	**$3.14**	**$5.47**	**$9.70**	**$11.77**
Project Yield (AFY)	1,500	3,000	4,550	4,550
Unit Cost ($ / AF)	**$2,090**	**$1,830**	**$2,140**	**$2,590**

Note: Pumping costs include the cost of groundwater pumping for GWA alternatives.

Table 6-8: Cost Summary for Alternatives

	GWA 1	GWA 2	GWA 3	RWA	TWA	GWA/RWA	GWA/TWA
Yield (AFY)	1,500	3,000	4,550	4,550	4,550	4,550	4,550
Capital Cost ($M)	$31.7	$56.6	$83.6	$95.0	$112.9	$111.3	$130.8
Unit Cost ($/AF)	**$2,090**	**$1,830**	**$1,780**	**$1,980**	**$2,390**	**$2,140**	**$2,590**

Figure 6-4: Capital Cost Summary

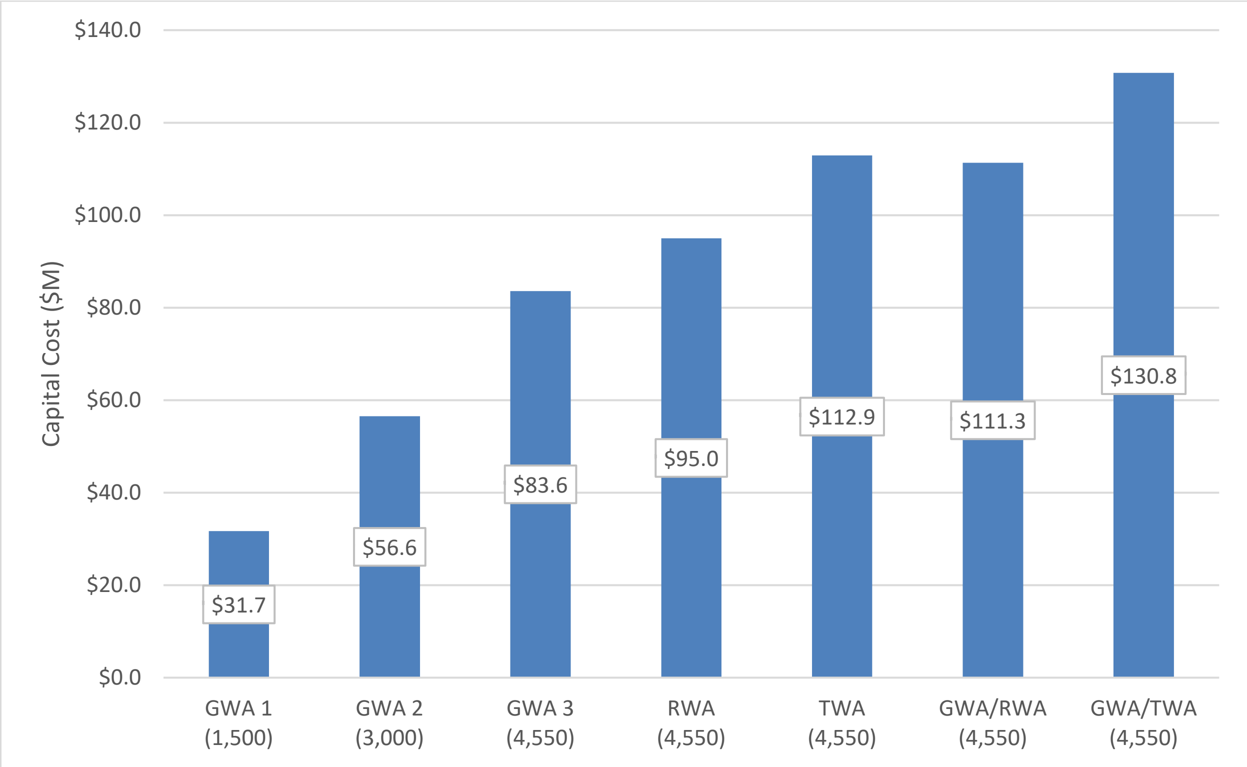
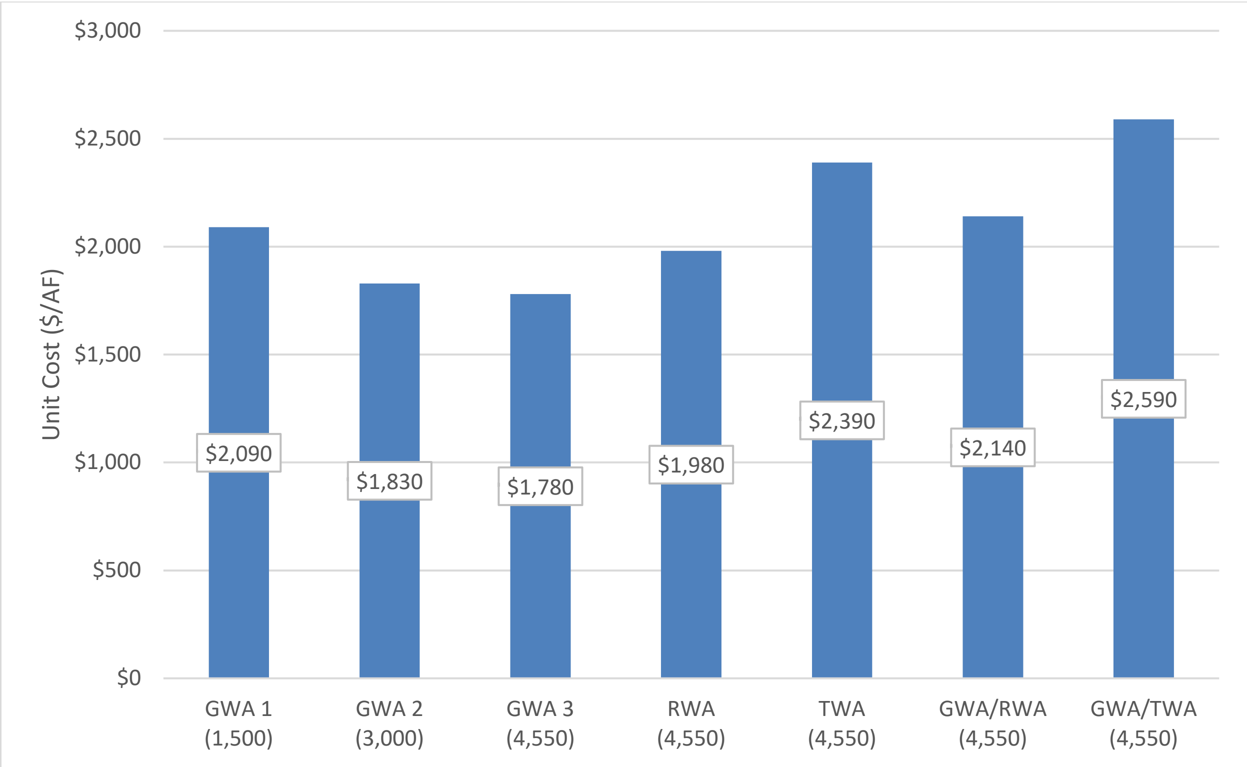


Figure 6-5: Unit Cost Summary



6.5 Alternative Water Supply / No Project Alternative

The District's 2017 Water Supply Management Plan Update estimated that future supply shortfalls would occur during more than 50% of years without additional water supplies and that the District's normal supplies are likely not sufficient in the future to avoid significant and recurring demand reductions, beyond normal conservation efforts. In addition, potential future reductions in the Cachuma entitlement (currently 9,332 AFY) would reduce supplies and create larger shortfalls of several thousand AFY depending on the reduction.

A no project alternative would result in the need for significant and recurring demand reduction efforts. For example, the 2017 WSMP Update estimated over 50% of years would require mandatory conservation with the maximum conservation in any one year of 40% in the future without additional supplies and assuming Cachuma entitlement remains the same. Over 90% of years would require mandatory conservation with the maximum conservation in any one year of 50% in the scenario where the Cachuma entitlement is reduced by 40%,

Although the No Project alternatives would avoid potential short-term environmental impacts, such as traffic impacts from construction activities and noise impacts from operation of equipment and vehicles, GWD still would have potential water shortages in drought years. Other long-term benefits associated with implementing the recycled water project include reduced dependence on surface water supplies, improved water supply reliability, increased local control of supplies, improved groundwater basin management, and increased climate change resiliency.

Additional water supplies would likely be required to reduce both the frequency and magnitude of the projected shortfalls. Purchasing supplemental imported water is the least expensive strategy; however, the quantity is limited by pipeline capacity, so additional local water supplies are needed. As a result, potable reuse is one of the only feasible options to provide this additional water and bridge the gap between supply and demand.

6.5.1 Other Considerations

Climate Change

A topic of growing concern for water planners and managers is climate change and the potential impacts it could have on California's future water supplies. Climate change models have predicted that potential effects from climatic changes include: increased temperature, reduction in Sierra Nevada snowpack depth, early snow melt and a rise in sea level.

All of the recycled water alternatives improve the District's climate change resilience by increasing reliance on local supplies with a lower embedded energy than SWP supplies and a supply that is not impacted by changes to temperature, precipitation, and snowpack.

State Planning Priorities

California Government Code Section 65041.1 define the State's "planning priorities, which are intended to promote equity, strengthen the economy, protect the environment, and promote public health and safety in the state, including in urban, suburban, and rural communities" and are:

(a) To promote infill development and equity

(b) To protect environmental and agricultural resources

(c) To encourage efficient development patterns

All of the alternatives protect the environment by reducing the use of imported water and reducing ocean discharges. The alternatives with higher yield provide a larger environmental protection benefit. In addition, the alternatives help to protect agricultural resources by providing a long-term, locally controlled, and drought resistant water supply.

Sustainable Water Resources Management

The alternatives developed are in alignment with SWRCB Resolution No. 2008-0030 which requires Sustainable Water Resources Management and acknowledges that sustainable water resources management is vital to California's future. Recycled water is among the most sustainable water resources as it reuses wastewater as opposed to allowing the wastewater to be discharged to the ocean and provides a drought resistant source. The resolution further directs SWRCB staff to assign a higher grant priority to climate related projects that are supported by local policies and ordinance.

6.6 Recommended Project

The 2017 WSMP Update identified a new, local water supply need of 1,500 AFY. GWA Phase 1 (1,500 AFY) provides the most cost effective and feasible pathway (considering cost risk, schedule risk, implementation flexibility, and public acceptance) to achieve this target. **Therefore, GWA Phase 1 (1,500 AFY) is the recommended project.**

The recommended project can be developed as the first phase of a larger potable reuse program that could ultimately yield up to 4,550 AFY and future phases may include:

- Additional groundwater augmentation (GWA Phase 2 and/or GWA Phase 3 alternatives);
- Raw water augmentation (GWA/RWA alternative); and/or
- Treated water augmentation (GWA/TWA alternative).

Selection of future phases will be dependent on several factors:

- Groundwater Augmentation (GWA) Cost: GWA is the lowest cost approach based on the alternatives definition assumptions in this report. The biggest unknown cost for a large (3,000 to 4,500 AFY) GWA project is potable water system improvement needs such as new production wells, new conveyance pipelines from wells to distribution system, and upgrades to the existing distribution system to increase capacity.
- Raw Water Augmentation (RWA) / Treated Water Augmentation (TWA) Cost: RWA and TWA regulations could ultimately cause project costs to be higher or lower than estimated in this report depending on the ultimate treatment, storage, monitoring, and reporting requirements.
- GWD Supply Need Timing: The timing of approved regulations for RWA and TWA is not known, but are anticipated by the early 2020s. The timing of need for potable reuse supplies beyond the Phase 1 GWA project will be further evaluated by GWD.
- Potable System Operations: An RWA or TWA project would result in operation of the potable distribution system largely as it does today – primarily gravity fed from CDM WTP or Van Horne Reservoir to 18-inch and 24-inch distribution pipelines. A large GWA project, on the other hand, would increase the volume of supplies entering the potable system from individual points with independent pumps, which results in more complex system operations.

These factors will be re-evaluated in the future as the District water supply and demand portfolio evolves over time.

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Chapter 7 Recommended Project

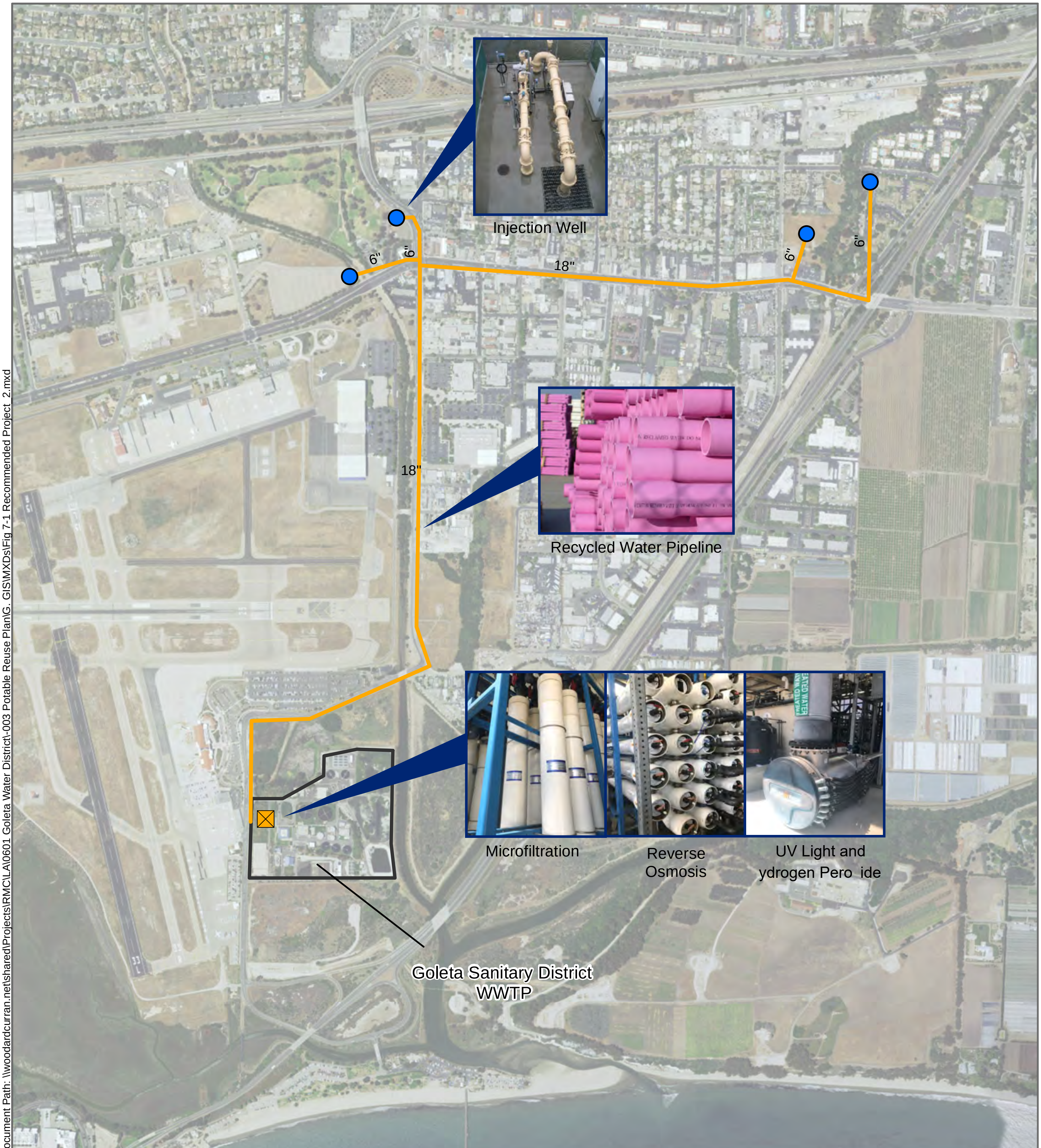
This chapter describes the Recommended Recycled Water Project (Recommended Project), including descriptions of project facilities, cost estimates, and an implementation plan (including construction financing plan).

7.1 Project Facilities

The Recommended Project, as shown in **Figure 7-1**, entails a 1.5 MGD advanced water purification facility (AWPF) (MF/RO/AOP) to treat effluent from the GSD WWTP for recharge of the Goleta Groundwater Basin via well injection with approximately 1,500 AFY of purified water. **Table 7-1** summarizes the recommended facilities and associated planning-level design criteria for the Recommended Project. The ultimate potable reuse program could yield up to 4,550 AFY; and future phases may include additional groundwater augmentation, raw water augmentation, and/or treated water augmentation. Refer to Section 9.1 for discussion of future phases.

Table 7-1: Recommended Project Facilities

Item	Description
Treatment	AWPF (MF/RO/AOP) 1.8 MGD Capacity 1.5 MGD Product Yield (1,500 AFY)
Conveyance	18-in Pipe, 9,800 LF 12-inch, 2,800 LF
Pump Station	100 HP, Q = 1,000 GPM, TDH = 200 ft 2 Pumps: 1 Duty, 1 Standby
Injection Wells	4 New Wells
Groundwater Wells	Existing District Wells
Monitoring Wells	4 New Wells



N

0 0.1 0.2 0.4
Miles

GSD WWTP
Advanced Water Purification Facility
Recycled Water Pipeline
Potential Injection Well Sites

Figure 7-1: Recommended Project: Groundwater Augmentation, 1,500 AFY

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7.2 Estimated Project Cost

Facilities and associated capital costs for the Recommended Project are summarized in **Table 7-2.** The 18-inch pipeline would be oversized for future potable reuse phases such that future phases could extend off of the initial pipeline terminus. The treatment and pump station facilities would be designed for future expansion. Recommended Project O&M costs and energy consumption estimates are presented in **Table 7-3**.

Table 7-2: Recommended Project, Capital Costs

Item	Value	Cost ($M)
Advanced Water Purification Facility	1.5 MGD	$10.3
Conveyance	18” @ 9,800 LF 6” @ 2,900 LF	$3.0
Pump Station	100 HP	$0.7
Injection Wells / Monitoring Wells	3 + 1 backup	$4.8
Construction Subtotal		**$18.7**
Construction Contingency (30%)		$5.6
Construction Total		**$24.4**
Implementation Costs (30%)		$7.3
Total Capital Costs		**$31.7**

Table 7-3: Recommended Project, O&M Costs

Item	Annual Energy Consumption (kWh/yr)	O&M Cost ($M/yr)
Treatment O&M	2,333,000	$1.03
Testing / Monitoring	--	$0.10
Pumping	427,000	$0.39
Total	**2,760,000**	**$1.52**

Note: Pumping line item groundwater pumping costs.

7.3 Construction Financing and Revenue Plan

Table 7-4 summarizes project funding and financing assumptions. The District intends to fund pre-construction planning tasks with available funds and construction costs could be funded with a combination of available grant funds and the balance of capital costs with a low-interest SRF loan. Potential grant funds and loans are discussed in Section 8.6. As shown in the table, the District must generate at least $3.1 million dollars per year in revenue and/or avoided existing costs to ensure SRF loan payback and sufficient O&M funding. Accordingly, the effects on customer rates from the project will require an updated cost of service study prepared in accordance with Proposition 218. The annual payment results in a unit cost for water at this feasibility level of $2,090/AF with a low-interest SRF loan and would be reduce by 13% to $1,820/AF with 25% grant funding of capital costs.

Table 7-4: Construction Financing Basis

Item	$M	Notes
Construction Cost	$24.4	Refer to Table 7-2
Implementation Tasks	$7.3	30% of construction costs
Total Capital Cost	**$31.7**	
SRF Annual Payment	$1.62	SRF financing at 3.0% over 30 Years
Annual O&M	$1.52	Refer to Table 7-2
Total Annual Cost	**$3.14**	
Annual Yield	1,500 AFY	
Unit Cost	**$2,090 / AF**	

Table 7-5: Construction Financing Basis with Grant Funding

Item	$M	Notes
Total Capital Cost	$31.7	Refer to Table 7-2
Grant Funding	$7.9	Assumes 25% of capital costs
Total Capital Cost w/ Grant Funding	**$23.8**	
SRF Annual Payment	$1.21	SRF financing at 3.0% over 30 Years
Annual O&M	$1.52	Refer to Table 7-3
Total Annual Cost	**$2.73**	
Annual Yield	1,500 AFY	
Unit Cost w/ Grant Funding	**$1,820 / AF**	

Chapter 8 Project Implementation Plan

Implementing the Recommended Project entails public support, regulatory approvals, environmental review, institutional partnerships, additional technical investigations, and facility design, construction, and operations. The following sections address each of these topics. First, an overall implementation schedule is presented.

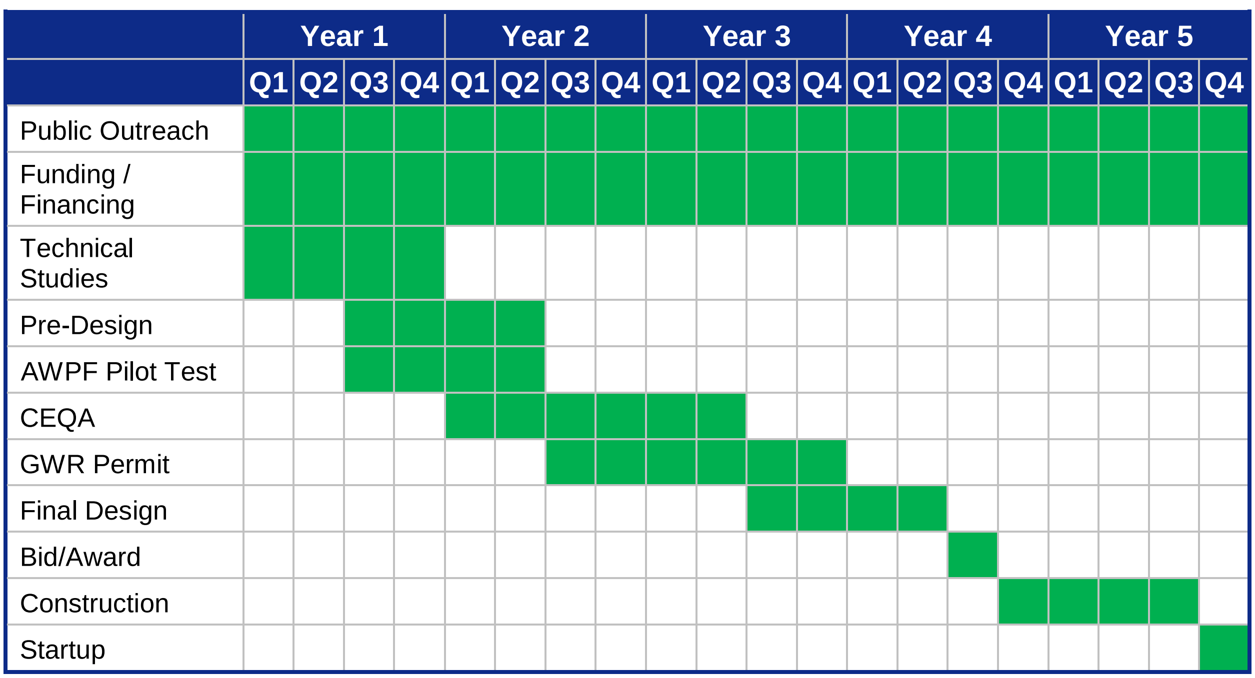
8.1 Implementation Schedule

The overall implementation plan for the Recommended Project is shown in **Figure 8-1**. Full implementation of the project would take approximately 5 years. Technical studies to further refine the project need to be completed in order to: 1) prepare the Engineering Report for DDW; 2) initiate environmental documentation; and 3) refine project cost estimates. The environmental documentation should be done in parallel with the Engineering Report.

From a project funding and financing perspective, CEQA certification is the critical path for gaining preliminary approval for grant funding and low-interest loans from the SWRCB. From a project start-up perspective, the Engineering Report approval is the critical path for acquiring a recycled water permit from the RWQCB, which is needed prior to start of operations. CEQA certification is also needed before the RWQCB can issue the GWR permit.

Design of the infrastructure improvements would continue after completion of the relevant preliminary studies in coordination with CEQA and permitting efforts. Funding and stakeholder/public outreach efforts would occur over the lifetime of the project. Pilot testing of treatment processes should be done in coordination with public outreach and preliminary design efforts.

Figure 8-1: Implementation Schedule for the Goleta Groundwater Augmentation Project



8.2 Stakeholder/Public Outreach

Implementation of potable reuse projects in other settings throughout California has illustrated that a public information program is an essential element of the project. A public information program includes both outreach and participation, which serve different functions. Outreach is a way of disseminating or collecting information to educate the public; participation implies a means for stakeholders to actively engage in and influence a plan.

Successful potable reuse projects have a number of characteristics in common:

- They are designed to improve water quality;
- They augment water supplies or prevent seawater intrusion versus being designed to dispose of wastewater;
- They maintain a historical water quality database and conduct research to support success;
- They are managed by agencies with established experience and that have gained the confidence of regulatory authorities.

Thus, an outreach program for the project should be initiated early in the planning process and be incorporated into an existing community relations program to reinforce the purpose and need for the project. GWD should engage with a public outreach consultant to develop an outreach program that is appropriate for Goleta. Elements of an outreach program for the project may include:

- **Planning Workshops**: To identify communication goals and objectives for the project, project challenges and opportunities, and key messages and audiences.
- **Purpose and Need Statement**: Review the reason for examining potable reuse and ensure that the purpose and need for the project are clearly and consistently stated. This could be the basis for key messages, informational materials, presentations and all other project communications.
- **Survey:** Conduct a baseline public opinion survey so that perceptions, awareness and knowledge about the District's water supply needs and sources, recycled water and potable reuse can be measured at the very start of the project. Key messages could also be tested to determine if they help respondents understand the project more clearly.
- **Communication Plan**: Develop a strategic communication plan that includes: a situation analysis; project challenges and opportunities; the communication goal and objectives; strategies or a list of how the goals and objectives would be accomplished; and outreach tactics or activities that are the communication tools for carrying out the strategies and meeting the goals or objectives.
- **Informational Materials:** Develop a fact sheet and frequently asked questions document that can be posted on the project or District website and printed for distribution at appropriate locations, including the District offices and at community presentations or events.
- **Website:** Evaluate the need for a separate project website or a page on the District's existing website. Post all information about the potable reuse project on the website.
- **Community Advisory Group**: Consider establishing a community advisory group to work with staff and the project team on an identified task related to the project. This task could be for the community advisory group to review the communication strategies and provide input on additional ways to expand outreach about the project in the service area.

8.2.1 Public Outreach Plan

Recycled water is currently used primarily for irrigation in Goleta and Santa Barbara; however, recycled water is not currently used for groundwater augmentation in Santa Barbara County. Public acceptance of recycled water as a non-potable supply has increased within the County; however, previous and parallel planning efforts exploring options for potable reuse of recycled water have shown that there are concerns in the community due to a lack of understanding of the project features and public health safeguards. The most prominent concern being water quality related to constituents of emerging concern (CECs). Notably, potable reuse has strong support from some local stakeholders, such as Heal the Ocean (which published a potable reuse report[7] in 2015) and many local water and wastewater districts.

The purpose of an outreach plan for GWD will be to increase the comfort level with the use of recycled water in Goleta by demonstrating steps taken to minimize risk to produce a healthy and safe water supply that is superior to other alternatives and how its use can benefit the public good.

The Public Outreach Plan would have several elements:

- Project/program purpose
- Public perception challenges
- Public communications plan
- Communications materials
- Learn from others

Project/Program Purpose

Successful implementation of a potable reuse program starts with articulating a clear purpose to both key stakeholders and the greater public. The purpose statement should include what the specific needs are and how the project/program benefits will meet those needs. Articulating a clear project purpose provides the public the necessarily rationale for why the project is being implemented.

Project Perception Challenges

Correctly understanding the local public perception challenges relative to potable reuse is necessary in order to identify an effective method to address them. This may include an overall understanding of misconceptions about recycled water as well as real concerns specific to IPR. A successful outreach program will implement tailored mechanisms and provide useful forums to bring those issues and challenges to light as opposed to assuming that specific challenges are the same as in other communities. For example, a common public perception challenge may be the concern over constituents of emerging concern, but without understanding specifically how and by whom that concern has been communicated, public education on the issue cannot be targeted to the appropriate customer segments.

Understanding public perception issues should not be left for the environmental review stage when nothing can be done to alleviate them. Engaging with the public early on during project planning will allow for a better understand of concerns and ability to address them. It should be made very clear, however, how input from the public will and won't be used so as to manage participation expectations.

As part of the project feasibility assessment, GWD engaged the Water Management and Long Range Planning Committee to provide initial feedback and identify concerns regarding an IPR project/program. If approved by the GWD Board of Directors for implementation, it is recommended that GWD conduct public meetings to highlight the proposed project and allow for the public to ask question and voice concerns. Information collected during these meetings will be used to help prepare a tailored GWD Project/Program Communications Plan. It may also be useful to be prepared with a list of questions to ask meeting participants and encourage discussion, such as:

- What, if any, are the parts of the program/project you are having trouble understanding?
- Do you generally support recycled water use?

[7] http://healtheocean.org/research/detail/potable_reuse_a_new_water_resource_for_california

- Do you believe that this IPR project will help meet the identified water resources needs?
- What are the greatest benefits you think this project will provide?
- What are your biggest concerns?
- Are there specific project elements you would like add, modify, remove?

Communications Plan

Based upon the above recommended outreach plan tenants, GWD developed a preliminary and basic potable reuse Communications Plan described here. It is anticipated that this plan will be refined based upon the input received during the initial public meetings as described previously.

Because potable reuse is not a mainstream topic in most communities, the purpose of public outreach should be to build awareness, trust, confidence, support, and acceptance of planned potable reuse projects. Individuals will then decide whether to support the production and use of this water (as is the current situation with public water supplies). To achieve this end, outreach for potable reuse projects should embrace the following concepts (Millan et al., 2015):

- Make the outreach program strategic, transparent, and thorough
- Build on lessons learned from existing potable reuse projects, research on relevant issues like CECs, and available communication strategies (such as risk communications)
- Start outreach early and engage the public throughout the lifetime of the project
- Use proven techniques and tools to listen to and communicate with the community, engage the media, and address public concerns
- Provide useful information to explain the role of water reuse in the water cycle, increase awareness of the value of potable reuse, and build confidence in the quality of ATW
- Create messages that are consistent and communicated to the entire community, including different audiences
- Build relationships with influential community members (e.g., opinion leaders)
- Create transparency in all aspects of the project, including costs, water quality, and safety
- Prepare for tough questions and address misinformation

8.3 Advanced Water Purification Facility Pilot Test

Pilot testing of AWPF facilities is common for potable reuse projects across California. Findings from completed pilot tests as well as from several operational AWPF facilities provide extensive documentation of treatment performance and understanding of design and operational issues. Since many of the lessons learned are applicable to this project, AWPF pilot testing for the Recommended Project is not mandatory but would nonetheless provide the following benefits:

- Supports outreach to the public through tours and media reporting
- Supports treatment system design efforts
- Allows for testing of emerging technologies that could reduce full-scale project costs or provide funding for pilot testing efforts
- Provides operator experience with AWPF facility operations
- Demonstrates operator competency to DDW and RWQCB
- Can address potential site-specific questions or issues raised by DDW or RWQCB
- Supports GSD and GWD institutional cooperation

These benefits must be weighed against the costs to conduct a pilot test, which can range from $500,000 to $1.5 million depending on several factors, including the duration of operations, extent of water quality testing, and extent of staff support from GSD and GWD. Pilot testing is recommended for the District for all of the benefits listed above.

The following describes the components for the District's AWPF Pilot Test project.

8.3.1 Pilot Test System

The pilot test system would consist of an approximately 30± gpm AWPF, which would include the following treatment operations in series: MF or UF, RO, UV, and peroxide. Additionally, the pilot system would include all of the ancillary components needed to support the operation of each treatment operation. These would include chemical feed systems and storage, cleaning chemicals and associated systems, tankage as required for inter-process use, on-line analyzers for real-time tracking of system performance, and alarming as needed to signal conditions outside of normal operating parameters.

8.3.2 Pilot Test Program

The testing program to evaluate an AWPF treatment system would consist of the following elements:

- Pilot Test Workplan. The Workplan would serve as the basis for testing. Presented in the Workplan would be the following:
    - Pilot testing purpose and objectives to establish the rationale for the workplan components.
    - Site selection within GSD WWTP. This will consider locations to minimize impacts to ongoing WWTP operations, sufficient utilities, and available footprint.
    - System configuration, including control points and sampling locations, as well as operating procedures.
    - System operating conditions to evaluate, including the number of test runs for each operating condition.
    - Sampling and analytical requirements. This includes sampling frequency by sample location and analyte, as well as identifying analyses to be conducted onsite by field operations staff and samples to be collected for analysis by an off-site laboratory facility.
    - Field staffing requirements and response procedures to address alarm conditions.
- Process Drawings. These would serve as the basis for construction of the pilot system and would include the following:
    - Process and instrumentation drawings (P&IDs)
    - Equipment layout drawing.
    - Listing of utility connection and size requirements for the system including but not limited to: source water; treated water discharge; residuals disposal; electrical power (number of services and type(s)); process air and/or other supplemental utilities; and signaling for local control/alarms and/or SCADA (as needed).
- Equipment Procurement and Pilot System Construction. Coordinate with the fabricator selected to construct the system. The general contractor would install the system based on field direction from the District's engineer in conjunction with the Process Drawings.
- Pilot System Startup and Testing. At the completion of pilot fabrication, the system would undergo a startup period to verify the proper installation of the equipment and that the system can operate as intended within the operating ranges needed for testing. Following successful startup, pilot testing would commence in accordance with the workplan.

- Pilot System Operations. GWD, GSD, and/or contracted staff would operate the pilot system in alignment with the workplan. During operations, staff would analyze the performance of the system based on the incoming data from the system and analytical results from offsite laboratory analysis. These data would be used to determine if adjustments to test conditions are needed.
- Completion of Pilot Testing and System Demobilization. At the conclusion of the pilot test, the system would be demobilized and disassembled by the contractor. District purchased equipment would be relocated as needed for storage. Rented equipment would be returned to the rental vendor. The test site would be restored to its original condition.
- Analysis of Final Pilot System Data and Pilot Report. Upon receipt of all data from the field and results from the offsite laboratory, the test findings will be analyzed and presented in a Pilot Report. Included in the report would also be design criteria and recommendations for the design of the full-scale AWPF facility.

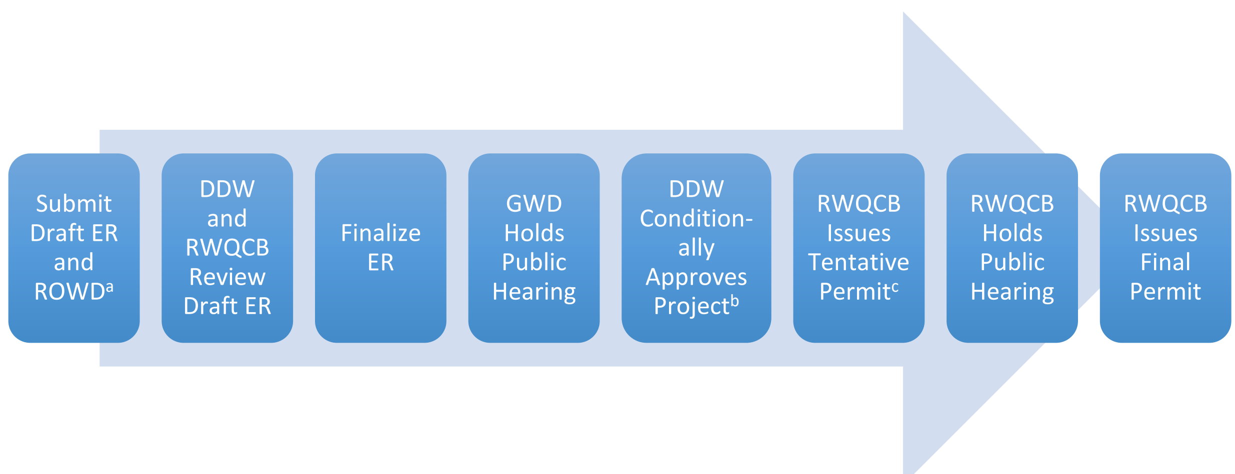
8.3.3 Pilot Test Schedule

The schedule for an AWPF Pilot Test is dependent on the period where the pilot test is operated, which can range from several months to conduct focused experiments to several years to support public outreach. The pilot test requires approximately 6 months to plan, design, procure, construct, and startup. The need for significant site improvements to construct and install the pilot system, such as construction of building or large amounts of concrete work or grading, would extend the pre-operational period.

8.4 Recharge Permit

Regulatory oversight of the project is carried out by the DDW and the Central Coast RWQCB, as described in Chapter 3. The general responsibilities of each agency through the regulatory approval process are illustrated in **Figure 8-2**.

Figure 8-2: RWQCB GWR Permit Regulatory Approval Process



a. ER – Engineering Report; ROWD – Report of Waste Discharge.
b. The conditional approval may include conditions recommended by DDW for the RWQCB to include in the permit.
c. The CEQA documentation must be certified before the tentative permit is released for public comment.

8.4.1 Engineering Report

As part of the DDW approval process, the District must submit a draft Engineering Report to DDW and RWQCB. The purpose of the engineering report is to describe how the project would comply with the Title

22 Criteria, the Basin Plan, and SWRCB Plans and Policies. The report would include the following types of information:

- The purpose and goals of the project
- The project participants
- The applicable rules and regulations
- The project facilities
- The industrial pretreatment/source control program
- The chemical quality of the source water (CSD WWTP raw wastewater)
- How compliance with the Title 22 Criteria pathogen control requirements would be achieved
- The proposed response retention time
- The quality of the recycled water and a comparison to Title 22 Criteria
- The proposed initial and maximum recycled water contributions
- A description of the groundwater basin and productions wells
- The results of groundwater modeling showing the travel time to the closest productions wells
- Maps showing the zone of controlled well construction
- An assessment of the project on contaminant plumes and dissolution of naturally occurring contaminants
- An anti-degradation assessment per the Recycled Water Policy
- The proposed monitoring program
- Compliance with the Basin Plan

All the supporting technical studies should be completed in order to prepare the draft Engineering Report. The development of the draft Engineering Report would take approximately six months with an additional six months to finalize the report (e.g., addressing DDW and RWQCB comments and revising the text). The actual time necessary for finalizing the report may be shorter or longer depending on the availability of DDW to review the draft report and resolution of regulatory comments on the draft report.

8.4.2 Public Hearing

Once the report is finalized, the District would schedule a public hearing to receive comments on the project. DDW would attend the hearing. Following the public hearing, depending on the comments received, DDW would send a letter to the RWQCB that conditionally approves the project and recommends that the RWQCB issue a tentative permit. The approval letter may contain conditions that must be implemented (and included in the permit) prior to operation of the project. The time necessary to receive the conditional approval letter is a function of the length of time needed to organize the hearing, DDW availability to participate in the hearing and approve materials to be presented at the hearing, and the time for DDW to issue the approval letter. This overall process is estimated to take about three months.

8.4.3 RWQCB Permit – Water Recycling Requirements (WRR)

A Report of Waste Discharge (ROWD) for the proposed recycled water recharge is submitted to the RWQCB to initiate the RWQCB permitting process. The ROWD must identify proposed treatment, discharge facilities and operations, and characterize potential impacts on water quality. The ROWD is typically submitted along with the draft Engineering Report.

After DDW has issued its conditional approval letter and after the project’s CEQA document is certified, the RWQCB would issue a tentative WDR/WRR. It is also possible to request that the District be given the opportunity to review a pre-public draft of the permit to resolve any significant issues in advance of the public review period. In accordance with the SWRCB Recycled Water Policy, a GWR project that submits a ROWD should be permitted within a year from receipt of DDW conditional approval. Therefore, it would be important to initiate and complete the CEQA process as soon as possible to expedite project permitting. Because the RWQCB agendas are typically full, it would be important to work with the RWQCB well in advance to schedule the tentative permit consideration. It is suggested that this be done when the ROWD is submitted along with the draft Engineering Report. Similar to the DDW review, the District would be actively involved during the review period.

8.4.4 Ongoing Regulatory Coordination

It would be important to begin early and remain engaged with DDW and RWQCB through project permitting and implementation. The DDW process is characterized by ongoing consultation between the project proponent and DDW throughout the project planning, predesign, design, and construction phases. Consultation with the RWQCB should occur both before and after submittal of the ROWD. Pre-submittal consultation is directed toward ensuring that the ROWD is structured to adequately address all RWQCB issues and concerns. Post-submittal consultation may be directed toward addressing subsequent RWQCB questions or requests for additional information. The timing and manner of engagement (e.g., in-person meetings versus conference calls) should be coordinated with the regulators based on their schedules and availability.

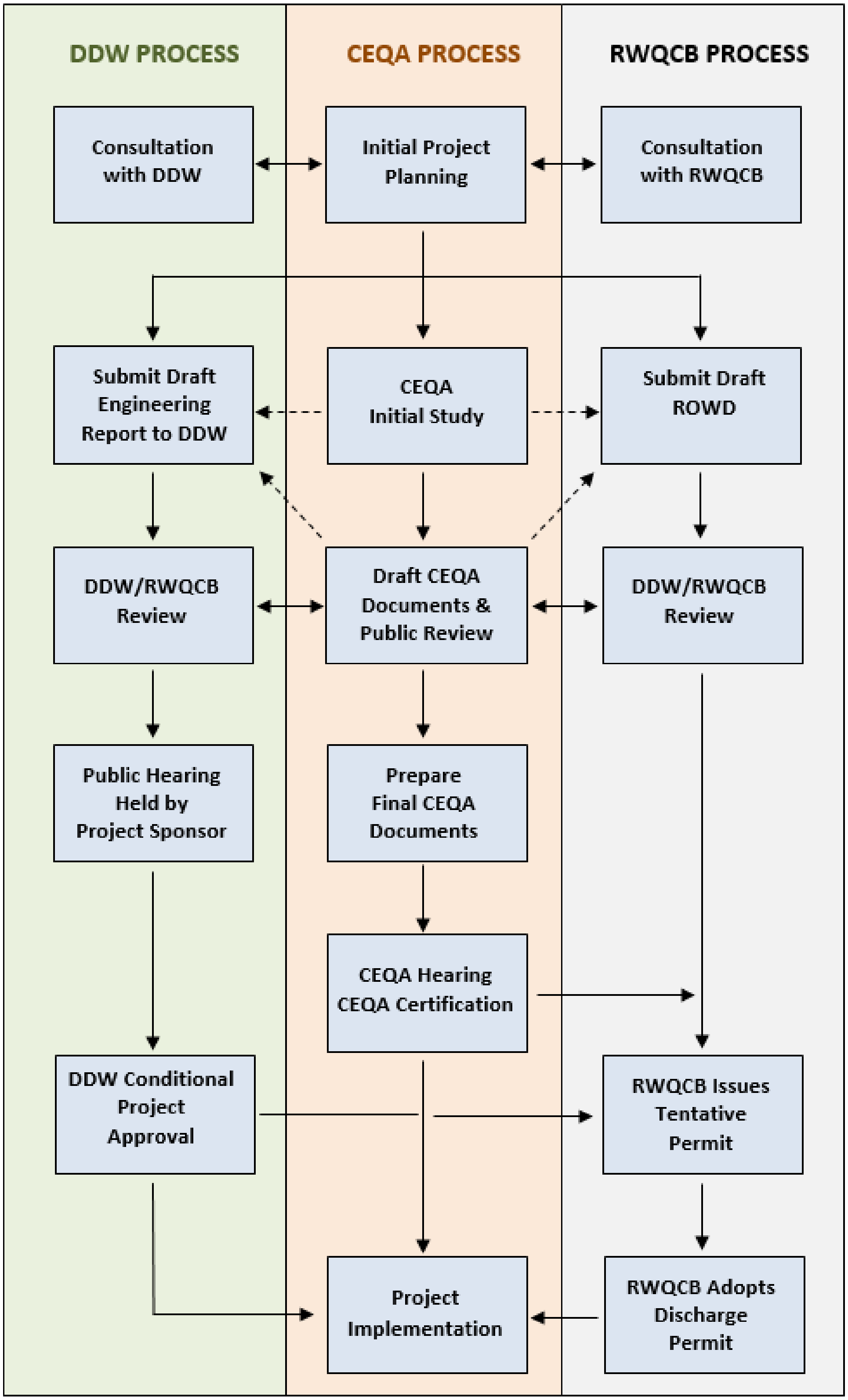
8.5 Environmental Documentation

All public projects in California must comply with the CEQA. If a project is not exempt, CEQA provides for the preparation of an Initial Study (IS) to analyze whether the project would have a significant adverse effect upon the environment. A Negative Declaration/Mitigated Negative Declaration could be issued if the analysis in the IS determines that the project or action, as proposed or as proposed with specific mitigation measures, would not have a significant adverse effect on the environment. If the analysis in the IS determines that the project or action has the potential to result in a significant impact(s) to the environment, then an Environmental Impact Report (EIR) would need to be prepared to further address such impacts. It is anticipated that the District will need to complete an EIR for the project. In addition to CEQA, a project is subject to National Environmental Policy Act (NEPA) if it is jointly carried out by a federal agency, requires a federal permit, entitlement, or authorization, requires federal funding, and/or occurs on federal land. The SWRCB SRF loan program (see the following section for further discussion) is partially funded by the U.S. Environmental Protection Agency and, as a result, requires additional environmental documentation beyond CEQA – but not as extensive as NEPA – that is referred to as "CEQA-Plus."

While the DDW, CEQA, and RWQCB processes can proceed on somewhat parallel paths, these approval processes are tied together by several critical scheduling nexus points. **Figure 8-3** presents a schematic depicting how the potential CEQA process integrates with the DDW project approval and RWQCB permitting processes. CEQA certification is required prior to RWQCB action to adopt the discharge permit. The RWQCB staff typically defers preparation of the tentative discharge permit until after full CEQA certification has been completed.

The environmental review process for the project is anticipated to take about 12 months to complete.

Figure 8-3: Interaction of Environmental and Permitting Processes for Recycled Water GWR Projects



8.6 Funding / Financing

A variety of funding opportunities are possible for this project, including the following:

- SWRCB Recycled Water Funding Program
- SWRCB Clean Water State Revolving Fund Loans
- DWR Integrated Regional Water Management Program
- Santa Barbara County Proposal to the Governor's Drought Task Force
- US Bureau of Reclamation (USBR) Title XVI Program
- USBR Treatment Research Funding

Each of these funding opportunities is described in further detail in the following sections.

8.6.1 SWRCB Recycled Water Funding Program

The SWRCB administers three types of recycled water funding: recycled water facilities planning grants, construction implementation grants and loans, and clean water state revolving fund loans. Construction grants and loans specific to recycled water programs fall under the Water Recycling Funding Program (WRFP) and follow the clean water state revolving fund policy. Once the Facilities Plan is in place, the District can focus on obtaining grants or low interest loans to cover the construction implementation costs.

The SWRCB currently administers a grants program to cover construction of recycled water facilities. The Water Recycling Funding Program Guidelines, adopted in 2015, provide for a construction grant that will cover 35% of actual eligible construction costs up to $15 million, including construction allowances. Eligible costs include construction allowances which may include engineering during construction, construction management, and contingencies limited to 15% of the construction grant value. To be eligible to receive grant funds, a minimum 50% local cost share match must be provided. More information about the program can be found here:
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/

8.6.2 Clean Water State Revolving Fund Loans

The SWRCB administers the Clean Water State Revolving Fund (CWSRF) Loan Program. This Program offers low-interest loans to eligible applicants for construction of publicly-owned facilities including wastewater treatment, local sewers, sewer interceptors, water reclamation facilities, and stormwater treatment. Funding under this Program is also available for expanded use projects, including implementation of nonpoint source projects or programs, and development and implementation of estuary comprehensive conservation and management plans.

The process for securing funds includes submitting a CWSRF application in addition to WRFP-specific application items. CWSRF loans typically have a lower interest rate than bonds, at half of the General Obligation bond (typically 2.5% to 3%, currently 1.8%) at the time of the Preliminary Funding Commitment. Loans are paid back over 20 or 30 years. Annually, the CWSRF program disburses $200 million to $300 million to agencies in California. There is no award maximum, but a maximum allocation of $50 million per year per agency exists. Repayment begins one year after construction is complete. SWRCB funds projects on a readiness-to-proceed basis. The application process can take up to 6 months; SWRCB recommends collecting required information and applying once the draft CEQA Plus documents, required resolutions, and financial package are completed.

Projects may receive a combination of grant and low interest loan construction financing. The application process for construction grants and loans is the same and involves completion of an application package consisting of four separate sections to document general project information, financial security, technical project information, and environmental documentation and placement on the competitive funding list. More information about the SWRCB CWSRF Program can be found here:

http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/srf_forms.shtml

8.6.3 DWR Integrated Regional Water Management Program

The DWR Integrated Regional Water Management (IRWM) Program provides planning and implementation grants to prepare and update IRWM Plans and to implement integrated regional water resources related projects. IRWM program funding is awarded through a competitive grants program, in which approved IRWM Regions submit application packages for funding multiple projects within their regions as a package.

DWR will be soliciting proposals for implementation grants under Proposition 1 in early 2018. Proposition 1 allocated $43 million to six IRWM regions within California's Central Coast and the Santa Barbara County region was allocated $6.3 million for the upcoming round. Though this is less funding than in previous IRWM rounds, this project would be eligible for an implementation grant so the District should continue engagement with the IRWM program and monitor the grant development schedule. Additional information about the IRWM grant program can be accessed here:
http://www.water.ca.gov/irwm/grants/index.cfm

8.6.4 Santa Barbara County Proposal to the Governor's Drought Task Force

The Santa Barbara County Office of Emergency Management has facilitated a series of meetings in early 2017 with regional stakeholders to identify and develop a list of regional priority projects that address both the immediate drought emergency and long- term water supply sustainability. An Action Working Group met regularly to develop a package of projects with the intent of securing support from each of the region's water agencies. A "comprehensive program of Water Reuse across the South Coast" was one of three new regional water supply projects identified by the working group and GWD's Recommended Project falls under this project. The recommendations have been forwarded to the Governor's office and local State representatives for further consideration and may result in funding.

8.6.5 USBR Title XVI Program

The USBR Title XVI grant program is focused on identifying and investigating opportunities for water reclamation and reuse. Funding is made available for the planning, design, and construction of water recycling treatment and conveyance facilities and is structured to cover up to 25% of the total project costs (up to $20 million), with project proponents contributing 75% or more of total project costs. Proposal requirements include technical and budgetary components, as well as a completed Title XVI Feasibility Study, which must be submitted to USBR for review and approval. While compliance with the National Environmental Policy Act (NEPA) is not required during the proposal phase, it is required prior to the receipt and expenditure of Federal funds. Also, previous grants required a project to be congressionally authorized to be eligible to receive Title XVI funding.

In December 2016, the Water Resources Development Act (WRDA), now called the Water Infrastructure Improvements for the Nation Act (WIIN) includes the revitalization of the Bureau of Reclamation's Title XVI water reuse and reclamation program. The act includes reformation of Title XVI into competitive grant program (previously, Congress added eligible projects to the Title XVI list) and includes authorization of $50 million for Title XVI. Grant implementation details and timing are not known at this time but are expected by the end of 2017. More information is available from USBR's website here:
https://www.usbr.gov/watersmart/title/index.html

8.6.6 USBR Treatment Research Funding

Each year, subject to available funding, USBR awards grants for treatment research. The proposed APWF Pilot Test (Section 8.3) would be eligible for two of the research programs that were funded in 2017: 1) Desalination and Water Purification Research program, which provides funding for the full spectrum of technology development and testing to support the commercialization of new desalination and water purification technologies; and 2) Title XVI Program research funding, which is focused on moving research to practice by supporting planning related research to help deploy technologies or processes that are currently available in the industry to help address water supply challenges.

The pilot scale testing projects in the Desalination and Water Purification Research Program can receive up to $200,000 per applicant, per year for a total funding of up to $400,000. The Title XVI Program includes up to $75,000 will be provided for projects that can be completed in up to 18 months, $150,000 for projects that can be completed in up to 24 months, and $300,000 in funding for research that can be completed within 36 months. USBR has indicated that research funding will be available for 2018 with a request for projects anticipated in late 2017.

8.7 Institutional Activities

A strong working relationship between the water and wastewater agencies is an essential component of a successful recycled water project. The GSD sources the WWTP effluent that will enter the AWPF for purification and may operate the AWTF as well. Consistent, high quality effluent is important for successful AWPF operations. In addition, ongoing coordination is required between WWTP, AWPF, and injection well operations to ensure reuse is maximized with limited interruptions.

In addition, GWD should coordinate with La Cumbre Mutual Water Company regarding the use of GWD's groundwater storage rights as part of the groundwater augmentation project and the project's lack of impact on their wells. Private potable well locations should be identified and evaluated prior to project design and permitting.

8.8 Technical Investigations

To support CEQA, regulatory, and design efforts, several technical investigations are needed either prior to or in parallel of their supporting activity. This section discusses these efforts.

8.8.1 Injection Well Siting Assessment

GWD conducted a new injection well siting assessment in 2015 that was used as the basis for locating injection wells in this report. As a next step, the previously identified sites and, if necessary, potential new sites should be evaluated to select preferred injection well sites for the Recommended Project. These sites will be used for groundwater modeling and environmental documentation. Site selection should be based on vegetation, soils, geology, topography (slopes), flood hazards, contamination, environmental impacts, proximity to existing production wells, ownership, and acquisition costs. In addition, an environmental constraints analysis could be performed to identify any fatal flaws or potential major mitigation requirements that might be associated with any of the sites.

8.8.2 Refined Groundwater Modeling

GSI (2017) completed an initial analysis, which is included in Appendix C, of travel times of injected purified water under two scenarios – 3,000 AFY and 6,000 AFY – using the Goleta Groundwater Basin Numerical Model. Both scenarios resulted in GWD potable supply being located far outside of the 4-month retention time. However, retention time modeling should be conducted for the Recommended Project size (1,500 AFY), proposed injection well locations, and with more conservative minimum retention time of 6 to 12 months. Additional groundwater modeling could evaluate more cost effective injection well locations, such as injecting at one or more well fields rather than individual wells spread throughout the basin.

8.8.3 Ocean Outfall Modification Assessment

As discussed in Section 5.4.1, reduced volume and increased density of effluent to the ocean outfall will impact the performance of the outfall, especially at the larger project sizes evaluated in this report. Producing 1,500 AFY of purified water will result in a similar reduction effluent flow to the ocean and the production of approximately 300 AFY of RO brine. The change in volume and density could require modifications to the outfall to prevent plugging of discharge ports so an analysis should be conducted that evaluates the impacts of the Recommended Project as well as future potable reuse phases being considered.

8.9 Engineering, Design, and Construction Activities

The new facilities for the project were presented in Table 7-1. This section discusses the effort needed to develop and implement the capital improvement projects identified for the project, including AWPF, conveyance pump stations, pipelines, injection wells, and monitoring wells.

8.9.1 Preliminary Design

As part of the preliminary design, detailed facilities plans would be prepared for all the new facilities identified for the project, including facilities layouts for the AWPF, conveyance pump station, pipeline alignment, and injection wells or spreading basins. The plans would also include revised capital and O&M cost estimates based on vendor quotes and proposals. During pre-design, the conceptual design developed in this report would be further developed, and assumptions would be updated, validated and documented. The conveyance pipeline alignments and injection well siting would be included in the pre-design report.

8.9.2 Final Design

Following preliminary design, design packages would be prepared for the AWPF, injection wells, monitoring wells, and conveyance pipelines. The AWPF design could proceed independently of the other facilities. A bid package (after permitting is completed) could likely be prepared in two months.

8.9.3 Bidding/Contract Award, Construction, and Startup

Bidding and contract award would commence once the bid package is complete. These tasks are assumed to take three months. The bidding and contract award period is defined as starting from when the bid package is sent for advertisement to the day that the notice to proceed to the contractor is issued. Construction of the AWPF, conveyance pipelines, and injection wells is anticipated to take one year. The startup period and final approvals of the AWPF and overall project are anticipated to take three months.

8.9.4 Operational Plan

Prior to the start of operations, the District will submit an Operation Optimization Plan to DDW and the RWQCB per Title 22 for review and approval. At a minimum, the plan must identify the operations, maintenance, analytical methods, and monitoring necessary for the project to meet regulatory requirements, as well as the reporting of monitoring results to DDW and the RWQCB. The plan must be representative of current operations and updated as appropriate.

Also, in accordance with Title 22, the District will demonstrate that all treatment processes have been installed and can be operated to meet their intended function prior to the start of operations by undertaking actions including, but not limited to, the following:

- Develop a Startup/Commissioning Plan to verify the correct installation of equipment and document proper performance for equipment
- Collect manufacturers’ standard factory tests and results
- Perform tests of all equipment to verify proper installations and functionalities
- Perform partial and complete startups and shutdowns of partial process treatment trains and whole AWPF
- Perform complete simulations of major and critical alarms
- Conduct startup and performance evaluation, including validation of the advanced oxidation process

Chapter 9 Conclusions

The Goleta Water District partnered with the Goleta Sanitary District and the SWRCB to prepare a recycled water facilities plan to explore options for expanding the use of recycled water to offset reduced surface water supply reliability and the related potential for water shortages in drought years. The Facilities Plan considered use of recycled water for a range of uses: irrigation, groundwater augmentation, raw water augmentation, and treated water augmentation. Groundwater augmentation via injection with full advanced water treatment (MF/RO/AOP) was selected as the preferred use of recycled water for an initial 1,500 AFY project based on:

- Allows use of new water supply at its highest and best use (potable use)
- Utilizes existing facilities – primarily the groundwater basin and GWD wells
- Provides ability to store supplies on a multi-year basis for years with low surface water deliveries
- Provides ancillary groundwater basin benefits, such as higher groundwater levels and lower risk of seawater intrusion

Implementation of a groundwater augmentation project would help GWD meet projected supply shortfalls identified in the 2017 Water Supply Management Plan Update by reducing its dependence on surface water – which has high variability and increasing costs – with a locally controlled and drought proof water supply. Chapter 8 has laid out the next steps to implement the recommended project and estimates the new supply could be on-line within 5 years of the start of project implementation.

9.1 Future Project Phases

The recommended project could be the first phase of a potentially larger potable reuse program. The ultimate potable reuse program could yield up to 4,550 AFY and future phases may include:

- Additional groundwater augmentation
- Raw water augmentation (supplementing surface water supplied to a local water treatment plant)
- Treated water augmentation (supplementing a drinking water distribution system directly)

Selection of future phases will be dependent on several factors:

- Groundwater Augmentation (GWA) Cost: GWA is the lowest cost approach based on the alternatives definition assumptions in this report. The biggest unknown cost for a large (3,000 to 4,500 AFY) GWA project is potable water system improvement needs, such as new production wells, new conveyance pipelines from wells to distribution system, and upgrades to the existing distribution system to increase capacity.
- Raw Water Augmentation (RWA) / Treated Water Augmentation (TWA) Cost: RWA and TWA regulations could ultimately cause project costs to be higher or lower than estimated in this report depending on the ultimate treatment, storage, monitoring, and reporting requirements.
- GWD Supply Need Timing: The timing of approved regulations for RWA and TWA is not known, but are anticipated by the early 2020s. The timing of need for potable reuse supplies beyond the Phase 1 GWA project will be further evaluated by GWD.
- Potable System Operations: An RWA or TWA project would result in operation of the potable distribution system largely as it does today – primarily gravity fed from CDM WTP or Van Horne Reservoir to 18-inch and 24-inch distribution pipelines. Whereas a large GWA project would increase the volume of supplies entering the potable system from individual points with independent pumps, which results in more complex system operations.

These factors will be re-evaluated in the future as the District water supply and demand portfolio evolves over time.

References

Goleta Sanitary District (GSD). 2015. NPDES Monitoring Program 2014 Annual Report.

Goleta Water District (GWD). 2017. Water Supply Management Plan Update. May.

GWD. 2016. Groundwater Management Plan Update. October.

GSI Water Solutions, Inc. (GSI). 2017. Indirect Potable Reuse Response Retention Time Groundwater Model Simulation Technical Memorandum. February 13.

GSI. 2016. Injection Modeling Results Draft Memorandum. February 1.

Millan, Mark, Patricia A. Tennyson, and Shane Snyder. 2015. *Model Communication Plans for Increasing Awareness and Fostering Acceptance of Direct Potable Reuse.* WRRF-13-02, WateReuse Research Foundation, Alexandria, VA.

Mosher, Jeffrey L., G.M. Vartanian, and G. Tchobanoglous. 2016. *Potable Reuse Research Compilation: Synthesis of Findings Final Report.* WRRF-15-01. December 2016.

Olivieri, A.W., J. Crook, M.A. Anderson, R.J. Bull, J.E. Drewes, C.N. Haas, W. Jakubowski, P.L. McCarty, K.L. Nelson, J.B. Rose, D.L. Sedlak, and T.J. Wade. 2016. *Expert Panel Final Report: Evaluation of the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse*. August 2016. http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/rw_dpr_criteria.shtml

Pecson, B.M, R.S. Trussell, A.N. Pisarenko, and R.R. Trussell. 2015. "Achieving Reliability in Potable Reuse: The Four Rs." Journal of the American Water Works Association, 107: 48-58.

Regional Water Quality Control Board, Central Coast Region (RWQCB). 2010. Waste Discharge Requirements for the Goleta Sanitary District Wastewater Treatment Plant Santa Barbara County

RWQCB. 1993. Water Quality Control Plan for the Central Coastal Basin.

RMC Water and Environment (RMC). 2013. South Coast Recycled Water Development Plan.

State Water Resources Control Board (SWRCB). Geotracker. Retrieved from http://geotracker.waterboards.ca.gov/

Trussell, R. Rhodes, R.S. Trussell, A. Salveson, E. Steinle-Darling, Q. He, S. Snyder, D. Gerrity (2015). *Equivalency of Advanced Treatment Trains for Potable Reuse; Treatment Train Toolbox*. WRRF-11-02, WateReuse Research Foundation, Alexandria, VA.

Tchobanoglous, G., J. Cotruvo, J. Crook, E. McDonald, A. Olivieri, A. Salveson, and R.S. Trussell. 2015. *Framework for Direct Potable Reuse*. WRRF-14-20, WateReuse Research Foundation, Alexandria, VA.

Appendix A - Existing Recycled Water System Customers

Customer Name	Billing Class	Average Annual Demand (AFY)
BRS Investment Properties LLC	RECYC3	15.5
Camino Real LLC	RECYC1	44.6
Citrix	RECYC3	11.2
City of Goleta	RECYC3	0.1
Dept of Transportation	RECYC3	3.0
Goleta Union School	RECYC1	6.5
Goleta Union School Dist	RECYC1	12.8
Hollister Business Park, Ltd.	RECYC1	6.1
Mariposa at Ellwood Shores LLC	RECYC3	0.0
Pacific Glen HOA	RECYC3	2.4
Regents of The University of California	RECYC3	1.0
Regents of The University of California	RECYC3	0.2
Sandpiper Golf Course	RECYC1	231.7
Santa Barbara Unified School Dist	RECYC3	29.0
SB County D42012	RECYC1	9.1
SB Processing & Dist Ctr	RECYC3	3.6
State of California Dept Of Transportation	RECYC3	3.3
Storke Ranch HOA	RECYC3	1.5
Storke Ranch HOA	RECYC3	0.5
The Hideaways Community	RECYC3	1.7
The Hideaways Community	RECYC3	7.7
Touchstone Golf, Glen Annie Golf Club	RECYC3	272.3
Towbes, Michael	RECYC3	0.4
UCSB	RECYC3	53.7
UCSB	RECYC3	8.4
UCSB	RECYC2	80.9
UCSB	RECYC3	1.4
UCSB	RECYC3	0.5
UCSB	RECYC2	32.5
UCSB	RECYC2	12.6
UCSB	RECYC2	55.9
UCSB Lot 60 Irrigation	RECYC2	0.0
UCSB/West Campus Point HOA	RECYC3	6.3
UCSB/West Campus Point HOA	RECYC3	4.9
UCSB-House/Sancat/Irr	RECYC2	6.7
Total		**928.3**

Appendix B - Potable Reuse Terminology

Excerpted from *Expert Panel Final Report: Evaluation of the Feasibility of Developing Uniform Water Recycling Criteria for Direct Potable Reuse*. (Olivieri et. al, 2016).

Terminology

Term	Definition
Advanced treated water	Water produced from an advanced water treatment facility for direct and indirect potable reuse applications.
Advanced water treatment	A general term used to describe the overall process and procedures involved in the treatment of wastewater beyond secondary wastewater treatment to produce advanced treated water.
Advanced water treatment facility	The treatment facility where advanced treated water is produced. The specific combination of treatment technologies employed will depend on the quality of the treated wastewater and the type of potable reuse (i.e., indirect potable reuse or direct potable reuse).
Barrier	A measure implemented to control microbial or chemical constituents in advanced treated water. A barrier can be technical, operational, or managerial in nature. Log reduction credits are assigned only for technical barriers.
Close-coupled processes	Two or more processes in series where the performance of the first process can affect the performance of the subsequent process or processes.
Concentrate	A liquid waste stream containing elevated concentrations of total dissolved solids and other constituents.
Constituent	Any physical, chemical, biological, or radiological substance or matter found in water and wastewater.
Constituent of emerging concern	Chemicals or compounds not regulated in drinking water or advanced treated water. They may be candidates for future regulation depending on their ecological toxicity, potential human health effects, public perception, and frequency of occurrence.
Contaminant	Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil. The term “constituent” could be used in place of “contaminant.”
Critical control point	A point in advanced water treatment where control can be applied to an individual unit process to reduce, prevent, or eliminate process failure and where monitoring is conducted to confirm that the control point is functioning correctly. The goal is to reduce the risk from pathogen and chemical constituents.
De facto potable reuse	The downstream use of surface water as a source of drinking water that is subject to upstream wastewater discharges (also referred to as “unplanned potable reuse”).

Term	Definition
Direct potable reuse	There are two forms of direct potable reuse. In the first form, advanced treated water is introduced into the raw water supply upstream of a drinking water treatment facility. In the second form, finished drinking water from an advanced water treatment facility permitted as a drinking water treatment facility is introduced directly into a potable water supply distribution system. The second form of direct potable reuse is not considered in detail in this document.
Disinfection byproducts	Chemicals formed by the reaction of a disinfectant (e.g., chlorine or ozone) with organic or inorganic matter found in treated water or wastewater.
Drinking water	Water that is supplied to a community for potable uses (including drinking, cooking, bathing, and other household uses) that meets the standards prescribed by the National Primary Water Regulations (40 CFR Part 141) of the U.S. Environmental Protection Agency and any applicable state or local regulations.
Engineered storage buffer	A storage facility used to provide retention time – before advanced treated water is introduced into the drinking water treatment facility or distribution system – to (1) conduct testing to evaluate water quality or (2) hold the water in the event that it does not meet specifications.
Environmental buffer	A groundwater aquifer or surface water reservoir, lake, or river into which advanced treated water is introduced before being withdrawn for potable reuse. In some cases, environmental buffers allow for (1) response time in the event that the advanced treated water does not meet specifications and (2) time for natural processes to affect water quality. Where tertiary effluent is applied by spreading, the environmental buffer provides both treatment and storage.
Finished water	Water produced by an advanced water treatment facility that also meets all federal, state, and local regulatory requirements for a drinking water treatment facility. Finished water can be introduced directly into a water supply distribution system.
Inactivation	Killing microorganisms or rendering them incapable of reproducing, thereby preventing their ability to cause illness.
Indirect potable reuse	The introduction of advanced treated water into an environmental buffer (e.g., groundwater aquifer, surface water reservoir) before being withdrawn for potable purposes (see also “*de facto* potable reuse”). Indirect potable reuse also can be accomplished with tertiary effluent when applied by spreading (i.e., groundwater recharge) to take advantage of soil aquifer treatment.

Term	Definition
Log (base 10) reduction	Log reduction corresponds to a reduction in the concentration of a constituent or microorganism by a factor of 10. For example, a 1-log reduction would correspond to a reduction of 90 percent from the original concentration. A 2-log reduction corresponds to a reduction of 99 percent from the original concentration.
Log (base 10) reduction credit	The number of credits assigned to a specific treatment process (e.g., microfiltration, chlorine disinfection, or ultraviolet disinfection), expressed in log units, for the inactivation or removal of a specific microorganism or group of microorganisms. A reduction of 90 percent would correspond to 1-log credit of reduction, whereas a reduction of 99 percent would correspond to 2-log credits of reduction.
Nonpotable reuse	A general term for all water reuse applications except those related to potable reuse.
Pathogen	A microorganism (e.g., bacteria, virus, *Giardia*, or *Cryptosporidium*) capable of causing illness in humans.
Public outreach	The process of communicating with and educating/informing the public on options and proposed plans for implementing potable reuse projects, as well as receiving input from the public, including questions and concerns that need to be addressed.
Public water system	A system used to provide the public with water for human consumption through pipes or other constructed conveyances, if such a system has at least 15 service connections or regularly serves at least 25 individuals; see Section 1401(4)(A) of the Safe Drinking Water Act.
Purified water	Some municipalities use the term “purified water” to refer to advanced treated water or finished water, especially in outreach and communication activities.
Redundancy	The use of multiple treatment barriers to attenuate the same type of constituent so that if one barrier fails, performs inadequately, or is taken offline for maintenance, the overall system still will perform effectively and risk is reduced.
Relative risk	Estimating the risks associated with a particular event for different groups of people.
Residuals	Waste streams and semisolids produced by wastewater treatment, advanced water treatment, and drinking water treatment processes.
Resilience	The ability to adapt successfully or restore performance rapidly in the face of treatment failures.
Risk	In risk assessment, the probability that something will cause injury combined with the potential severity of that injury.

Term	Definition
Robustness	The use of a combination of treatment technologies to address a broad variety of constituents and changes in concentrations in source water.
Safety	Practical certainty that a substance will not cause injury under carefully defined circumstances of use and concentration.
Source control	The elimination or control of the discharge of constituents into a wastewater collection system that can impact wastewater treatment, are difficult to treat, and can impair the final quality of the secondary-treated wastewater effluent entering the advanced water treatment facility.
Treatment reliability	The ability of a treatment process or treatment train to consistently achieve the desired degree of treatment, based on its inherent redundancy, robustness, and resilience.
Treatment train	A grouping of treatment technologies or processes to achieve a specific treatment or water quality goal or objective.
Wastewater characteristics	General classes of wastewater constituents, such as physical, chemical, and biological constituents.

Appendix C - Groundwater Injection Assessment Memo

Technical Memorandum

Date: February 13, 2017 **Project No.:** 0528.004

To: Rob Morrow / RMC

CC: Ryan Drake, Brooke Welch / GWD

From: Bryan Bondy, PG, CHG / GSI Water Solutions, Inc.

RE: Indirect Potable Reuse Response Retention Time

Groundwater Model Simulation

Introduction

In November 2016, Goleta Water District staff requested that GSI Water Solutions (GSI) perform a groundwater model simulation using the Goleta Groundwater Basin Numerical Groundwater (the Model) to evaluate response retention time in support of a potable reuse study being developed for the District. Further information concerning the requested model simulation was provided by RMC Water and Environment (RMC) in January 2017. This memorandum briefly describes the model simulation inputs and results.

Model Simulation Description

The model simulation was adapted from Scenario 4a of GSI (2015)[1], which considers average hydrologic conditions. The model simulation considers 6,000 acre-feet per year (AFY) of advanced-treated recycled water injection via eleven hypothetical

[1] GSI, 2015, Final Draft Technical Memorandum No. 2, Goleta Groundwater Basin Numerical Model Update & Training Project, Model Predictive Scenario Results (Task 2), January 27, 2015.

injection well locations provided by RMC (Table 1 and Figure 1). The assumed maximum injection rate for the injection wells provided by RMC is 0.5 million gallons per day (mgd).

Table 1. Simulated Hypothetical Injection Wells and Rates

Injection Well Location Description	X Coordinate[1]	Y Coordinate[1]	Injection Rate (mgd)[2]	Injection Rate (AFY)[2]
Coralino	6,013,209	1,990,639	0.5	560
Girls Inc.	6,020,511	1,985,506	0.5	560
Hollipat	6,016,393	1,985,001	0.5	560
Kellogg Property	6,012,994	1,986,345	0.5	560
Kellogg School	6,012,568	1,989,957	0.5	560
Lassen Dr. Park	6,017,177	1,987,333	0.5	560
San Marcos HS	6,022,827	1,987,609	0.5	560
San Pedro Creek	6,009,131	1,985,985	0.36	399
SB-MTD	6,015,869	1,987,320	0.5	560
St. Raphael	6,014,774	1,986,453	0.5	560
Well Option 2	6,009,529	1,986,482	0.5	560
Totals	N/A	N/A	5.36	6,000

Notes: (1) NAD 1983, SP CA Zone V. (2) Totals may not match sums of values due to rounding.

The model simulation considers pumping from GWDs potable wells as described in GSI (2015), except that the two hypothetical new wells included in that scenario were omitted. Additionally, the pumping rate for the SB Corp well was increased from 120 AFY to 500 AFY based on the District's plan to replace this well pumping. The total simulated GWD pumping is 7,200 AFY. GWD pumping wells are summarized in Table 2. Pumping well locations are shown on Figure 1.

Table 2. Simulated GWD Pumping Wells and Rates

Pumping Well	X Coordinate[1]	Y Coordinate[1]	Pumping Rate (mgd)[2]	Pumping Rate (AFY)[2]
Airport	6,008,200	1,986,381	1.12	1,255
Anita	6,020,024	1,984,088	0.54	602
Berkeley	6,014,306	1,989,524	0.43	480
El Camino	6,020,257	1,987,117	0.55	612
Oak Grove	6,025,123	1,988,214	0.21	240
San Antonio	6,024,883	1,987,345	0.81	902
San Marcos	6,023,298	1,986,215	0.60	676
San Ricardo	6,017,129	1,984,107	0.81	904
SB Corp	6,015,120	1,984,280	0.45	500
Shirrell	6,009,608	1,989,066	0.32	360
University	6,019,167	1,988,784	0.60	673
Totals	N/A	N/A	6.43	7,200

Notes: (1) NAD 1983, SP CA Zone V. (2) Totals may not match sums of values due to rounding.

All other model inputs are identical to the Scenario 4a described in GSI (2015). The reader is referred to GSI (2015) for further information concerning the groundwater model.

Model Simulation Results

Injection

The model simulation results indicate that it is likely feasible to inject 6,000 AFY of advanced-treated recycled water while simultaneously pumping 7,200 AFY. Potential artesian conditions (groundwater levels higher than land surface) are suggested at several injection locations. This is not likely to be a significant issue because injection was simulated in areas where the basin is confined; however, high groundwater levels should be more carefully evaluated prior to design (if a project is proposed) to ensure that geologic hazards or nuisance conditions are not created or exacerbated.

Response Retention Time

The primary purpose of the model simulation was to evaluate the ability to satisfy Title 22 minimum response retention time requirements for the injection of advanced-treated recycled water. Pursuant to Title 22 regulations, the minimum allowable response retention time is 2 months. If groundwater modeling is utilized for permitting, a safety factor of two is required, hence, 4 months must be demonstrated. The model simulation results indicate that GWD potable supply wells are not located within a 4-month response retention (travel) time relative to the simulated injection wells provided by RMC. Figure 1 shows the injection and pumping well locations together with 120 day (4-month) recycled water travel paths. As shown on Figure 1, injected recycled water generally travels in the direction of groundwater flow (perpendicular to groundwater elevation contours shown in Figure 1) and travel distances in the subsurface are estimated to be approximately 600-700 feet under the conditions simulated.

Response Retention Time Limitations

The following limitations apply to the results presented above:

1. The results are only valid for the specific combination of simulated injection/pumping wells and rates under the average hydrologic conditions simulated.

2. Response retention times for active private potable wells were not evaluated. The locations of currently active private potable wells were not available for this evaluation.

3. Travel times calculated by the groundwater model are not conservative. The groundwater model assumes that groundwater flow is uniformly distributed across each model layer versus real world conditions where groundwater flow is focused in the most permeable sections of the aquifer. Hence, model results are an ideal, vertically-averaged velocity, whereas actual velocities in the field can be many times higher than modeled if considerable groundwater flow is focused in a relatively thin, but highly permeable zone.

Conclusions and Recommendations

The following conclusions can be made based on the modeling results:

1. It may be feasible to inject 6,000 AFY of advanced-treated recycled water while simultaneously pumping 7,200 AFY.

2. Potential artesian conditions (groundwater levels higher than land surface) are suggested at several injection locations and should be evaluated further. This condition may vary depending upon how long District wells have previously been operating.

3. Injected recycled water travel distances are estimated to be approximately 600-700 feet under the conditions simulated. Actual recycled water travel distances in the subsurface could be significantly greater due to aquifer heterogeneity that cannot be simulated using the model.

4. GWD potable supply wells are not located within a 4-month response retention (travel) time relative to the simulated injection wells provided by RMC. Even if actual recycled water velocities are significantly greater than simulated, most GWD wells would likely remain outside of a 4-month travel time zone.

Based on the foregoing, GSI recommends the following:

1. Consideration should be given to performing additional groundwater modeling to evaluate more cost effective injection well locations. One concept that could be evaluated would be to inject at one or more well fields at different locations in the basin, rather than individual wells spread throughout the basin, as was evaluated for this memorandum. A well field concept would reduce pipeline costs significantly compared to the injection well locations utilized in this evaluation.

2. Consideration should be given to performing pilot injection testing using a tracer to better assess travel times prior to project design and permitting. One possible pilot injection program would be to inject potable water into the San Marcos well and recovery it at the future Puente well. Ideally, several monitoring wells would be drilled between these wells to evaluate groundwater gradients and velocities. The District should work closely with Division of Drinking Water and the Regional Water Quality Control Board when designing the pilot injection program to ensure that that it supports the permitting process.

3. Private potable well locations should be identified and evaluated prior to project design and permitting.

Attachments

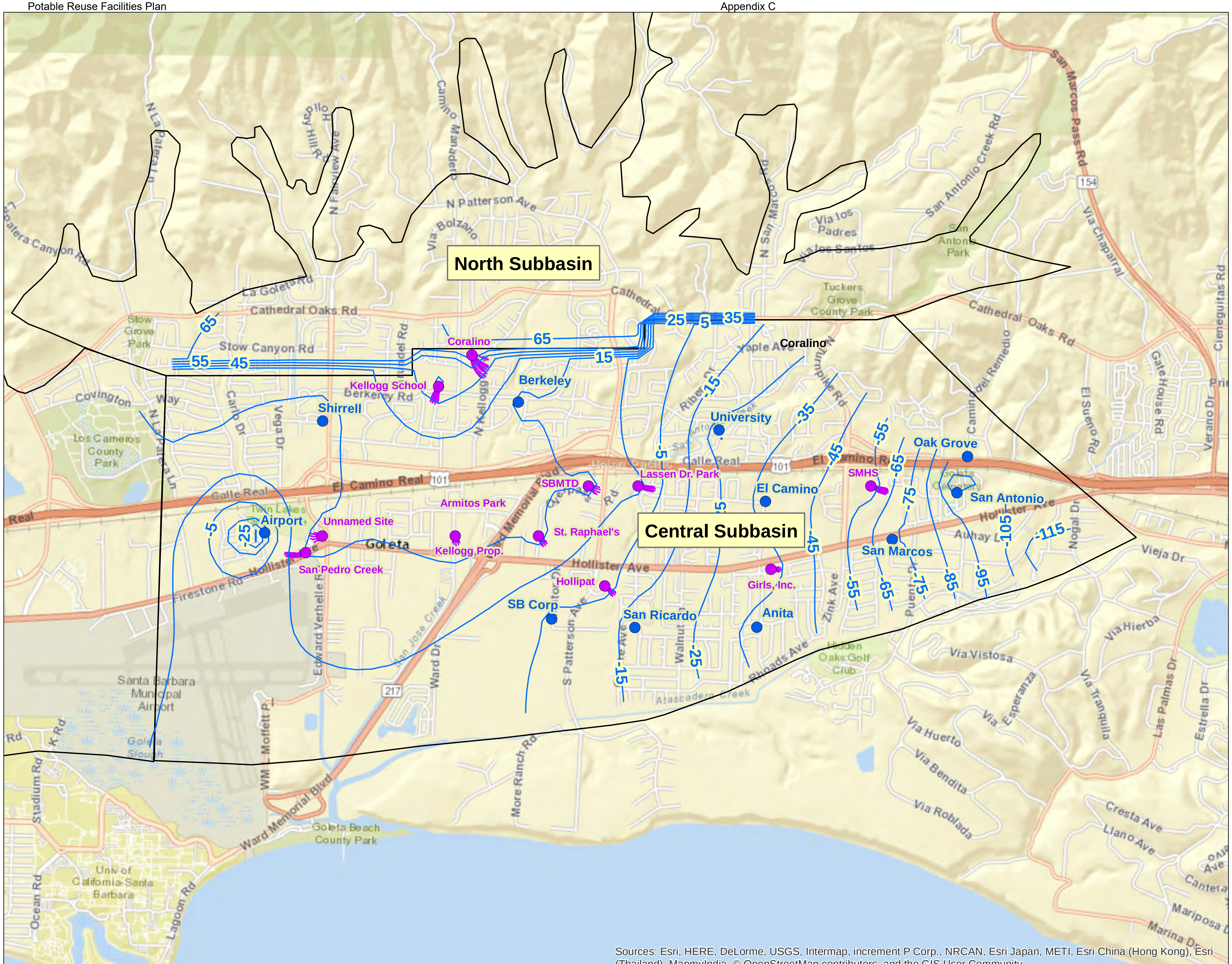


FIGURE 1

Indirect Potable Reuse
Response Retention Time Evaluation

Goleta Water District
Santa Barbara, County, CA

Legend

- Simulated Recycled Water Injection Well
- GWD Potable Pumping Well
- Groundwater Elevation (feet msl)
- 120 Day Recycled Water Travel Path
- Basin/Subbasin Boundary

N

0 1,000 2,000
Feet

MAP NOTES:
Date: January 28, 2017
Data Sources: Goleta Water District, RMC, ESRI

GSI Water Solutions, Inc.

Appendix D - Detailed Cost Estimates

		Goleta Potable Reuse Facilities Plan "A" Alternatives (5,890 AFY / 4,620 AFY) Costs					Goleta Potable Reuse Facilities Plan "B" Alternatives (4,550 AFY) Costs				Goleta Potable Reuse Facilities Plan "Phased" Alternatives (1,500 - 4,550 AFY) Costs			
	Alt	**A1**	**A2**	**A2a**	**A3**	**A4**	**B1**	**B2**	**B3**	**B4**	**C1**	**C2**	**C3**	**C4**
Capital Costs		**GWA**	**RWA 1**	**RWA 1 Alt**	**RWA 2**	**TWA**	**GWA**	**RWA 1**	**RWA 2**	**TWA**	**GWA (1500)**	**GWA (3000)**	**GWA + RWA**	**GWA + TWA**
Treatment														
Ozone		$ -	$ -	$ -	$ -	$ 8,400,000	$ -	$ -	$ -	$ 7,200,000	$ -	$ -	$ -	$ 7,200,000
BAC		$ -	$ -	$ -	$ -	$ 1,600,000	$ -	$ -	$ -	$ 1,400,000	$ -	$ -	$ -	$ 1,400,000
UF		$ 12,600,000	$ 12,600,000	$ 12,600,000	$ 12,600,000	$ 12,600,000	$ 10,100,000	$ 10,100,000	$ 10,100,000	$ 10,100,000	$ 3,500,000	$ 7,000,000	$ 10,100,000	$ 10,100,000
RO		$ 16,100,000	$ 16,100,000	$ 16,100,000	$ 16,100,000	$ 16,100,000	$ 12,800,000	$ 12,800,000	$ 12,800,000	$ 12,800,000	$ 4,500,000	$ 9,000,000	$ 12,800,000	$ 12,800,000
UV-AOP		$ 10,300,000	$ 10,300,000	$ 10,300,000	$ 10,300,000	$ 10,300,000	$ 6,500,000	$ 6,500,000	$ 6,500,000	$ 6,500,000	$ 2,300,000	$ 3,900,000	$ 6,500,000	$ 6,500,000
Chlorine		$ -	$ 900,000	$ 900,000	$ 900,000	$ 900,000	$ -	$ 400,000	$ 400,000	$ 400,000	$ -	$ -	$ 400,000	$ 400,000
Purified Water Storage		$ -	$ 2,250,000	$ 2,250,000	$ 2,250,000	$ 6,300,000	$ -	$ 1,800,000	$ 1,800,000	$ 4,950,000	$ -	$ -	$ 1,800,000	$ 4,950,000
Advanced Monitoring		$ -	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 5,000,000	$ -	$ 1,000,000	$ 1,000,000	$ 5,000,000	$ -	$ -	$ 1,000,000	$ 5,000,000
BNR		$ -	$ 4,787,000	$ 4,787,000	$ 4,787,000	$ 4,787,000	$ -	$ 4,787,000	$ 4,787,000	$ 4,787,000	$ -	$ -	$ 4,787,000	$ 4,787,000
Additional Tertiary		$ -	$ -	$ -	$ -	$ 6,600,000	$ -	$ -	$ -	$ 4,200,000	$ -	$ -	$ -	$ 4,200,000
Outfall Modification		$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ 500,000	$ -	$ -	$ 500,000	$ 500,000
Conveyance														
Pump Station		$ 2,925,000	$ 2,925,000	$ 4,550,000	$ 3,575,000	$ 3,575,000	$ 2,275,000	$ 2,925,000	$ 2,925,000	$ 2,600,000	$ 650,000	$ 1,300,000	$ 2,925,000	$ 2,600,000
Pump Station 2		$ -	$ 4,225,000	$ 4,550,000	$ 4,875,000	$ -	$ -	$ 3,575,000	$ 3,900,000	$ -	$ -	$ -	$ 2,600,000	$ -
Pipeline 6"		$ 1,620,000	$ -	$ -	$ -	$ -	$ 1,392,000	$ -	$ -	$ -	$ 348,000	$ 720,000	$ 720,000	$ 720,000
Pipeline 12"		$ 2,376,000	$ -	$ -	$ -		$ 1,260,000	$ -	$ -	$ -	$ -	$ 504,000	$ 504,000	$ 504,000
Pipeline 18"		$ 2,646,000	$ -	$ 5,670,000	$ -	$ 5,346,000	$ 2,646,000	$ 10,800,000	$ -	$ 5,346,000	$ 2,646,000	$ 2,646,000	$ 11,826,000	$ 6,318,000
Pipeline 24"		$ -	$ 14,400,000	$ -	$ 14,400,000	$ -	$ -	$ -	$ 14,400,000	$ -	$ -	$ -	$ -	$ -
Brine Line 6"		$ -	$ -	$ -	$ 3,200,000	$ -	$ -	$ -	$ 3,200,000	$ -	$ -	$ -	$ -	$ -
Major Crossings		$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ -	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ -	$ -	$ 1,000,000	$ 1,000,000
Injection / Monitoring Wells		$ 14,400,000	$ -	$ -	$ -	$ -	$ 12,000,000	$ -	$ -	$ -	$ 4,800,000	$ 8,400,000	$ 8,400,000	$ 8,400,000
Raw Construction Total		**$ 64,467,000**	**$ 70,987,000**	**$ 64,207,000**	**$ 75,487,000**	**$ 83,008,000**	**$ 49,473,000**	**$ 56,187,000**	**$ 63,312,000**	**$ 66,783,000**	**$ 18,744,000**	**$ 33,470,000**	**$ 65,862,000**	**$ 77,379,000**
Construction Contigency	30%	$ 19,340,000	$ 21,300,000	$ 19,260,000	$ 22,650,000	$ 24,900,000	$ 14,840,000	$ 16,860,000	$ 18,990,000	$ 20,030,000	$ 5,620,000	$ 10,040,000	$ 19,760,000	$ 23,210,000
Construction Total		**$ 83,807,000**	**$ 92,287,000**	**$ 83,467,000**	**$ 98,137,000**	**$ 107,908,000**	**$ 64,313,000**	**$ 73,047,000**	**$ 82,302,000**	**$ 86,813,000**	**$ 24,364,000**	**$ 43,510,000**	**$ 85,622,000**	**$ 100,589,000**
Implementation Costs	30%	$ 25,140,000	$ 27,690,000	$ 25,040,000	$ 29,440,000	$ 32,370,000	$ 19,290,000	$ 21,910,000	$ 24,690,000	$ 26,040,000	$ 7,310,000	$ 13,050,000	$ 25,690,000	$ 30,180,000
Avoided NPR System Costs		$ (9,200,000)	$ (9,200,000)	$ (4,600,000)	$ (9,200,000)	$ (9,200,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Capital Cost		**$ 99,747,000**	**$ 110,777,000**	**$ 103,907,000**	**$ 118,377,000**	**$ 131,078,000**	**$ 83,603,000**	**$ 94,957,000**	**$ 106,992,000**	**$ 112,853,000**	**$ 31,674,000**	**$ 56,560,000**	**$ 111,312,000**	**$ 130,769,000**
Annual Costs														
Treatment O&M		$ 3,900,000	$ 3,990,000	$ 3,990,000	$ 3,990,000	$ 4,990,000	$ 2,940,000	$ 2,980,000	$ 2,980,000	$ 3,840,000	$ 1,030,000	$ 1,990,000	$ 2,980,000	$ 3,840,000
Testing / Monitoring		$ 100,000	$ 500,000	$ 500,000	$ 500,000	$ 1,000,000	$ 100,000	$ 500,000	$ 500,000	$ 1,000,000	$ 100,000	$ 100,000	$ 500,000	$ 1,000,000
Pumping		$ 841,180	$ 720,000	$ 894,000	$ 860,000	$ 366,000	$ 755,000	$ 646,000	$ 674,000	$ 262,000	$ 389,000	$ 490,000	$ 542,000	$ 262,000
Avoided NPR System Costs		$ (800,000)	$ (800,000)	$ (800,000)	$ (800,000)	$ (800,000)								
O&M Subtotal		**$ 4,041,180**	**$ 4,410,000**	**$ 4,584,000**	**$ 4,550,000**	**$ 5,556,000**	**$ 3,795,000**	**$ 4,126,000**	**$ 4,154,000**	**$ 5,102,000**	**$ 1,519,000**	**$ 2,580,000**	**$ 4,022,000**	**$ 5,102,000**
Annualized Capital Cost		$ 5,089,000	$ 5,652,000	$ 5,301,000	$ 6,040,000	$ 6,688,000	$ 4,265,000	$ 4,845,000	$ 5,459,000	$ 5,758,000	$ 1,616,000	$ 2,886,000	$ 5,679,000	$ 6,672,000
Total Annual Cost		**$ 9,131,000**	**$ 10,062,000**	**$ 9,885,000**	**$ 10,590,000**	**$ 12,244,000**	**$ 8,060,000**	**$ 8,971,000**	**$ 9,613,000**	**$ 10,860,000**	**$ 3,135,000**	**$ 5,466,000**	**$ 9,701,000**	**$ 11,774,000**
Project Yield	AFY	4,620	4,620	4,620	4,620	4,620	4,550	4,550	4,550	4,550	1,500	3,000	4,550	4,550
Unit Cost	**$/AFY**	**$1,980**	**$2,180**	**$2,140**	**$2,300**	**$2,660**	**$1,780**	**$1,980**	**$2,120**	**$2,390**	**$2,090**	**$1,830**	**$2,140**	**$2,590**

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