Long Term Supplemental Water Supply Alternatives Report

DECEMBER 2015

COUNTY OF SANTA BARBARA
CALIFORNIA

Prepared by:

RMC
water and environment

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Long Term Supplemental Water Supply Alternatives Report

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In Association with:

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List of Abbreviations

AF	acre feet
AFD	acre feet per day
AFY	acre feet per year
Ag	agricultural
CBCD	Coastal Branch Capacity and Delivery
CCWA	Central Coast Water Authority
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Analysis
CSD	Community Services District
CWD	County Water District
DDW	Department of Drinking Water
DPR	direct potable reuse
DWR	California Department of Water Resources
ft	feet
gpcd	gallons per capita per day
GSA	Groundwater Sustainability Act
GSP	groundwater sustainability plan
GSD	Goleta Sanitary District
GSWC	Golden State Water Company
GWR	groundwater recharge
IPR	indirect potable reuse
IRWMP	Integrated Regional Water Management Plan
LCSD	Laguna County Sanitation District
LID	low impact development
M&I	municipal and industrial
MGD	million gallons per day
MSD	Montecito Sanitary District
MWC	Mutual Water Company
NCSD	Nipomo Community Services District
NPR	non-potable reuse
NRDC	Natural Resources Defense Council

RWQCB	Regional Water Quality Control Board
SGMA	Sustainable Groundwater Management Act
SLO	San Luis Obispo
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
USBR	United States Bureau of Reclamation
USD	Unified School District
USFS	United States Forrest Service
VAFB	Vandenberg Air Force Base
WD	Water District
WTP	water treatment plant
WWTP	wastewater treatment plant

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Chapter 1 Introduction

On August 26, 2014, the County of Santa Barbara Board of Supervisor's directed the Santa Barbara County Water Agency (Water Agency) to complete a study that identified options for increasing water supplies available to meet long-term Santa Barbara County (Region) demands. The immediate interest in determining supply options was in part a result of the challenges faced within the County during the most recent and, in some ways, most severe drought on record.

The resulting Long Term Supplemental Water Supply Alternatives Project (Project) and Report (Report) was completed by the Water Agency with RMC Water and Environment (RMC or Project Team) in December 2015.

1.1 Purpose of the Report

At the time of this Report's completion, the current drought was in its fourth year. It was not, however, the intent of the Report to address the current impacts experienced as a result of the drought. The intent was to focus on preparing for subsequent droughts that could be even more severe as a result of changing climate conditions and natural climatic variability. To meet that overarching goal, the Project Team implemented a planning process to create a final Report that meets several key objectives.

- Identify options to access new supplies for the Region by 2040
- Identify a comprehensive list of subregional, regional, and inter-regional supply options
- Characterize feasibility, reliability, cost, and implementation considerations for options
- Involve technical planning partners and public in the process
- Provide the technical basis for future decision making and implementation
- Begin collaboration on regional projects for future implementation

This Report's focus is on water supply options and does not similarly explore or discuss water use efficiency options. It is recognized that in order to meet future water resources needs, the Region will need to also examine ways in which current and new supplies identified in this Report can be used more efficiently to meet the same demands. It is also important to note, that while supply options are discussed, there has been no decision to implement any one of these options as a result of this planning process. Rather, it is assumed that the analysis and results provided in the Report will provide a sound basis for future decision making.

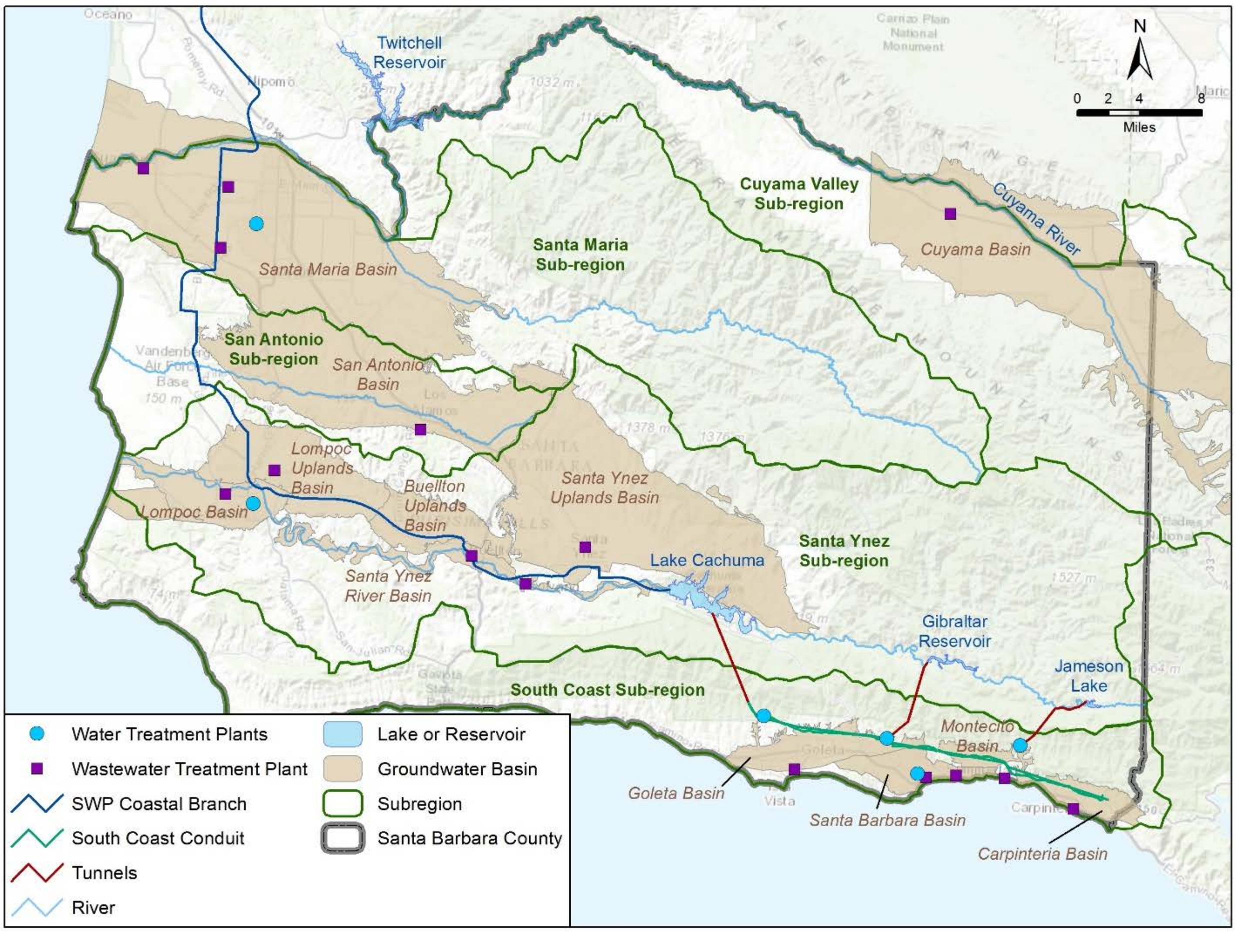
1.2 Planning Setting

Santa Barbara County occupies approximately 2,800 square miles in the central coastal area of California, bordered on the west and south by the Pacific Ocean, with 110 miles of coastline. The Region is highly diverse in terms of climate and topography with five major ecological zones and numerous subareas ranging from arid high desert regions in the interior; mountains and foothills; and coastal plains. Summers are warm and dry; the winters are cool and often wet. Annual precipitation ranges from 8 inches near Cuyama Valley to a maximum of about 36 inches at the uppermost elevations of the Santa Ynez Mountains. The Region's population is over 430,000 with most of the people living in the coastal valleys and in the cities of Santa Barbara and Santa Maria.

The 2013 Integrated Regional Water Management Plan (IRWMP) states that total 2012 water demands within the Region are about 280,000 acre-feet per year (AFY) with 75% used for agricultural irrigation (RMC, 2013). The other 25% of municipal and industrial demands are consumed at an average rate of approximately 180 gallons per capita day (gpcd), although conservation has increased in response to the State order to achieve a statewide 25% reduction in water demand, resulting in per capita demands between 50 and 175 gpcd.

Surface river watersheds and groundwater basins are current key sources of supply for the Region, as is locally produced recycled water. These local supplies are generated within the Region, however approximately 15 percent of the Region's water supply is imported through the Coastal Branch extension of the State Water Project (SWP) system.

Figure 1-1: Santa Barbara County Setting



According to the Santa Barbara County Water Supply and Demand Study (GEI, 2013), in 2010, the Region's water sources included about 28,000 AFY imported water, 8,000 AFY local surface water, 25,000 AFY Lake Cachuma water, 154,000 AFY groundwater and 2,000 AFY recycled water provided by water purveyors. Additional demands are met through private wells, typically for agricultural uses, and may not be reflected in the supply volumes above. The recent drought resulted in 5% allocations for the SWP system in 2014 and 20% allocations in 2015, coupled with very limited local surface water flows, the Region was heavily dependent upon water stores in surface and groundwater reservoirs as well as high level water use efficiency programs. With the increased pumping in groundwater basins, many local wells went dry or became compromised causing some farmers to fallow their land. Some areas even trucked in water to meet residential demands. The effects of the drought, however, were not felt consistently across the Region.

As a result of these variations in settings, demands and supplies, water resources planning within the County is often done at a subregional scale. In keeping with regional planning efforts such as the IRWMP, this Project also used the five County subregions to characterize needs and existing supply strategies (as shown in Figure 1-1). The water resources setting of each subregion are is described here.

Santa Maria: The subregion's water resources are based on the adjudication agreement of the Santa Maria Basin. Given that the local groundwater basin is actively managed with various sources of recharge, there has been minimal impact from the recent drought relative to other areas of the Region.

San Antonio: This subregion is dominated by private pumping to meet agricultural demand that was impacted by the drought, and is served solely from the groundwater basin. Vandenberg Air Force Base's main groundwater production wells are located in this basin, which has been able to meet its own water supply needs during the drought.

Cuyama: This subregion's groundwater basin, which serves as the sole source of water supply to the area, is only recharged through naturally occurring local surface water. The Cuyama Basin is currently considered to be in critical overdraft by the State due to periods of intense pumping and low annual rainfall. Most of the demand is from private agricultural uses but there is a definite concern about long-term reliability for local communities.

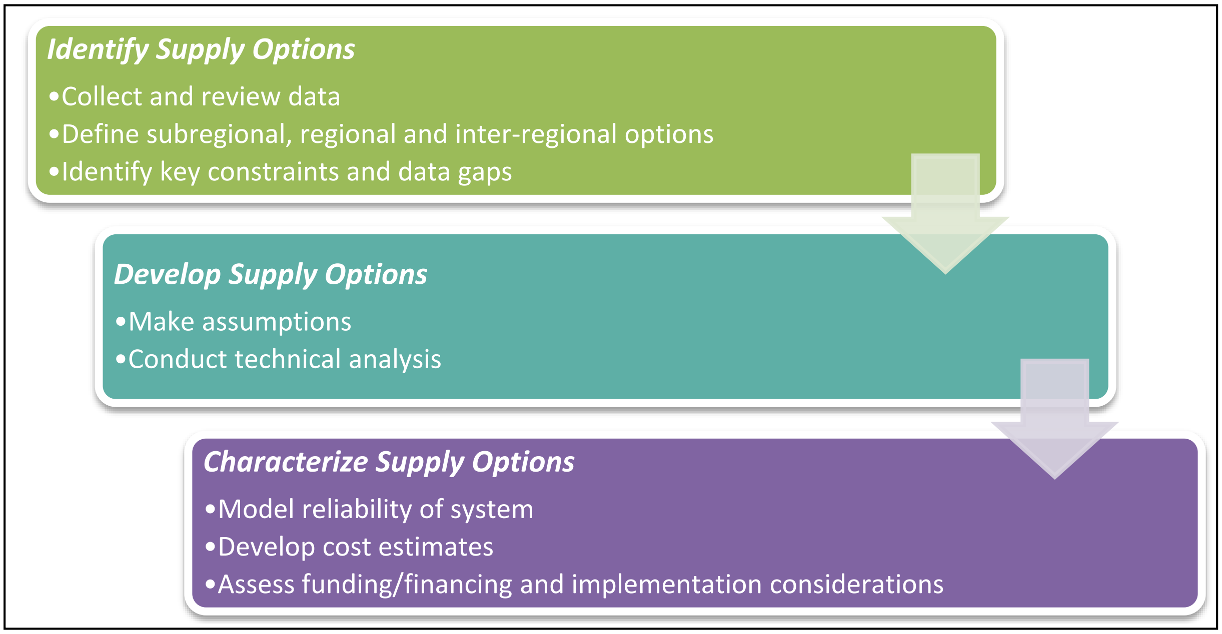
Santa Ynez: This subregion has multiple basins recharged by the Santa Ynez River which must pass through Lake Cachuma and other sources (imported water and recycled water). Since Lake Cachuma is the primary supply source for the South Coast subregion, the management of reservoir flows must meet both subregion's needs. The Santa Ynez River also has environmental flow requirements. In addition, there are concerns over water quality in some of the basin areas as a result of naturally occurring sources of hexavalent chromium.

South Coast: This subregion has the greatest population served predominately by supplies stored at Lake Cachuma, as well as small local reservoirs that have been significantly impacted by sedimentation, limiting local storage potential. Lake Cachuma has also seen drastic declines as a result of having very minimal inflows from both local and imported surface supplies. Given this subregion's smaller groundwater basin sizes, the limited surface supplies greatly impacted the availability of supply during the drought.

1.3 Planning Process

The Project Team developed a planning process to allow for an assessment of a comprehensive list of potential supply options. This planning process (shown in Figure 1-2) benefited greatly from input received from both public and key stakeholders. The planning process began with two initial public meetings held in the cities Santa Barbara and Santa Maria to inform the public about the project and get input on water resources needs and supply options that should be considered. The Agency also created a project webpage with updated information and an opportunity to submit supply option ideas.

Figure 1-2: Project Planning Process



The project also convened a Planning Partners group to provide technical input at key project milestones. The Planning Partners are selected representatives from municipal water purveyors, wastewater agencies and representatives of private water users (those with rights and access to water supplies outside of local agencies) within the Region. The public meetings and meeting dates are listed in Table 1-1. In addition, Planning Partners were given the opportunity to review and comment on technical memorandums prepared for the project in August 2015, and the opportunity to review and comment on the Draft Report in October 2015.

The water supply options identified as part of the Project included those received from both the public and the Planning Partner group. This step resulted in over 120 water supply options, which are listed in Appendix A and further discussed in this Report. The Planning Partners also provided valuable feedback on project assumptions, options evaluations and implementation considerations.

Table 1-1: Public Meetings

Meeting	Meeting Location	Meeting Date
Public Meeting 1	County Board of Supervisors Hearing Room Santa Maria	September 29, 2014
Public Meeting 2	County Planning Commission Hearing Room Santa Barbara	September 30, 2014
Santa Maria Subregional Meeting	County Public Works Building, Santa Maria	October 29, 2014
San Antonio Subregional Meeting	Senior Center Meeting Hall, Los Alamos	September 29, 2014
Santa Ynez Subregional Meeting	City Council Chambers, Buellton	September 29, 2014
South Coast Subregional Meeting	County Board of Supervisors Conference Room, Santa Barbara	October 15, 2015
Cuyama Subregional Meeting	Webinar and Conference Call	November 25, 2014
Planning Partner Meeting 1	Central Coast Water Authority, Buellton	February 26, 2014
Planning Partner Meeting 2	Central Coast Water Authority, Buellton	June 9, 2015

Chapter 2 Sources of Supply

Santa Barbara County has access to several supply sources that are generated locally, regionally and statewide. The first step in assessing the alternative water supplies available for the County to meet its future demands was to determine the volume of "unused supplies" available. For the purposes of this Report, unused supply is considered a water supply that is not already, or planned to be, used to meet a current or future water resource need; and is therefore potentially available to meet water supply needs in the Region. Since the availability of these supply sources can change periodically based upon seasonal or annual precipitation and use variability, the Project estimated unused supplies using historical data from the past ten years along with reasonable assumptions as to continued availability. It should be noted that the use of historical data in estimating unused supplies does not account for potential long term variability due to concerns such as increased instream demands and climate change. The methodologies used to estimate the availability of unused supplies are detailed in this chapter, and include:

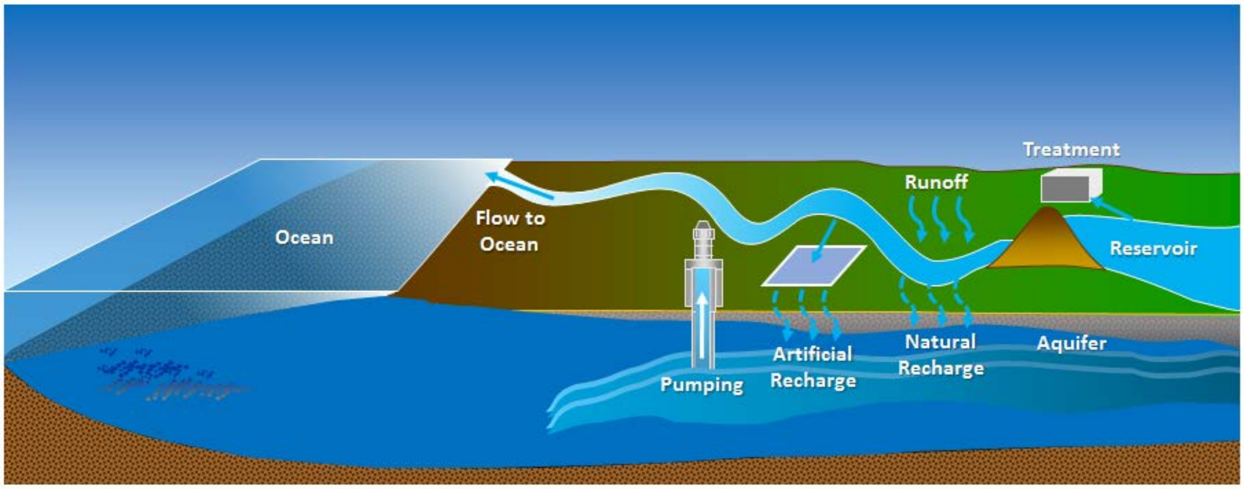
- Local surface/stormwater (Section 2.1)
- Imported water (Section 2.2)
- Recycled water (Section 2.3)
- Groundwater (Section 2.4)
- Ocean desalination (Section 2.5)

2.1 Local Surface/Stormwater

Local surface/stormwater is water derived from rain that falls within the Region, flows over land and into storm drains, streams and rivers to the ocean, and can be captured either on the surface or recharged for storage in groundwater basins, as shown in Figure 2-1. Stormwater supply is a form of local surface water supply that is highly variable as it only represents the additional peak supplies generated during storm events. Generally, local surface water base flows in streams and rivers are fully allocated, meaning that the majority of "unused" supply is from storm flow events. To clarify, the Project will examine the following forms of unused local surface/stormwater:

- **Unused stream flow:** Storm flows in local streams not already utilized as a supply or already identified to meet environmental flow requirements
- **Urban runoff:** Overland runoff from storm events which has fallen on an urban area prior to reaching storm drains or surface water bodies
- **Surface water system losses:** Losses of water from surface water bodies, including evaporation from reservoirs and evapotranspiration from phreatophytes (deep rooted plants that consume large quantities of water, such as Arundo) along rivers
- **Watershed runoff increases:** Increases in precipitation reaching water supply sources through watershed management.

Figure 2-1: Local Surface Water/Stormwater Supplies



Unused Stream Flows

Unused stream flows are assumed to flow to the ocean through local rivers or creeks. These flows do not currently contribute to municipal, agricultural or environmental supplies nor do they recharge local groundwater basins. To estimate the amount of unused flow potential that exists in the Region, historical stream gauge data for each of the County's major rivers and streams as well as reservoir operations data to account for spills and flood releases were used. Figure 2-2 shows the location of each of these rivers.

Figure 2-2: Santa Barbara County River Systems with Unused Flow

It was assumed that unused stream flows are flows above the minimum base flow, which was established for each river and creek to account for existing municipal and agricultural supply use as well as environmental flows. Rainfall in the Region is highly variable, both annually and seasonally, with cycles of wet and dry years (the water year classification) along with wet winter months and dry summer months. Knowing this, it was assumed that unused stream flows would be available only during winter months in wet years. Table 2-1 provides a summary of the water year classifications used in this analysis, which is relatively balanced as it includes wet, dry and normal years.

Table 2-1: Water Year Classifications

Year	Water Year Classification
1989	Dry
1990	Dry
1991	Normal
1992	Wet
1993	Wet
1994	Normal
1995	Wet
1996	Normal
1997	Normal
1998	Wet
1999	Normal
2000	Normal
2001	Wet
2002	Dry
2003	Normal
2004	Dry
2005	Wet
2006	Normal
2007	Dry
2008	Normal
2009	Dry
2010	Normal
2011	Wet
2012	Dry
2013	Dry

Some rivers in the Region are highly managed, including the Santa Maria River and Santa Ynez River, meaning the above analysis could not be used as stormwater is typically captured in reservoirs for use downstream and for flood control purposes. For these rivers, historical records of reservoir spilling and/or flood releases were examined. It was assumed that these spills and flood releases would be available as unused stream flow.

Annual average supply is then calculated based on the following formula:

$$\text{Annual Average Unused Supply} = \text{Average Event Year Unused Supply} \times \frac{\text{Avg. Number of Event Years}}{\text{10 year rolling average}}$$

Unused stream flows for each of the Region's major rivers are provided in Table 2-2. Note that these unused stream flows represent a rolling average period of 10 years, calculated over the historic record of data available for each river (see Table 2-2), but represent wet year flows and therefore can be expected to be variable from year to year.

Table 2-2: Average Unused Stream Flows

River	Average Unused Stream Flows	Total Period Used[1]
Santa Maria River	7,600 AFY	1969-1998
Sisquoc River	9,500 AFY	1989-2013
San Antonio Creek	1,400 AFY	1989-2013
Cuyama River	4,400 AFY	1989-2013
Santa Ynez River	56,000 AFY	1952-2013
Salsipuedes Creek	0 AFY	Not applicable
San Jose Creek	2,000 AFY	1989-2013
Toro Creek	0 AFY	Not applicable
Carpinteria Creek	3,000 AFY	1989-2013

1. Total period used is based on the historic record of data available for each river.

Urban Runoff

As described above, urban runoff is overland runoff from storm events which has fallen on an urban area prior to reaching storm drains or surface water bodies. This runoff can be captured and used directly for irrigation (typically using rain barrels or cisterns) or allowed to infiltrate into the ground to recharge groundwater (commonly seen in low impact development or LID). The volume of urban runoff available for use as a water supply was calculated using the following equation which considers the size of urban areas in each subregion, average historical precipitation, land use and an assumption of the amount of stormwater currently running off the area as opposed to infiltrating into the ground (the runoff coefficient, shown below):

Total Runoff = Precipitation x Runoff Coefficient x Runoff Area

The Runoff Coefficient varies by land use type, and was calculated using the equation:

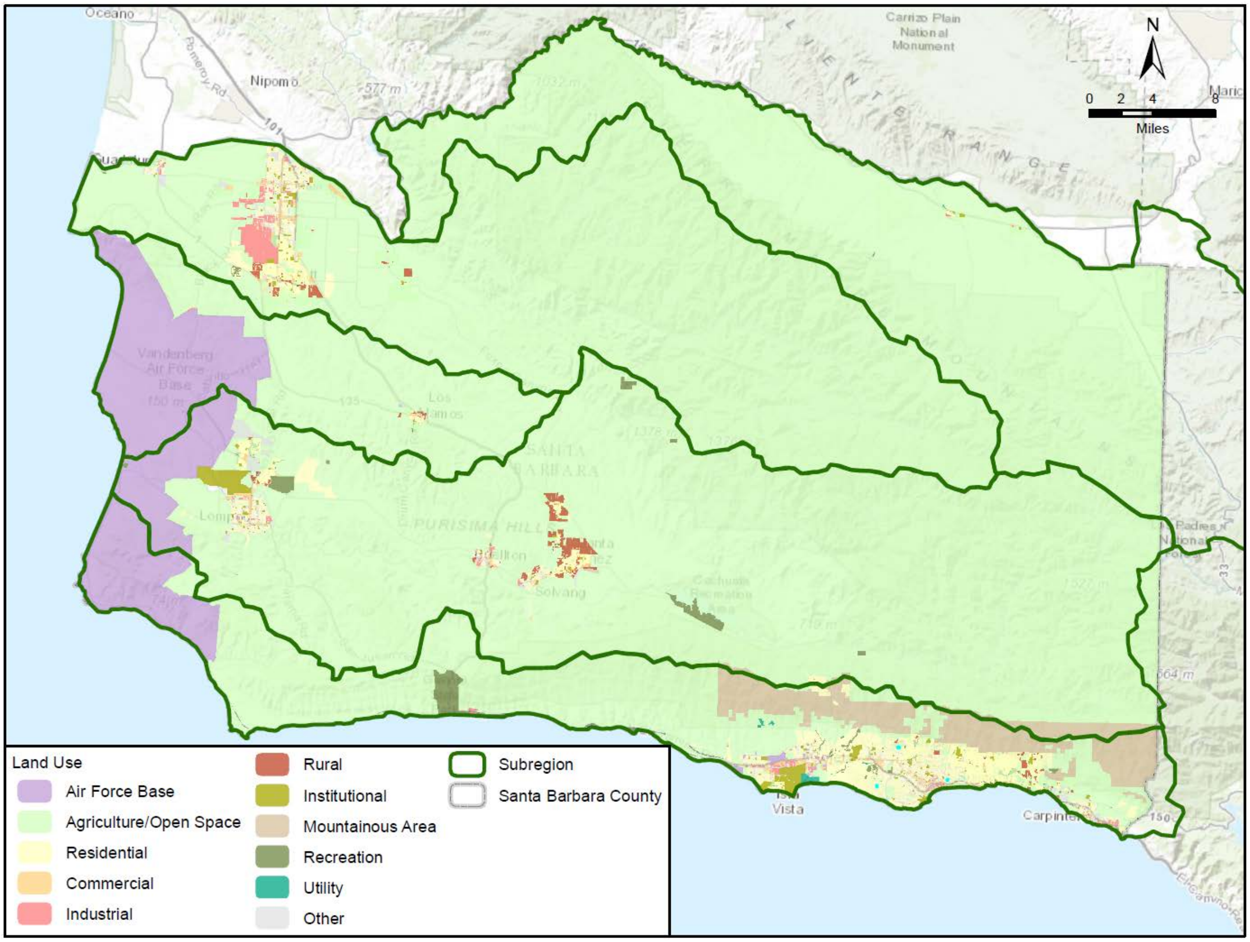
Runoff Coefficient = 0.009 x Imperviousness (%) + 0.05

The volume of urban runoff available for direct use or recharge in each of the subregions is shown in Table 2-3.

Table 2-3: Urban Runoff Available for Direct Use and Recharge

Subregion	Runoff by Land Use (AFY)			
	Residential	Commercial	Institutional	Total
Cuyama Valley	7	2	5	14
Santa Maria	2,541	756	353	3,650
San Antonio	30	7	4	41
Santa Ynez	1,841	510	478	2,829
South Coast	4,415	1,413	1,238	7,066
Santa Barbara County Total	8,834	2,688	2,078	13,600

Figure 2-3: Land Uses within Santa Barbara County and Urban Areas Used in Urban Runoff Calculation



Surface Water System Losses

Surface water system losses, defined as losses of water from surface water bodies through evaporation from reservoirs and phreatophyte evapotranspiration along rivers, may be reduced through the use of reservoir covers, removal of vegetation along rivers and creeks or application of coatings that prevent evapotranspiration from plants or evaporation from reservoirs. Supply available through reduction in surface water system losses was calculated for both reservoir evaporation reduction and evapotranspiration reduction. Reservoir evaporation reduction supply was estimated using a standard evaporation rate of 3.6 feet (ft) per year, which is based on the historical evaporation at Lake Cachuma, and applied to the surface area of each of the four reservoirs within the Region when filled to capacity. The maximum supply loss for each reservoir is shown in Table 2-4, and are calculated based on the water surface area at reservoir capacity.

Table 2-4: Estimated Evaporation Loss by Reservoir

Reservoir	Surface Area (acres)	Supply Loss (AFY)[1]
Twitchell Reservoir	3,700	13,248
Lake Cachuma	3,100	11,100
Gibralter Reservoir	335	1,200
Jameson Lake	138	494

1. Supply loss represents losses when reservoirs are at capacity.

Evapotranspiration loss from phreatophytes was estimated based on a streamlined method that used a standard evapotranspiration rate of three feet per year for phreatophytes and the estimated area of phreatophytes along the Santa Maria River, San Antonio Creek and Santa Ynez River. The estimated area of phreatophytes was calculated using aerial photos that show vegetation along these rivers. Given that these aerial photos were not of high enough quality to determine the type of plant seen, all vegetation viewed as being adjacent to each river or creek was used in the area calculation to provide an upper end of the potential range of potential losses. Table 2-5 shows the calculated supply losses from phreatophytes.

Table 2-5: Evapotranspiration Loss Unused Supply

River	Phreatophyte Area (acres)	Unused Supply (AFY)
Santa Maria River	20	60
San Antonio Creek	130	400
Santa Ynez River	800	2,400

Watershed Runoff

Some recent studies have sought to show that forest thinning to reduce vegetation reduces evapotranspiration and increases the percentage of precipitation that reaches rivers and streams, thereby increasing flows and potential water supplies (Bales et. al., 2011).

The United States Forest Service (USFS) has historically implemented vegetation management programs in the Lake Cachuma watershed as a means of forest fire prevention which provides the added benefit of reduced sedimentation in reservoirs and streams. Increasing such practices in watersheds that are upstream of reservoirs may provide additional surface water supply through increased runoff.

To try and estimate a potential unused supply for this Project, it was assumed that average reservoir inflows may be increased by a conservative 2% (Bales et. al., 2011). Reservoir inflows were estimated for wet, normal, and dry years to establish a range of supply accounting for annual variability. Average estimated inflows for Lake Cachuma were available, but Twitchell Reservoir inflows needed to be calculated using the following equation:

Reservoir Inflow = Change in Storage + Releases – Evaporation – Precipitation

Table 2-6 presents each reservoir's potential supply from implementation of a strategic watershed management program. Note that additional volume in the reservoirs may be necessary in order to capture this unused supply.

Table 2-6: Estimated Unused Supply from Upper Watershed Evapotranspiration

Reservoir	Average Unused Supply (AFY)
Twitchell Reservoir	530
Lake Cachuma	1,810

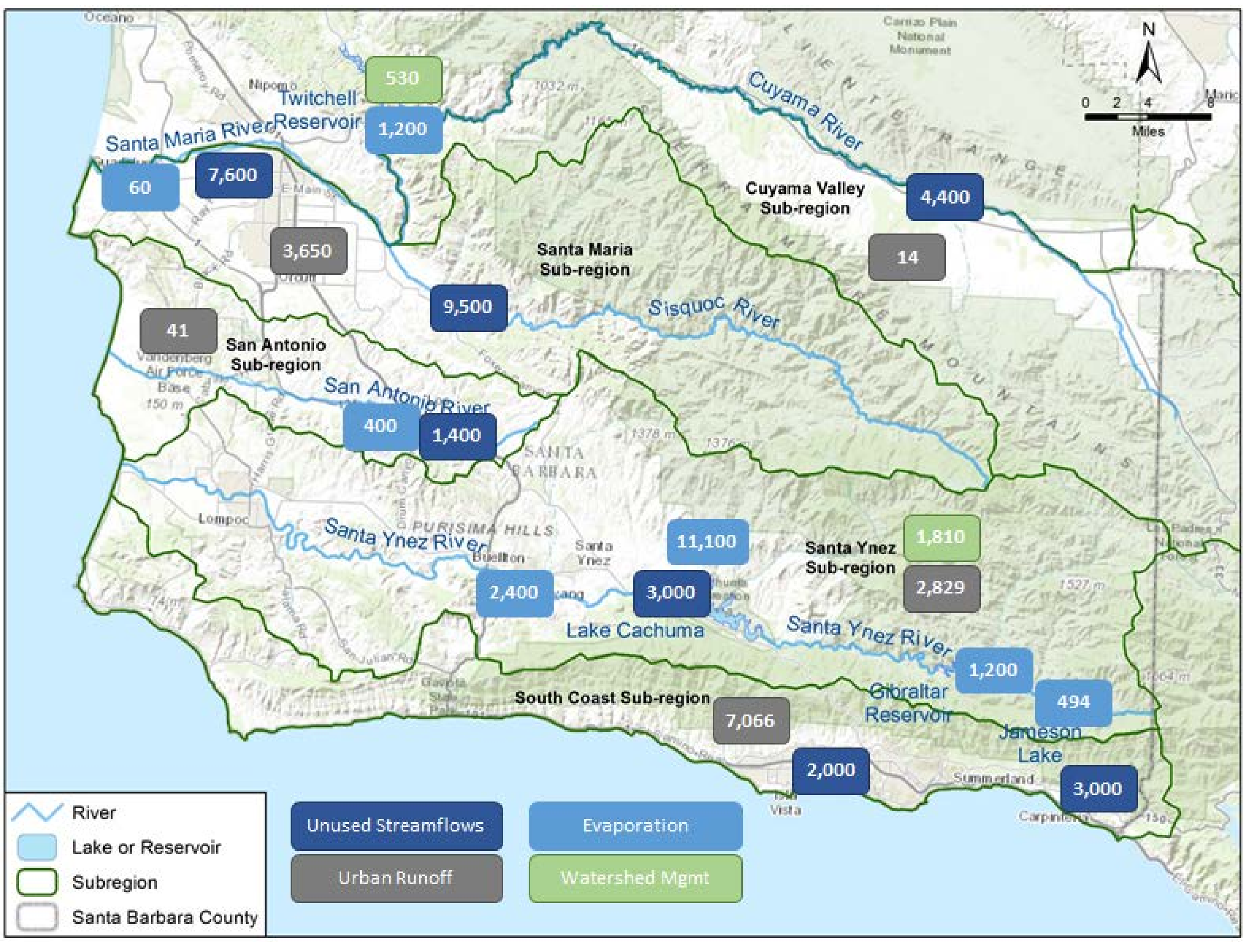
Summary Surface/Stormwater Supply

Table 2-7 and Figure 2-4 summarize the unused local surface water and stormwater supplies estimated for the Region.

Table 2-7: Local Surface Water / Stormwater Unused Supplies

Source	Unused Supply (AFY)
Unused Stream Flows	96,200
Urban Runoff	13,600
Surface Water System Losses	28,900
Watershed Management	2,300

Figure 2-4: Surface/Stormwater Supplies Available (AFY)



2.2 Imported Water

Imported water is water supply that is delivered from outside the Region. Currently, the only imported water used in the Region is delivered through the SWP's Coastal Branch which enters the County in the north near the City of Santa Maria, and ends at Lake Cachuma, as shown in Figure 2-5.

Figure 2-5: Imported Water Facilities

Santa Barbara County serves as the contractor of ultimate financial responsibility as the primary SWP contractor, with the Central Coast Water Authority (CCWA) serving as the administrator. The County receives an annual allocation of SWP water based on its Table A amount. Table A water is the contracted portion of SWP supply allocated to each SWP contractor. Like Santa Barbara, neighboring San Luis Obispo County contractors also receive SWP supply through the SWP Coastal Branch. In some previous years, Santa Barbara and San Luis Obispo County contractors have not used their fully available Table A allocations, indicating that there is potential for unused Table A water that may be available.

In addition to unused Table A water allocation, SWP contractors may receive Article 21 water, which is a provision in the SWP contract for delivering water that is available in addition to Table A amounts, but is not considered Table A water. Additional SWP supplies are also accounted for as Turnback Pool water, which is excess Table A water offered by SWP contractors directly to other contractors. Finally, Suspended Table A water may also be available as a form of unused supply. Suspended Table A water was water contracted to the Santa Barbara County Flood Control District, but suspended payment for in the 1980's. The CCWA is currently investigating reacquisition of these supplies.

In addition to SWP water, it could be possible for the Region to obtain non-SWP imported water from other water rights holders within California or to import water from outside California. The potential water supply volumes from undelivered SWP supply, Suspended Table A SWP supply, non-SWP supplies and out-of-state imported supplies are discussed below.

Undelivered State Water Project Supply

SWP Table A available supplies have been greatly reduced during recent drought years and so both San Luis Obispo County and Santa Barbara County have been using all of their available allocations. There is, however, historical record that shows not all of the allocations were fully utilized in previous years – resulting in undelivered and, therefore, potential for future unused Table A supplies. Estimates of potential undelivered Table A supplies were calculated for the San Luis Obispo County and Santa Barbara County subcontractors by comparing historic Table A allocations (defined by DWR as a percentage of each subcontractors' Table A amount) for the Santa Barbara County/CCWA and the San Luis Obispo County Subcontractors against historic deliveries.

Each year's Table A annual allocation percentage was multiplied by each subcontractor's total Table A amount to obtain the Table A allocation volume. The actual deliveries for that year were then subtracted to develop the estimate of undelivered Table A supply. The total (2004-2013) and average 10-year (2004-2013), 5-year (2009-2013), wet year (years when allocation is greater than 60%) and dry year (years when allocation is less than 60%) for both Santa Barbara and San Luis Obispo subcontractors are shown in Table 2-8. Based on this wet year classification and approximately 20 years of historical SWP allocation data, 7 out of 10 years are classified as "wet years". These values represent the amount of potential unused supply within existing Table A allocations of SWP that could be used by the Region. It should be noted that although the City of Santa Maria appears to have had unused water over the last five years, it has carried over or banked excess imported water.

It should also be noted that some portion of the undelivered supplies summarized in Table 2-8 may be stored in the San Luis Reservoir and used as Carry-Over Water for following years. However, there is not a 1:1 conversion from undelivered supplies to Carry-Over Water and water is lost in the conversion. Additionally, Carry-Over water is subject to loss when San Luis Reservoir spills, in which case these supplies become part the Article 21 program and must be re-purchased. Analysis of SWP deliveries and San Luis Reservoir spills for the Santa Barbara County Subcontractors from 2003-2012 (DWR, 2014) determined that approximately 60% of the undelivered water was lost in the conversion to Carry-Over Water and of that Carry-Over water, 74% was lost to spills. This analysis highlights the potential opportunity to develop additional storage (e.g. groundwater banks, surface storage, etc.) to provide a higher level of reliability than storage only at San Luis Reservoir.

Based on the data presented in Table 2-8, approximately 10,600 AFY of SWP supplies allocated to Santa Barbara County goes unused in the average wet year. This wet year supply is translated into an annual unused supply of 7,400 AF based on the following formula:

$$\text{Annual SWP Unused Supply} = \text{Average Wet Year Unused Supply} \times \frac{\text{Avg. Number of Wet Years}}{\text{10 years}}$$

Table 2-8: Santa Barbara and San Luis Obispo Counties' SWP Table A Unused Supply (AFY)

Subcontractor	Allocation (AFY)	Drought Buffer[1] (AFY)	Total Reserved (AFY)	Total Supply (AFY)	10-YR Avg (AFY)	5-YR Avg (AFY)	Wet Year Avg (AFY)	Dry Year Avg (AFY)
Santa Barbara County Subcontractors								
City of Guadalupe	550	55	605	884	88	141	81	79
City of Santa Maria	16,200	1,620	17,820	7,564	756	555	1,261	-
GSWC	500	50	550	901	90	10	150	-
Vandenberg AFB	5,500	550	6,050	10,642	1,064	1,316	1,384	468
City of Buellton	578	58	636	114	11	23	8	13
Santa Ynez ID No.1	2,000	200	2,200	-	-	-	-	-
Carpinteria CWD	2,000	200	2,200	6,947	695	609	990	276
Goleta Valley WD	4,500	2,950	7,450	26,383	2,638	2,514	3,605	1,043
La Cumbre MWC	1,000	100	1,100	1,691	169	155	282	-
City of Santa Barbara	3,000	300	3,300	12,059	1,206	1,147	1,534	790
Montecito WD	3,000	300	3,300	7,319	732	586	1,212	156
Morehart Land Co.	200	20	220	1,056	106	111	124	73
SB TOTALS	39,028	6,403	45,431	75,560	7,555	7,167	10,631	2,898
San Luis Obispo County Subcontractors								
Morro Bay	1,313	2,290	3,603	12,025	1,202	806	1,527	716
CA Men's Colony	400	400	800	1,439	144	91	197	65
County Ops Center	425	425	850	1,522	152	97	209	67
Cuesta College	200	200	400	716	72	46	98	32
Pismo Beach	1,240	1,240	2,480	8,395	840	547	1,026	559
Oceano CSD	750	-	750	394	39	-	35	46
San Miguelito MWC	275	275	550	1,919	192	152	236	126
Avila Beach CSD	100	-	100	551	55	36	69	35
Avila Valley MWC	20	60	80	294	29	23	35	22
San Luis Coastal USD	7	7	14	31	3	3	4	2
SLO TOTALS	4,730	4,897	9,627	27,286	2,728	1,801	3,436	1,670

Notes:

1. Represents the 3,908 AFY county-wide drought buffer apportioned to each contractor plus an additional 2,500 AFY entitlement acquired by Goleta Water District.

CSD = Community Services District
CWD = County Water District
MWC = Mutual Water Company
SLO = San Luis Obispo County
GSWC = Golden State Water Company
USD = Unified School District
WD = Water District

Additional unused supplies in the SWP system outside of the County can be accounted for through the Article 21 and Turnback Pool programs. For the purpose of this analysis it is assumed that these volumes may be obtained by the County through transfers and exchanges. Table 2-9 provides a summary of possible supply volumes from Article 21 and Turnback Pool water based on an average of available supplies through these programs from 2002-2012.

Table 2-9: Unused SWP Supplies through Article 21 and Turnback Pool

SWP Program	10 Year Average Unused Supply (AFY)
Article 21 Water	5,000
Turnback Pool Water	600

Suspended Table A State Water Project Supply

Of Santa Barbara County's original 57,700 AFY SWP Table A allocation, 12,214 AF was suspended by the Department of Water Resources (DWR) after the Santa Barbara County Flood Control District stopped making payments to fund the full project. The suspended 12,214 AFY has not been allocated elsewhere and Santa Barbara County Flood Control District has the right to reacquire the suspended water through payment of suspended costs plus interest for any portion of reacquired allocation. As with the existing SWP supplies, annual deliveries of the unused suspended Table A supply would be subject to availability. It should be noted that DWR has stated that the County no longer has exclusive rights to Suspended Table A SWP supply, and that Palmdale Water District has expressed an interest in the supply.

Non-State Water Project Supplies

Non-SWP supplies could potentially be obtained and wheeled through SWP facilities. Transfers are potentially available in annual, short-term, and long-term agreements. Transfers are possible with SWP contractors, federal/Central Valley Project contractors, and individual water rights holders. There are numerous examples of water transfers throughout the state, with both north of Delta and south of Delta water agencies. Given that opportunities for these types of supply transfers are dependent upon timing and negotiations with individual right holders as well as SWP capacity, it was not possible to determine a volume of unused supply that may be available through this imported water source.

Out-of-State Imported Supplies

In order to be comprehensive, options that could tap into water supplies outside of California were also explored. Several of these supply sources were identified from public input and in previous studies including:

- Alaskan icebergs
- Alaskan rivers
- Columbia River
- Mississippi River
- Missouri River

The *Colorado River Basin Water Supply and Demand Study* (USBR, 2012) examined these supplies to determine the potential volume and cost of acquiring and conveying them to Southern California, of which the Region is only one part. Given the scale of the options discussed, the total volumes of unused supply were not necessarily quantified, with the supply potential correlated to conveyance infrastructure sizing. Supply from all sources listed above were not assumed to be limited in terms of availability, but rather limited by the ability to integrate the imported supply into the existing conveyance systems in Southern California. A minimum limit of 200,000 - 600,000 AFY was assumed based on rough estimates of integration capability for importing water from Alaskan icebergs, Alaskan Rivers, Columbia River, Mississippi River, and Missouri River. Because these supply sources are considerable in size, it is conceivable that an increased yield may be attained; however, this is subject to the ability to convey the supplies to the County. It is assumed that 1% of the minimum supply limit may be available to the County based on the projected population of the county relative to the entire Colorado Basin. Unused supply is summarized in Table 2-10 and calculated based on the following formula:

$$\textit{Unused Supply} = \textit{Colorado Basin Supply} \times \frac{\textit{2040 County Population}}{\textit{2040 Colorado Basin Population}}$$

Table 2-10: Supplies Imported from Out of State

Supply Source	County Unused Supply (AFY)
Alaskan Icebergs	2,000
Alaskan Rivers	6,000
Columbia River	6,000
Mississippi River	6,000
Missouri River	6,000

Summary Imported Water Supply

Table 2-11 summarizes the unused imported water supplies estimated for the Region.

Table 2-11: Imported Water Unused Supplies

Supply Source	Unused Supply (AFY)[3]
Undelivered State Water Project Supply – Santa Barbara County (10-year average)	7,500
Undelivered State Water Project Supply –San Luis Obispo County (wet year average)[2]	3,400
Suspended Table A State Water Project Supply	8,000
Non-State Water Project Supplies	Indeterminable
Out-of-State Imported Supplies	2,000 – 6,000[1]

1. Assumes only one out-of-state imported supply would be implemented.
2. Assumes undelivered SWP supply from San Luis Obispo County would only be obtained during wet years.
3. Unused Supply values have been rounded to the nearest 100 AFY

2.3 Recycled Water

Recycled water is wastewater that has been treated at a wastewater treatment plant (WWTP) to a point that it can be used as a form of water supply served to meet a demand. The Region currently uses recycled water in a number of locations for non-potable uses such as irrigation, industrial/commercial air conditioning and processes, flushing toilets and urinals, or dust control, among other uses. The locations of all existing WWTPs in the Region are shown in Figure 2-6 and highlights those WWTPs that currently provide recycled water for non-potable uses.

Though several of these WWTPs currently provide recycled water for non-potable use, a greater volume of recycled water supply is discharged as effluent to local creeks, rivers, and the ocean and therefore goes unused. Some WWTP effluent is also discharged on land, which contributes to the recharge of underlying groundwater basins. In order to estimate the volume of unused recycled water, data on projected effluent and current use was obtained. By subtracting current recycled water use from the projected effluent, the projected unused supply for each WWTP was calculated. For the purposes of this Report, only WWTPs with greater than 1 million gallons per day (MGD) of unused effluent were examined. Table 2-12 shows the combined projected effluent, current use and estimated unused recycled water supply from each WWTP operated by a single agency or serving an individual community.

Figure 2-6: Wastewater Treatment Plants within Santa Barbara County

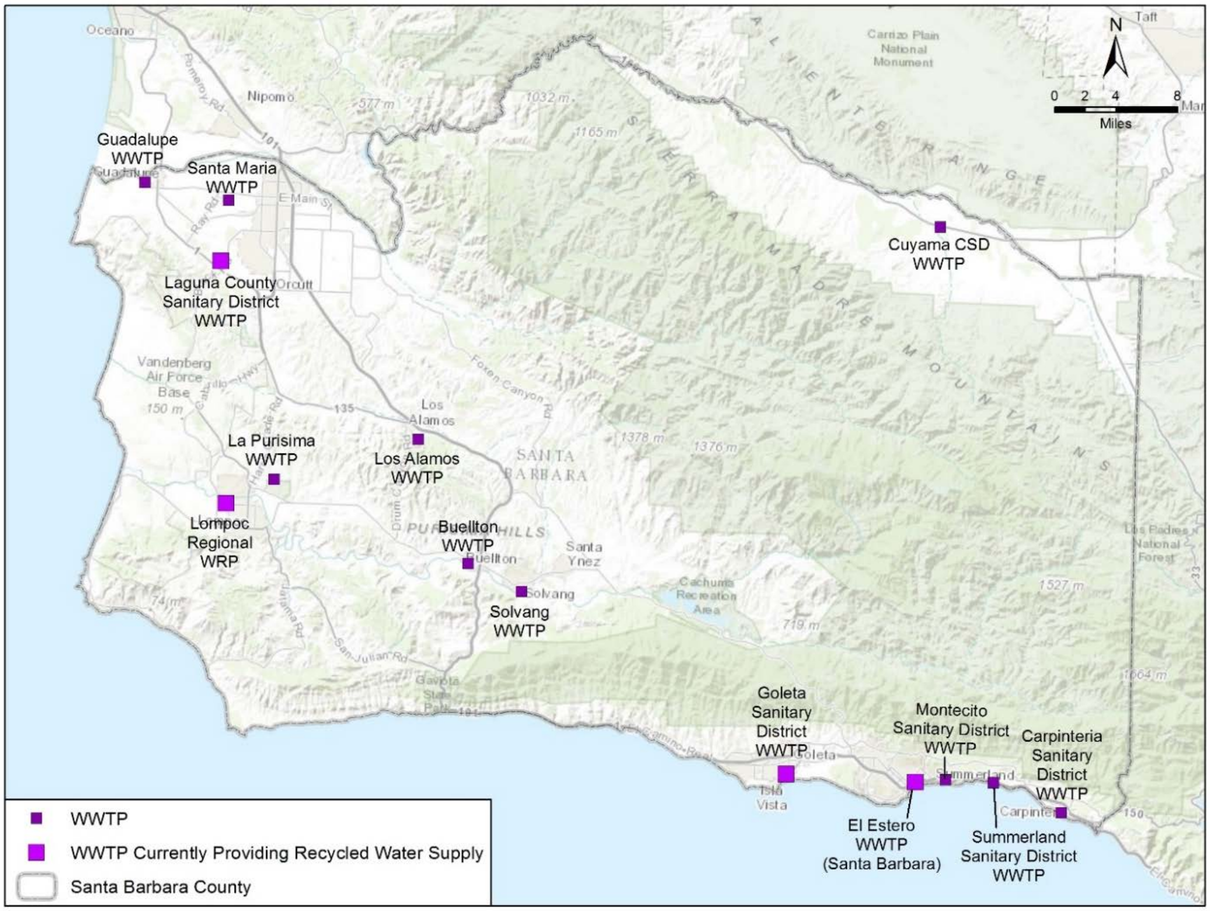


Table 2-12: Unused Recycled Water Supply

Community	Projected Effluent (AFY)	Projected Year	Current Use (AFY)	Unused Supply (AFY)
Laguna County SD	5,600	2030	60[1]	5,540
Guadalupe	1,100	2040	0	1,100
Lompoc	4,400	2030	6	4,400
Goleta	8,400	2035	790	7,600
Santa Barbara	8,600	2030	1,100	7,500
Summerland	160	Long Term[2]	0	160
Montecito	1,000	Long Term[2]	0	1,000
Carpinteria	1,800	Long Term[2]	0	1,800
Cuyama Community SD	60	Not available	0	60
Totals	**31,120**		**1,956**	**29,160**

1. LCSD currently uses 2,300 AFY of effluent at a spray field as discharge, but as this is not considered an existing or future potable demand, it is technically still available as an unused supply.
2. "Long Term" is defined as ultimate build-out based on general plans.

Wastewater may also be used for non-potable uses prior to leaving a property, and is referred to as graywater use. Graywater is wastewater generated on-site from a washing machine, shower or bathroom sink that can be subsequently also used on-site without further treatment to meet non-potable demands. It should be noted that increasing localized graywater use will decrease available supply for centralized recycled water production. Potential graywater supplies were estimated using the population of each city and community in the County, the estimated 2040 water usage (in gpcd), an assumed water savings of 28% total to represent the percentage of graywater generated by a site, and an assumed participation rate of 25% of the population.

Table 2-13: Graywater Supply Calculation Inputs and Supply

City of Community	2040 Population	2040 GPCD	Unused Graywater (AFY)
Santa Maria Subregion			**Total: 1,928**
City of Santa Maria	122,154	119	1,141
Golden State Water Co.	34,830	221	604
City of Guadalupe	12,000	111	105
Private SMV, M&I and Ag	7,670	128	77
Casmalia CSD	140	60	0.7
San Antonio Subregion			**Total: 39**
Los Alamos CSD	2,746	117	25
Private San Ant. M&I and Ag	1,577	117	14
Santa Ynez Subregion			**Total: 1,151**
City of Lompoc	50,710	117	466
Vandenberg Village CSD	7,181	149	84
Mission Hills CSD	5,376	135	57
Vandenberg AFB	6,800	180	96
City of Buellton	7,200	197	111
City of Solvang	6,600	200	104
Santa Ynez RWCD ID #1	8,939	226	159
Private Santa Ynez-Lompoc M&I, Ag	5,467	172	74
South Coast Subregion			**Total: 2,700**
Carpinteria VWD	17,537	117	161
Montecito WD	13,658	422	452
City of Santa Barbara	101,466	117	932
La Cumbra MWC	4,353	320	109
Goleta WD	109,861	111	957
Private South Coast M&I, Ag	5,231	217	89
Cuyama Valley Subregion			**Total: 25**
Cuyama CSD	779	175	11
Private Cuyama Valley M&I, Ag	1,021	175	14

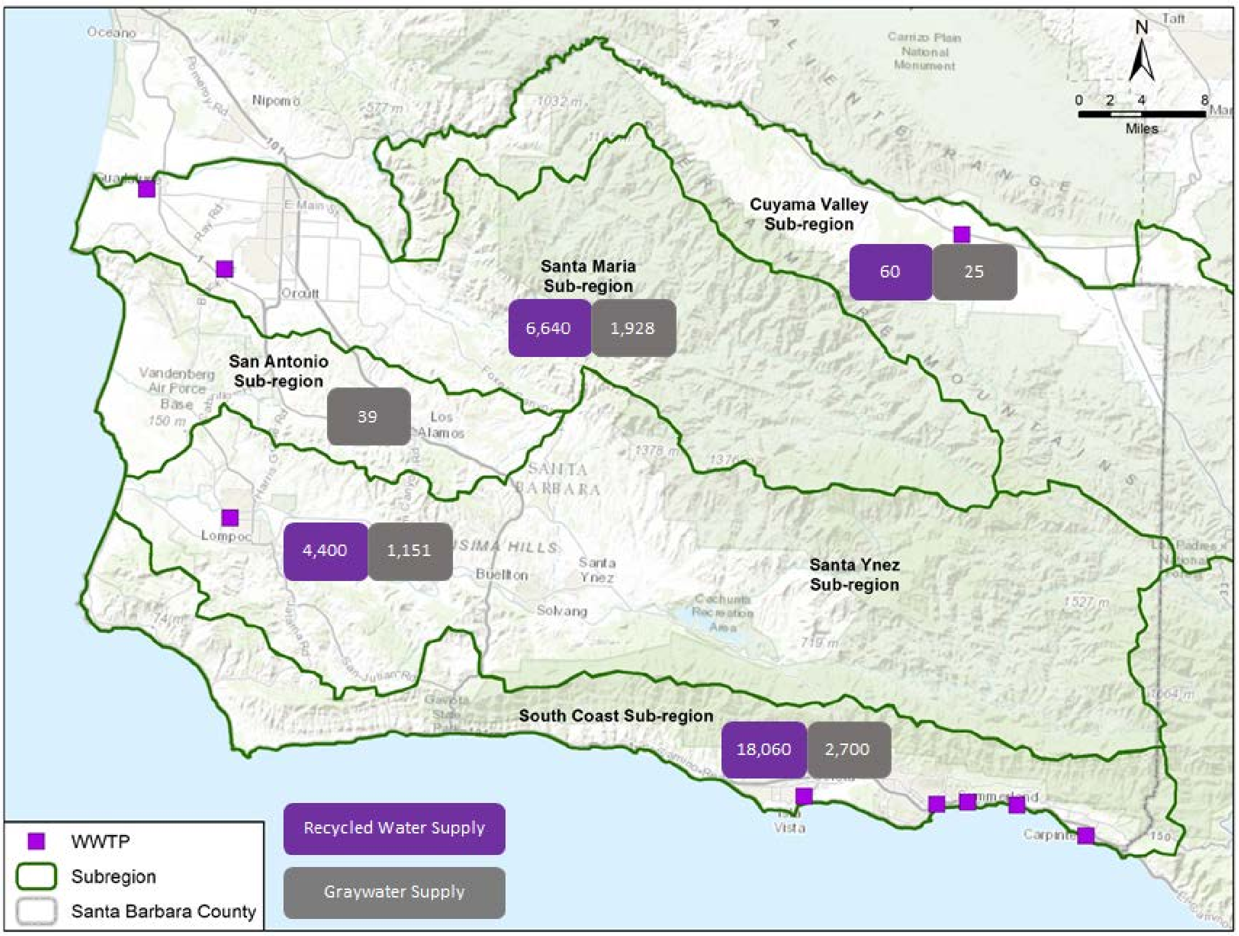
Summary Recycled Water Supply

Table 2-14 summarizes the unused recycled water supplies estimated for the Region and Figure 2-7 shows those estimates by subregion.

Table 2-14: Recycled Water Unused Supplies

Source	Unused Supply (AFY)
Recycled Water	29,200
Graywater	4,700

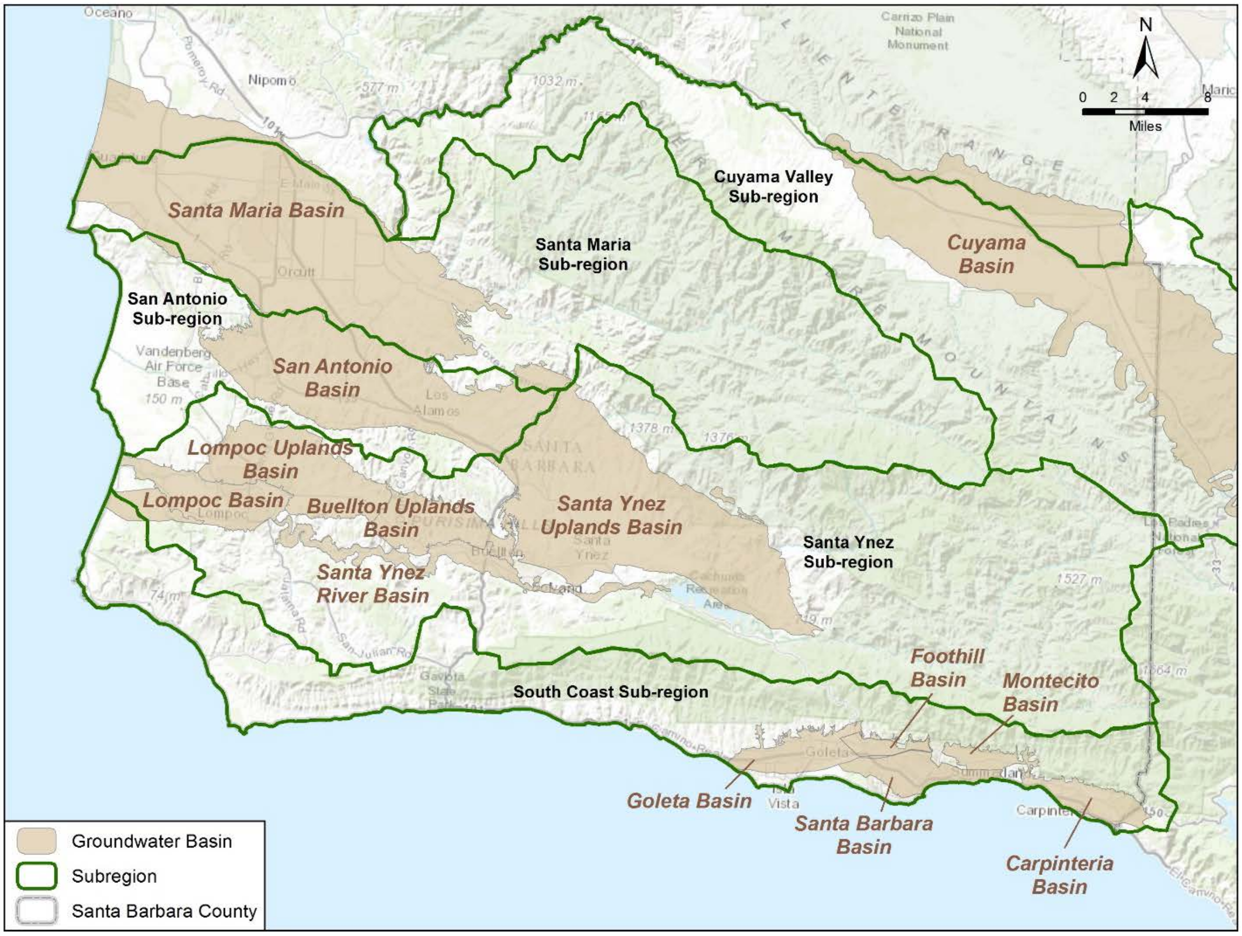
Figure 2-7: Recycled Water Unused Supplies (AFY)



2.4 Groundwater

Groundwater is water that is held underground in pores in the gravel/sand or crevices in rock. Cities and water agencies throughout the Region actively help to meet demand for water supply by pumping the water out of several groundwater basins. As shown in Figure 2-1, groundwater basins are filled or "recharged" when surface water filters through the soil down to an aquifer, where it is stored. Groundwater recharge can take place both naturally when surface water enters the ground through soil infiltration, under river/creek beds, or is facilitated using engineered spreading basins and injection wells. Figure 2-8 shows the location of the groundwater basins within Santa Barbara County.

Figure 2-8: Groundwater Basins in Santa Barbara County



Available groundwater supply was estimated by reviewing reports from previous studies and communicating with Planning Partners. It was found that several sources of unused supply may exist as a result of compromised groundwater quality. There is some belief that sources of unused supplies may also exist within untapped aquifers and entrained in bedrock fractures. For the purposes of this Report, the potential for additional groundwater pumping as a result of increased recharge of surface supplies is not considered an unused groundwater supply since it relies upon the source of the surface supply that would be recharged and is therefore assessed in other sections.

Compromised Groundwater Quality

Compromised groundwater quality is an issue faced in several groundwater basins in the County, including the Santa Ynez Uplands, Santa Barbara Storage Unit No. 3, and Santa Maria Basins. As a result of poor water quality, these sources (some of which were used previously) aren't currently being used as a supply and are called "underused supplies" for the purposes of this Project. Underused supply in these areas was estimated through review of previous studies, groundwater reports and communications with groundwater pumpers. It should be noted that in order to use these supplies, it will be necessary to implement treatment or other strategies. Table 2-15 shows the groundwater basins, quality issues and estimated underused supply.

Table 2-15: Compromised Groundwater Quality Supplies

Groundwater Basin Area	Groundwater Quality Issue	Unused Supply (AFY)
Santa Ynez Uplands	Hexavalent Chromium (Chrom-6)	9,800
Santa Barbara (Storage Unit No. 3)	Total Dissolved Solids (TDS)	100
Santa Maria and Guadalupe	TDS	12,000

Untapped Aquifers

The Chalice Basin, located north-east of the Goleta Basin beneath Slippery Rock Ranch, is thought (by some Planning Partners) to contain large volumes of underutilized groundwater. Slippery Rock Ranch estimates that there is 500-1,000 AFY (Goleta Water District, 2014) of potential groundwater supply in the basin that is, for the most part, unused beyond meeting the demands of Slippery Rock Ranch. Based on previous studies, Goleta Water District believes that some connectivity between the adjudicated Goleta Basin and Chalice Basin exists and that the Chalice Basin provides natural underflow to Goleta Basin and is therefore part of the already adjudicated Goleta Basin system and can't be considered "unused." Goleta Water District has requested that Slippery Rock Ranch conduct an environmental analysis under California Environmental Quality Analysis (CEQA) to determine potential impacts from pumping and sale of water from the property. For this reason it can't be confirmed that there is in fact unused supply in Chalice Basin at this time. Some Planning Partners also stated that there may be untapped groundwater in the Carpinteria Basin. However, based on reports, production wells reach all identified aquifers within the Carpinteria Basin, and therefore it cannot be confirmed that an untapped aquifer exists without further technical analysis.

Bedrock Entrained Groundwater

Specific drilling methods may be utilized to access water entrained within bedrock fractures; however, due to insufficient data, the quantity of potential unused supplies cannot be estimated.

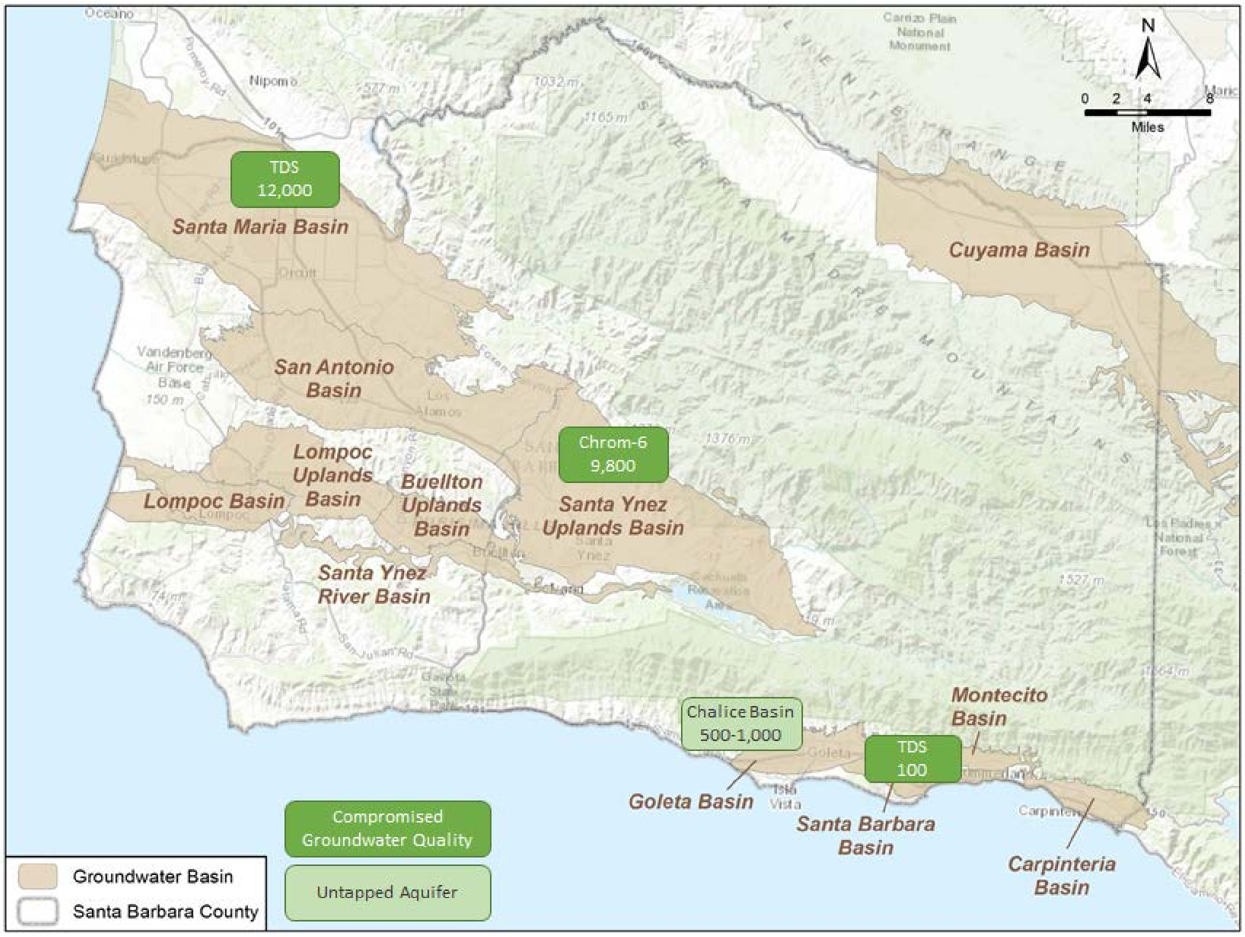
Summary Groundwater Supply

Table 2-16 and Figure 2-9 summarize the unused groundwater supplies estimated for the Region. It should be noted that as an additional supply, groundwater is subject to state law, local management agreements and other considerations such as out of basin uses.

Table 2-16: Groundwater Unused Supplies

Source	Unused Supply (AFY)
Compromised Groundwater Quality	21,900
Untapped Aquifers	500-1,000
Bedrock Entrained Groundwater	Indeterminable

Figure 2-9: Groundwater Unused Supplies (AFY)



2.5 Ocean Desalination

Ocean desalination is the treatment of ocean water for use as a potable water supply. Ocean water is conceivably an unlimited source of water and, therefore, supply is only limited by a project's infrastructure capacity, which is reflective of permitting allowances. Currently, the only ocean desalination plant in the Region belongs to the City of Santa Barbara. This plant is not in use, but the City of Santa Barbara is currently working to bring the plant back online. Potential siting for additional ocean desalination plants are discussed further in Chapter 3.

2.6 Supply Reliability and Climate Change

Reliability of the supply sources described in this Chapter are characterized by their susceptibility to annual and seasonal variations in precipitation and natural storage. This is not to be confused with system or operational reliability, which is characterized by the likelihood that a conveyance, storage, or treatment component constraint or failure would result in a temporary loss of the supply. The system reliability would need to be considered when looking at the full scale project infrastructure and operations required to deliver a supply from its source to its end user and is, therefore, assessed on a case by case basis.

It is also important to note the difference between sustainability versus reliability. In this Report, reliability is based on anticipated frequency that a volume of supply may be available according to historical record (10-20 years) and does not necessarily address long-term sustainability, which may be impacted by additional factors such as changes in climate, policy, or regulations. For this Project, reliability for each supply source is characterized as low, moderate, or high relative to the other supply sources identified. Table 2-17 provides a summary of reliability by source of supply, and is further discussed below.

Table 2-17: Supply Reliability

Supply Source	Reliability
Stormwater/Surface Water Capture	Low
Stormwater/Surface Water Loss Reduction	Low
Imported Water	Moderate
Recycled Water	High
Groundwater	Moderate
Ocean Desalination	High

Stormwater/Surface Water

Local stormwater unused supplies identified for direct capture in the Region have the lowest level of supply reliability due their high level of daily, seasonal and annual variability. The annual average unused supplies estimated in this Report are based on a 10-year rolling average using historical precipitation and flow data and therefore do not reflect the variable nature of when these supplies actually occur and the volumes that occur when they do. Since the frequency and intensity of storms cannot be accurately predicted, reliability may be best characterized by event probability in historical data. This assumes that hydrologic history repeats, which may not be the case when considering the long-term effects of climate change.

The reliability of measures that may be taken to increase overall regular flows in the County's river systems are also characterized as having a low reliability. Evaporation and evapotranspiration reduction measures may increase water supply every year but the total amount is variable. The supply generated from evaporation reduction may vary based on the reservoir storage within a given year and it is anticipated that supply generated through evapotranspiration reduction will not vary significantly year to year. It should be noted, however, that there is little evidence that evapotranspiration reduction measures provide a significant lasting effect on surface water system base flows.

Watershed management practices to thin forested vegetation growth and thereby increase runoff reaching lakes and rivers may result in additional supply within any given year; however, the supply generated is expected to increase significantly only in wet years and may increase further as a result of consecutive wet years. In addition, the availability of storage in reservoirs to capture supply from watershed management must be considered, especially during wet years.

Imported Water

Imported water is characterized as having a moderate level of reliability given that its susceptibility to precipitation variability that is somewhat moderated by large-scale supply storage and the ability for transfers and exchanges within the conveyance system.

The SWP is currently the County's sole source of imported water; however, other potential imported supplies identified in this Report may be considered more reliable. Unused SWP supplies identified in this Report are based on a 10-year average of undelivered allocations. Annual allocations are determined and reported by DWR based on the key factors described in the SWP Reliability Report, which is intended to assist contractors in water supply planning. SWP allocations are largely based on annual precipitation and reductions resulting from the numerous challenges affecting long-term sustainability of the Bay Delta as a source of supply. Factors affecting Delta extractions include climate change, land subsidence, potential levee failures, protection of endangered and threatened fish species, and potential modification of the system due to the twin-tunnels project.

Other sources of imported water identified in this Report are also subject to annual variability. It could be assumed that out of state resources acquired from systems in generally wetter climates may be considered more reliable than California's imported water programs; however, given that these systems have never before been implemented, it is unclear as to how reliable those sources would truly be.

Recycled Water

Recycled water is widely considered to be a highly reliable source of supply. Supply variability is predominately driven by daily indoor water usage patterns that affect wastewater production. Seasonal variability may occur as a result of usage patterns as well as sewer system infiltration by stormwater that can occur due to cracks in wastewater pipes. There is very little annual variability of recycled water supply as it is generally a function of indoor water usage within a service area and not as sensitive to the predominately outdoor water use reductions seen in drought years. Increases in water usage are generally found in service areas with potential for population and/or industrial growth. Declining recycled water supply may result from increased indoor water use efficiency or a declining population or economy.

Groundwater

Groundwater is characterized as having a moderate level of reliability due to the groundwater basins' abilities to store large volumes of water, but if supplies are subject to recharge by local surface water/stormwater, as discussed above, it can also be variable. In addition, some areas within groundwater basins may be impacted by groundwater quality which will limit pumping. If insufficient surface water recharge occurs, continual pumping could lead to overdrafting of groundwater basins. Recharge of these basins with recycled, imported or local surface water/stormwater can help to improve reliability of these basins, however the reliability of these recharge scenarios is assigned to the source of that recharge supply. The Region will have the opportunity to further evaluate groundwater reliability with the enactment of the Sustainable Groundwater Management Act (SGMA) of 2014, which provides a framework for sustainable management of groundwater supplies by local authorities. SGMA will require the formation of groundwater sustainability agencies (GSAs) that must assess conditions in their local water basins and adopt groundwater sustainability plans (GSPs). DWR will require that GSPs for groundwater basins in critical overdraft by 2020 and for medium and high priority basins by 2022.

Ocean Desalination

Once operational, desalinated ocean water is considered to have the highest level of supply reliability as there is no variability in availability. Although various implementation considerations may limit the potential supply generated, the source of supply is generally limited only by the seawater intake facility.

Climate Change

Climate change, and its impacts on water resources, has become of greater concern given the occurrence of two state-wide droughts with in the last eight years. Water resources planners are working to predict and address potential impacts of climate change on water supplies to ensure long-term sustainability. In 2013, the IRWMP conducted an analysis of climate change impacts on water resources in the Region based on existing literature and studies. The primary impacts of climate change on water resources are expected to stem from higher temperatures and changes in climate patterns that may lead to:

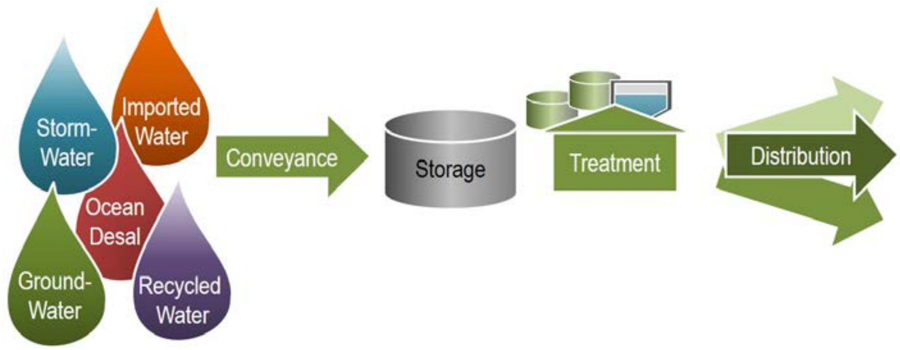
- Decreases in average precipitation while at the same time experiencing more intense storms, reducing local surface/stormwater availability for direct use and groundwater recharge
- Sea level rise that could lead to salt water intrusion of coastal groundwater basins and impacts to coastal water and wastewater infrastructure
- Increase in wildfire risk, which could threaten downstream water quality and lead to the loss of reservoir storage capacity due to sedimentation

SWP supplies may also be impacted by climate change due to reductions in statewide average precipitation, changes in precipitation timing and less precipitation falling as snow in the Sierra Mountains. The IRWMP indicated that DWR estimates the potential decrease in SWP deliveries that may be expected with climate change to be between 7% - 10% by 2050, and 21% - 25% by 2100.

Chapter 3 Supply Options

To meet the water resource needs and challenges of the Region, a list of potential system options was identified to connect unused water supply discussed in Chapter 2 to meet end user demands. The supply options identified for the Project are from previous and existing supply studies, input from Planning Partners and the public, and examples of programs and projects implemented in areas outside the Region. These supply options were developed and assigned an estimate of potential available supply based on the assumptions and calculations described throughout this Chapter.

Figure 3-1: Components of a Supply Option



A good deal of previous and parallel work has been and is being done within the Region to identify and assess the technical viability of many of the supply options identified for this Project. The information contained in these studies and plans was used to determine where any gaps in information existing about both current conditions and potential future supply options. Where data gaps were found, high level planning analyses were conducted or assumptions made based upon available information. Under some circumstances, previous work was based upon conditions and data that have since changed and so ways were explored to either update or replace necessary information.

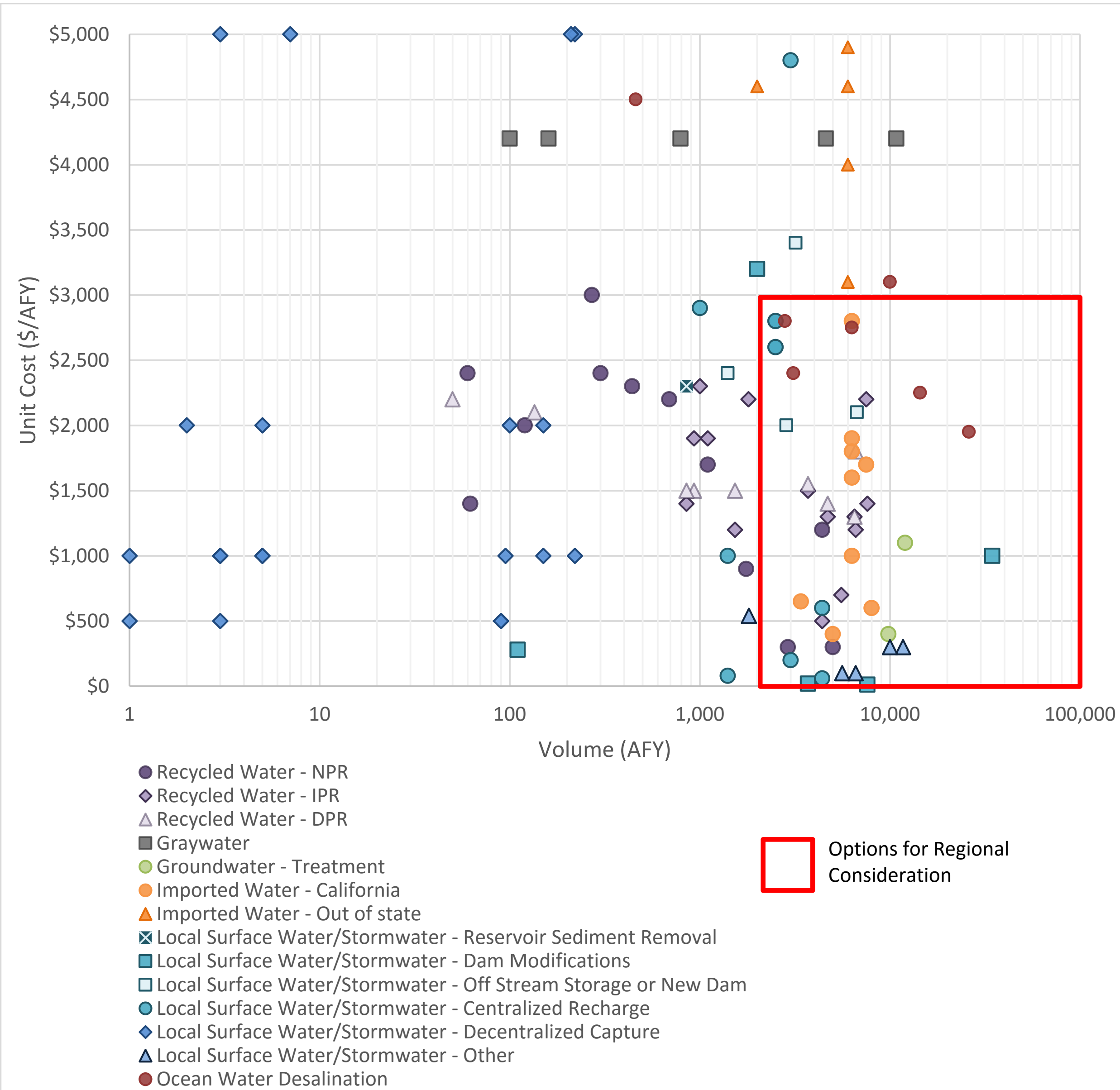
The supply option development process, represented in Figure 3-1, resulted in over 120 full and stand-alone supply options presented in this Chapter. Figure 3-2 provides a matrix of the options developed as part of this Report showing estimated volumes of water relative to the estimated unit costs. Appendix A contains the complete list of options; however, this Chapter focuses on those options that are larger in scale (could produce more than 2,000 AFY) and with higher levels of cost-effectiveness (would cost less than $3,000/AF). These featured options are within the red square outlined in Figure 3-2. More detailed charts are provided for each of the options, along with additional considerations for implementing the options and preliminary conclusions.

The calculated general unit costs for each option allow for an easier comparison of options that produce a wide range of yields. Where possible, costs from other studies were used or the Project Team calculated them by estimating planning level costs for each of the major components needed to implement the options, and then developing a compiled cost (costs that add up each of the major components needed to implement the supply option) tailored to each option based upon the highest supply volume that could be assumed to be produced. Planning level costs are considered to be general, high level costs that will require more detailed cost estimates be developed once detailed planning and engineering has been conducted. Unit costs include both capital costs and operations and maintenance costs. In order to include the maximum number of options at a comparable level of analysis, detailed project costs estimates for each supply option were not conducted. Once a specific project is identified, a detailed cost analysis should be completed before determining the cost-effectiveness of a project.

The ability to actually implement an option also must be considered when assessing supply feasibility. While these implementation considerations are not necessarily quantified or quantifiable, they are included as part of each of the supply option characterizations provided in this Chapter. However, a rough implementation timeframe classification within 5 years, within 5-10 years, and beyond 10 years was assumed for each option.

All of these implementation considerations were provided by the Project Team and Planning Partners as a result of reviewing previous work and discussions held during the project process. They are not intended to be exhaustive, but do provide the basis for further analysis for the conclusions drawn by this Report.

Figure 3-2: Supply Option Unit Costs versus Volume

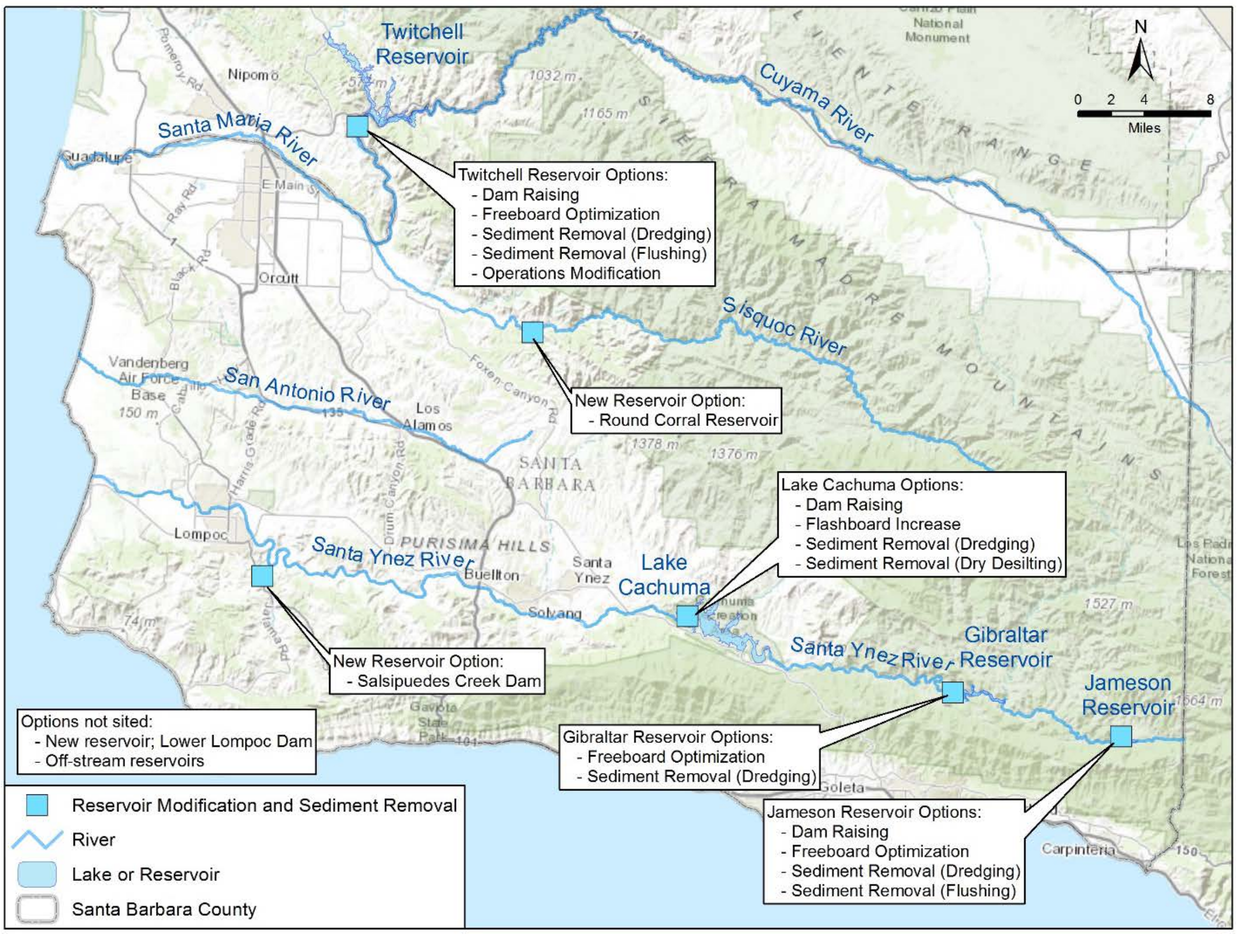


Note: Options costing greater than $5,000/AFY are not represented on this chart.

3.1 Increased Surface Storage Capacity

Increasing reservoir storage capacity in the Region is one way of taking advantage of unused supplies, specifically highly variable local surface/stormwater supplies. Supplies collected in reservoirs can later be treated and used directly or sent downstream to recharge groundwater basins. This section examines supply options that modify existing reservoirs as well as the construction of new in-stream reservoirs and off stream storage facilities. Figure 3-3 provides a map of the options considered that will increase surface storage capacity, and are further discussed below.

Figure 3-3: Increase Surface Storage Capacity Options Considered



Increased Storage Capacity in Existing Reservoirs

Increasing storage capacity of existing reservoirs is one way of capturing unused surface/stormwater supplies. The type of options that can be implemented depend on the design of the dam, the spillway, and the outlet works. On some dams, it may be possible to utilize "residual freeboard," which is the distance between the maximum allowable water storage elevation and the crest of the dam, by installing release gate flashboards or by retrofitting the existing spillway with a concrete or rubber dam structure. If residual freeboard is not available or desirable, it is also possible to physically raise the dam.

In addition to reservoir modifications that improve spill elevations, an increase in capacity of reservoirs can be achieved through sediment removal. Sediment removal options include dredging or flushing. Dredging involves picking up the accumulated sediment manually, either hydraulically with water to form a slurry or mechanically by physically digging the sediment up with an Excavator, and transporting it to another area. Flushing is the removal of sediment that uses increased water flows through low level dam outlets to scour sediment out of the reservoir and allowing it to be transported downstream using the surface water. For this Project, all feasible sediment removal options were assumed to be implemented to remove a portion of or nearly all sediment accumulation. It should be noted that due to the need to drain the reservoirs in order sufficiently flush sediments, flushing is not a feasible option for Lake Cachuma due to the configuration of the outlet works. In addition, the Region is heavily dependent on the reservoir for the supply storage and, therefore, cannot be reduced to such a low level as to allow for flushing to be successful. Therefore, sediment removal through flushing is not considered further for Lake Cachuma to expand its capacity.

Each of the feasible options for increasing existing reservoir storage capacities was applied to the appropriate reservoirs to determine the maximum increase in storage that could be achieved. In order to determine the average annual supply yield associated with reservoir spill elevation/dam modifications and sediment removal, the local surface/stormwater supply available for each river system contributing to the reservoir was assumed to be available as a supply. Note that the unused supply volumes of an average event year may be constrained by the volume attained through a particular reservoir improvement. Table 3-1 summarizes the increased storage capacity and resulting supply volumes from reservoir spill elevation/dam modifications. Potential additional supply is estimated as the average annual supply available (calculated using the period of record) over the number of wet years or spill events occurring during a 10 year period at Twitchell Reservoir, Jameson Reservoir and Gibraltar Reservoir. Estimates of potential additional Lake Cachuma supplies are based on actual spills from Lake Cachuma from 1952-2013. Increased supply based on firm yield, which is defined as the maximum quantity of water that can be guaranteed with some degree of confidence during a critical period, is assumed to be equal to a 1:10 ratio of increased supply to increased storage. Applying this calculation to Lake Cachuma, which has a current capacity of 190,000 AF, approximately 19,000 AFY of firm supply would be expected. Note that the supply volumes listed in the table do not take into account system-wide effects such as increases in upstream storage resulting in loss to downstream storage. The supply yields estimated for each of these projects could also vary based on how each reservoir is operated. For example, some wet years may provide large volumes of water supply in adjacent years; therefore, the supply in the reservoir must be used prior to the next wet season in order to capture the next year’s supply. The supply yields described here should be considered the upward-bound of what can be captured as a supply.

Lake Cachuma

Lake Cachuma, located on the Santa Ynez River, is used to store local surface and imported water to supply cities and communities both within the Santa Ynez River watershed through releases from the dam and to the South Coast area via the Tecolote Tunnel. Water supply from Lake Cachuma is used both directly and for downstream groundwater recharge. There are a number of options available for increasing storage in Lake Cachuma that are described below.

Table 3-1: Options for Increasing Reservoir Storage Capacities (average annual)

Options that Increase Storage Capacity in Existing Reservoirs	Increased Storage (AF)	Increased Supply, based on average available yield (AFY)	Increased Supply, based on firm yield[1] (AFY)
Lake Cachuma Dam Raising	197,000	34,500	19,700
Lake Cachuma Flashboard Increase	9,300	3,700	900
Lake Cachuma Lake Sediment Removal (dredging)	20,900	6,600	2,100
Lake Cachuma Lake Sediment Removal (dry desilting)	2,100	700	200
Twitchell Reservoir Dam Raising	385,000	5,800	Not applicable
Twitchell Reservoir Freeboard Optimization	245,000	5,800	Not applicable
Twitchell Reservoir Sediment Removal (dredging or flushing)	43,000	4,300	Not applicable
Twitchell Reservoir Operations Modification	n/a	7,600	Not applicable
Jameson Reservoir Dam Raising	5,000	2,000	Not applicable
Jameson Reservoir Freeboard Optimization	110	40	Not applicable
Jameson Reservoir Sediment Removal (dredging or flushing)	2,100	850	Not applicable
Gibraltar Reservoir Freeboard Optimization	280	110	Not applicable
Gibraltar Reservoir Sediment Removal (dredging)	9,200	3,700	Not applicable

1. Firm supply is assumed to be equal to one tenth of the reservoir capacity and is limited by the average available yield.

Lake Cachuma Dam Raising

Methods for increasing storage capacity through spill elevation modification in Lake Cachuma have been examined in the past in previous studies, including the 1987 study of Enlargement of Cachuma Reservoir by DWR that examined the potential for raising the dam by 20 ft and 50 ft. A 20 foot dam raise would increase the reservoir elevation to 770 ft, while a 50 ft dam raise would raise the reservoir elevation to 800 ft. The resulting total reservoir capacities and capacity expansion are listed in Table 3-2. It should be noted that a comprehensive inundation analysis has not yet been completed, and a detailed survey would be required to evaluate potential inundation impacts from these options to existing Cachuma Lake Recreation Area features. However, raising the dam would potentially impact the boat ramp (753 ft elevation), parking lot (755-800 ft elevation), water treatment plant (757 ft elevation), various access roads and paths, restaurant, and various trees. As shown in Table 3-2, Lake Cachuma could increase storage by up to 197,000 AF (over existing capacity) by increasing the reservoir to the maximum dam raise of 800 feet, which would be sufficient to capture all of the 34,500 AFY of average local surface/stormwater supply available from the Santa Ynez River or 19,700 AFY of firm yield – noting that this would require enough storage potential to capture peak wet weather events when they occur (which would be much larger than the average annual yield estimated).

Table 3-2: Lake Cachuma Current and Potential Expanded Capacities with Dam Raising

Reservoir Elevation (ft)	Total Reservoir Capacity (AF)	Potential Capacity Expansion (AF)	Notes
Current Capacities			
753	193,305		Existing Spillway w/Existing Flashboard
762	221,087	27,782	Max Potential Capacity without Dam Raise
Expanded Capacities			
770	252,121	68,000	Reservoir capacity based on capacity at elevation of 750 ft plus 68,000 additional AF for a 20 ft raise
800	381,121	197,000	Max Elevation of Spillway Raise. Reservoir capacity based on capacity at elevation of 750 ft plus 197,000 additional AF for a 50 ft raise

Lake Cachuma Flashboard Increase

An analysis of flashboard increase at the existing spillway was conducted. Lake Cachuma was previously raised in 2004 with the installation of 4 foot flashboards. Installation of flashboards at Lake Cachuma could provide an additional 3 ft in elevation of the maximum water surface, which could potentially provide an additional 9,300 AF of storage capacity based on surveys completed by the Wallace Group in 2014, and allow for capture of an additional 3,700 AFY of average water supply yield from the Santa Ynez River or 900 AFY of firm yield. It should be noted that a comprehensive inundation analysis has not yet been completed based on raising the reservoir elevation to 756 ft, and a detailed survey would be required to evaluate potential inundation impacts from these options to existing Cachuma Lake Recreation Area features. However, raising the dam would potentially impact the boat ramp (753 ft elevation), parking lot (755-800 ft elevation), water treatment plant (757 ft elevation), various access roads and paths, restaurant, and various trees. A USBR dam safety analysis would also be necessary to implement this option.

Lake Cachuma Lake Sediment Removal (Dredging)

Lake Cachuma, as with other reservoirs in the Region, has suffered from a reduced volume due to a buildup of sediment. The original capacity for Lake Cachuma was 214,200 AF (after having received a 3 ft increase in its spillway after it was originally constructed), and is estimated to have a current capacity of 193,300 AF, meaning there is 20,900 AF of accumulated sediment in the reservoir. Removing this sediment buildup would allow for up to an additional 20,900 AF of capacity to capture an estimated average yield of 6,600 AFY or an estimated firm yield of 2,100 AFY of unused supply from the Santa Ynez River (as well as additional imported water), based on additional capacity obtained and compared to historical Lake Cachuma spills.

Lake Cachuma Lake Sediment Removal (Dry Desilting)

Removal of sediment from Lake Cachuma could also take place through dry desilting, which is the removal of sediment from the area of reservoir exposed by the lower reservoir level during dry periods using excavation equipment. According to a 2014 Aerial Survey and Sedimentation Update for Lake Cachuma, it's likely that a majority of the sediment accumulation has occurred within the deeper portion of the reservoir below approximately 605 feet elevation. For the purposes of this Report and given that the current level of the reservoir is above this area of sediment accumulation, it's conservatively assumed that only 10% of sediment accumulation is currently exposed and could be removed through dry desilting. Based on historic water storage, there would be rare opportunities to access the other 90% of sediment. An additional 2,100 AF of storage could be obtained. This additional storage equates to an average yield of approximately 700 AFY of supply or a firm yield of approximately 200 AFY of supply.

Lake Cachuma Cost Sensitivities and Implementation Considerations

The unit costs of increasing reservoir storage capacity Lake Cachuma are sensitive to a number of factors - particularly the methods used to achieve each of the options. In the case of dam modifications, raising the dam is expected to cost significantly more than flashboard increase due to the additional construction necessary. In the case of sediment removal, flushing of sediment has a lower unit cost than dredging as dredging requires equipment be used to physically remove and transport the sediment for disposal.

A number of implementation considerations apply to the Lake Cachuma options that will increase reservoir storage. All of the options described here may require coordinated resource management agreements with state and federal resource and land management agencies. Surface water rights will need to be considered given that downstream water rights or environmental flow requirements may impact the amount of water that can be attained from each option. The average supply yields estimated for each of these options could also vary based on how Lake Cachuma is operated. Some wet years may provide large volumes of water supply in adjacent years; therefore, the supply in the reservoir must be used prior to the next wet season in order to capture the next year's supply. The supply yields described here should be considered the upward-bound of what can be captured as a supply.

Sediment removal in Lake Cachuma would likely require extensive environmental considerations and permitting requirements, and are expected to be potentially challenging given past and current environmental and regulatory issues. Sediment removal would also require the development of feasibility studies to assess removal and disposal methods and locations, as well as more accurately determine the firm yield of supply that can be obtained. In addition, the relocation of dredging materials must be considered as it could impact areas downstream. As noted previously, flushing is not considered a feasible option for Lake Cachuma due to the need to drain the reservoir which is depended upon as a source of supply. It may be possible to implement dry desilting, however, the high unit cost could make this option prohibitive.

Dam raising or flashboard increases at Lake Cachuma will require additional studies be completed to determine possible inundation area with higher reservoir levels that could impact facilities and features such as the Cachuma Lake Park boat ramp, parking lot, various access roads and paths, restaurant, water treatment plant and various trees. Dam modifications may also require updated catastrophic failure analysis. In addition, modifying the dam could have sedimentation impacts on upstream reaches as water levels increase. As with sediment removal, additional study is necessary to determine the firm yield of supply that can be obtained through dam raising and freeboard optimization based on various dam operations scenarios and reservoir levels.

Finally, it was assumed that options that would remove sediments would be implementable within 5 years given that large construction projects would not be necessary, while those options requiring construction to complete would require 5-10 years.

Twitchell Reservoir

Twitchell Reservoir, located upstream of the Santa Maria River on the Cuyama River, is used to store local surface water for downstream recharge in the Santa Maria Basin as a primary source of supply to the watershed as well as for flood control. Declining yields have been seen from the Twitchell Reservoir as a result of natural sedimentation since its construction in 1958. The conservation pool, which is defined as the specified storage volume dedicated to water supply as opposed to flood control, has already shrunk and will continue to decline, assuming the flood pool remains unchanged in order to provide the same level of downstream flood protection benefits from the dam. Releases from the conservation pool provide water supply for recharging the Santa Maria Groundwater Basin. The California Department of Fish and Wildlife (CDFW) is examining Twitchell Reservoir and the Santa Maria River system as they relate to flow conditions for steelhead migration. As with Lake Cachuma, several options are available to increase capacity at Twitchell Reservoir, and are described below.

Twitchell Reservoir Dam Raising

The storage expansion analysis for Twitchell Reservoir included analysis of freeboard criteria, increased storage capacity/shoreline inundation, and potential fatal flaw identification. This analysis found that in order to prevent inundation of roads and other infrastructure, the reservoir elevation could not go above 672 ft. The analysis did, however analyze potential capacities above this elevation, as shown in Table 3-3, but in order to raise the reservoir elevation above 672 ft, the impacts would need to be addressed. If water were stored up to the spillway at 686.5 ft elevation, an additional 245,180 AF of capacity could be obtained while the maximum elevation analyzed (752 ft) would yield an additional 385,000 AF of capacity. Although additional expanded capacities were examined, as shown in Table 3-3, using the current dam capacity would be more than sufficient to capture an additional 5,800 AFY of average supply yield available from the Cuyama River.

Table 3-3: Twitchell Reservoir Current and Potential Expanded Capacities with Dam Raising

Reservoir Elevation (ft)	Reservoir Capacity (AF)	Expanded Conservation Pool (AF)	Expanded Dam Crest (AF)	Notes
Current Capacities				
621.5	108,128			Top of Conservation Pool
651.5	194,971	86,843		Intake Spillway/ Top of Flood Control Pool
672	266,095	145,379		Maximum elevation prior to infrastructure inundation
686.5	353,308	245,180		Reservoir Spillway
688	361,539	253,411		Max Potential Capacity without Dam Raise. Assumes a minimum freeboard of 4 ft
Potential Expanded Capacities				
702	386,211	278,083	2,001	
722	410,237	302,109	26,027	
742	460,260	352,132	76,050	
752	493,245	385,116	109,034	Max Elevation of Spillway Raise based on an approximate 100 ft raise from the intake spillway

Twitchell Reservoir Freeboard Optimization

Analysis of freeboard optimization was also conducted and found that an additional 245,000 AF of storage capacity could be attained, which would also allow for capture of an additional 5,800 AFY of average supply yield from the Cuyama River as well as potential additional flows from the Alamo and Huasna drainages in San Luis Obispo County.

Twitchell Reservoir Sediment Removal (Dredging or Flushing)

As stated previously, Twitchell Reservoir has experienced sedimentation that has reduced its conservation pool. The original capacity of Twitchell Reservoir was 240,000 AF, and is estimated to have a current capacity of 197,000 AF, meaning there is 43,000 AF of accumulated sediment in the reservoir. Removing this sediment buildup would allow for up to an additional 43,000 AF of capacity to capture an estimated 4,300 AFY of average supply yield from the Cuyama River.

Twitchell Reservoir Operations Modification

The Project Partners also noted that it could be possible to modify reservoir operations to allow for enlarging the conservation pool during times when it would not impact flood control. Based on a feasibility study that was previously conducted, it was found that modifying reservoir operations could yield an additional 7,600 AFY of average supply yield per year, assuming all spills are captured. This is a non-capital cost option, but it would require regulatory approvals.

Twitchell Reservoir Cost Sensitivities and Implementation Considerations

As with Lake Cachuma, the unit costs of increasing reservoir storage capacity in Twitchell Reservoir are sensitive to a number of factors - particularly the methods used to achieve each of the options. In the case of dam modifications, raising the dam is expected to cost significantly more than freeboard optimization due to the additional construction necessary. In the case of sediment removal, flushing of sediment has a lower unit cost than dredging as dredging requires equipment be used to physically remove the sediment. Twitchell Reservoir Operations Modifications are not expected to require capital costs, but will require planning and regulatory approvals. In addition, options are sized to capture wet year supplies, which further drives up costs.

A number of implementation considerations apply the Twitchell Reservoir options that will increase reservoir storage. All of the options described here may require coordinated resource management agreements with state and federal resource and land management agencies. Surface water rights will need to be considered given that downstream water rights or environmental flow requirements may impact the amount of water that can be attained from each alternative. The average supply yields estimated for each of these options could also vary based on how Twitchell Reservoir is operated. Some wet years may provide large volumes of water supply in adjacent years; therefore, the supply in the reservoir must be used prior to the next wet season in order to capture the next year's supply. The supply yields described here should be considered the upward-bound of what can be captured as a supply.

Sediment removal in Twitchell Reservoir would likely require extensive environmental considerations and permitting requirements, and are expected to be potentially challenging given past and current environmental and regulatory issues. Sediment removal would also require the development of feasibility studies to assess removal and disposal methods and locations, determine sediment impacts on existing outlet works, and more accurately determine the firm yield of supply that can be obtained. In addition, the relocation of dredging materials must be considered as it could impact areas downstream.

Dam raising or freeboard optimization at Twitchell Reservoir will require additional studies be completed to determine possible inundation area with higher reservoir levels, such as structures and roadways, and may also require updated catastrophic failure analysis. In addition, modifying the dam could have sedimentation impacts on upstream reaches as water levels increase. As with sediment removal, additional study is necessary to determine the firm yield of supply that can be obtained through dam raising and freeboard optimization based on dam operations.

Operational modifications at Twitchell Reservoir will require a reservoir modeling study be conducted to assess the existing operational rule curve, and will require coordination with and approval from the US Army Corps of Engineers. It should be noted that water has gone above the rule curve three times in the past and surcharged conservation water in the flood pool.

It's assumed that options that would modify operations or remove sediments would be implementable within 5 years given that large construction projects would not be necessary, while those options requiring construction related to dam modification would require 5-10 years.

Jameson Reservoir

Jameson Reservoir is located on the Santa Ynez River upstream of Lake Cachuma, northeast of the City of Montecito. Water from the river is collected behind Juncal Dam, and delivered via the Doulton Tunnel to Montecito where it's treated for direct use.

Jameson Reservoir Dam Raising

An analysis was conducted to determine the possible increase in capacity that can be achieved at the reservoir through dam modifications, although it should be noted that the analysis did not account for system-wide effects such as increases in upstream storage resulting in loss to downstream storage. Currently, Jameson Reservoir's spillway crest elevation is 2,224 ft and the dam crest elevation is 2,230 ft. Based on the inundation area, it was assumed that the maximum limit for potential dam spillway raise elevations would be 2,260 ft. If the spillway crest were raised, there would be expanded capacities at various elevations beneath the existing required freeboard elevation and beyond. Table 3-4 shows the potential capacity expansions of the reservoir with 4, 16, 26 and 36 ft dam raises., Based on the maximum spillway raise elevation of 2,260 ft, the reservoir capacity could be expanded by up to 5,000 AF yielding an additional 2,000 AFY of average water supply yield could potentially be captured in the reservoir.

Table 3-4: Jameson Reservoir Potential Expanded Capacities with Dam Raising

Reservoir Elevation (ft)	Reservoir Capacity (AF)	Potential Capacity Expansion (AF)	Notes
Current Capacities			
2,224	5,114	0	Reservoir Spillway
2,226	5,228	114	Max Potential Capacity without Dam Raise. Assumes a minimum freeboard of 4 ft based on Division of Safety of Dams requirements.
Potential Expanded Capacities			
2,228	5,367	253	
2,240	6,863	1,749	
2,250	8,433	3,319	
2,260	10,192	5,078	Max Elevation of Spillway Raise. Maximum reservoir spillway raise based on potential inundation area at an elevation of 2,260 ft, which borders overtopping the highest point of natural geology between the two man-made dam structures of the reservoir.

Jameson Reservoir Dam Freeboard Optimization

Analysis of freeboard optimization was also conducted, and found that an additional 110 AF of storage capacity could be attained, which would also allow for capture of an additional 40 AFY of average water supply yield from the Santa Ynez River.

Jameson Reservoir Sediment Removal (Dredging or Flushing)

Sediment removal at Jameson Reservoir would allow for additional capture of water in the Santa Ynez River as well. The reservoir's original capacity was 7,200 AF, but has been reduced to 5,100 AF. If the sediment were removed from the reservoir, it's estimated that up to 2,100 AF of additional capacity could be obtained, resulting in capture of an additional 850 AFY of average local surface water yield.

Jameson Reservoir Cost Sensitivities and Implementation Considerations

As with other reservoir modification and sediment removal options, the unit costs of increasing reservoir storage capacity in Jameson Reservoir are sensitive to a number of factors. In the case of dam modifications, raising the dam is expected to cost significantly more than freeboard optimization due to the additional construction necessary. In the case of sediment removal, flushing of sediment has a lower unit cost than dredging as dredging requires equipment be used to physically remove the sediment. In addition, options need to be sized to capture larger wet year event flows for long-term storage, which increases costs.

A number of implementation considerations apply the Jameson Reservoir options that will increase reservoir storage. All of the options described here may require coordinated resource management agreements with state and federal resource and land management agencies. Surface water rights will need to be considered given that downstream water rights or environmental flow requirements may impact the amount of water that can be attained from each alternative. The average supply yields estimated for each of these options could also vary based on how Jameson Reservoir is operated. Some wet years may provide large volumes of water supply in adjacent years; therefore, the supply in the reservoir must be used prior to the next wet season in order to capture the next year's supply. The supply yields described in this Report should be considered the upward-bound of what can be captured as a supply.

Sediment removal in Jameson Reservoir would likely require extensive environmental considerations and permitting requirements, and are expected to be potentially challenging given past and current environmental and regulatory issues. Sediment removal would also require the development of feasibility studies to assess removal and disposal methods and locations, determine sediment impacts on existing outlet works, and more accurately determine the firm yield of supply that can be obtained. In addition, the relocation of dredging and flushing materials must be considered as it could impact areas downstream, particularly Gibraltar Reservoir which is approximately 10 miles downstream of Jameson Reservoir.

Dam raising or freeboard optimization at Jameson Reservoir will require additional studies be completed to determine possible inundation area with higher reservoir levels that could impact structures and roadways, and may also require updated catastrophic failure analysis. As with sediment removal, additional study is necessary to determine the firm yield of supply that can be obtained through dam raising and freeboard optimization based on dam operations.

It's assumed that options that would remove sediments would be implementable within 5 years given that large construction projects would not be necessary, while those options requiring construction related to dam modification would require 5-10 years.

Gibraltar Reservoir

Gibraltar Reservoir, also located on the Santa Ynez River upstream of Lake Cachuma, is located north of the City of Santa Barbara. Water from the river is collected behind Gibraltar Dam, and diverted to the City of Santa Barbara via the Mission Tunnel where it's treated for direct use. Water from this reservoir has historically provided approximately 1/3 of the city's water supply.

Gibraltar Reservoir Freeboard Optimization

Should the spillway of the dam be raised, it's assumed that the existing dam structure would need to maintain at least four feet of freeboard, which means only a one foot raise could be achieved for the existing Gibraltar Dam. A one foot raise of the spillway would provide roughly 280 AF of additional storage, resulting in capture of an additional 110 AFY of average supply yield from the Santa Ynez River. It should be noted that potential inundation impacts will need to be evaluated if the reservoir level is raised.

Gibraltar Reservoir Sediment Removal (Dredging)

Sediment removal at Gibraltar Reservoir would allow for additional capture of water in the Santa Ynez River as well. The reservoir's original capacity was 14,500 AF, but has been reduced to 5,300 AF. If the sediment were removed from the reservoir, it's estimated that up to 9,200 AF of additional capacity could be obtained, resulting in capture of an additional 3,700 AFY of average local surface water yield. It should be noted that due to the existing dam structure, flushing is not considered a sediment removal option.

Gibraltar Reservoir Cost Sensitivities and Implementation Considerations

As with other reservoir modification and sediment removal options, the unit costs of increasing reservoir storage capacity in Gibraltar Reservoir are sensitive to a number of factors. At Gibraltar Reservoir, raising the dam was determined to be infeasible, making freeboard optimization the only dam modification option (DWR 1985). Cost sensitivities are related to the method of optimization (e.g. rubber dams or concrete dam structure). In the case of sediment removal, flushing of sediment was determined to not be feasible due to the dam structure, making dredging the only sediment removal option. It should be noted that the City of Santa Barbara is able to store Gibraltar water in Lake Cachuma as part of the Pass Through Agreement, which restores the City's Gibraltar supply without physical expansion of Gibraltar capacity.

A number of implementation considerations apply the Gibraltar Reservoir options that will increase reservoir storage. The two options described above may require coordinated resource management agreements with state and federal resource and land management agencies. The average supply yields estimated for each of these options could also vary based on how Gibraltar Reservoir is operated. Some wet years may provide large volumes of water supply in adjacent years; therefore, the supply in the reservoir must be used prior to the next wet season in order to capture the next year's supply. The supply yields described here should be considered the upward-bound of what can be captured as a supply.

Sediment removal in Gibraltar Reservoir would likely require extensive environmental considerations and permitting requirements, and are expected to be potentially challenging given past and current environmental and regulatory issues. Sediment removal would also require the development of feasibility studies to assess removal and disposal methods and locations, determine sediment impacts on existing outlet works, and more accurately determine the firm yield of supply that can be obtained. In addition, the relocation of dredging materials must be considered as it could impact areas downstream, including Lake Cachuma which is located approximately 20 miles downstream.

Freeboard optimization at Gibraltar Reservoir will require additional study to determine possible inundation area with higher reservoir levels that could impact structures and roadways, and may also require updated catastrophic failure analysis. As with sediment removal, additional study is necessary to determine the firm yield of supply that can be obtained through dam raising and freeboard optimization based on dam operations.

It is assumed that options that would remove sediments would be implementable within 5 years given that large construction projects would not be necessary, while those options requiring construction related to dam modification would require 5-10 years.

Increased Storage Capacity with New Reservoirs and Off-Stream Storage

Capture of unused local surface/stormwater with new, in-stream reservoir facilities and off-stream storage was also examined as a part of this Project. The following is a description to the potential locations and supply yields that could be achieved through construction of these types of options.

In-Stream Reservoirs

Since a new reservoir facility could potentially be located in a variety of places throughout the Region, new reservoir options for this Report were limited to sites that have already been explored in previous studies. A previous summary of the potential capacity and supply capture associated with those options was completed by DWR and Santa Barbara County Flood Control District in 1985 and is provided in Table 3-5. The supply volume available through each of these new reservoirs, while sized to capture the larger, infrequent storms that occur in the Region, is calculated based on average annual stream flows and factors in releases to satisfy downstream water rights, losses to evaporation and spills, as needed. It should be noted that construction of any new in-stream reservoir, particularly along the California coastal area, would be very difficult if not impossible to permit due to endangered fisheries that inhabit the coastal streams.

Table 3-5: Potential New Reservoir Capacities

Surface Watershed	Reservoir	Capacity (AF)	Supply, based on average yield (AFY)[1]
Santa Ynez Watershed	Salsipuedes Creek Dam	50,000	2,850
Santa Ynez Watershed	Lower Lompoc Dam	25,000	3,190
Santa Maria Watershed	Round Corral Reservoir	50,000-82,000	5,500-6,700

1. All supply average yields are based on the supply capture cited in DWR, 1985.

Off-stream Storage

As opposed to in-stream reservoirs created by constructing a dam, off-stream storage may be engineered to capture diverted, unused surface/stormwater flows for supply and later use. For this Report, off-stream storage is assumed to be an open earthen reservoir. Alternatively, the new reservoirs could be lined to prevent percolation so supplies can be retained above ground. Unlined earthen reservoirs could also be used to increase groundwater infiltration and would be akin to spreading grounds discussed later in this Report in Section 3.4. It's assumed that water supply collected in off-stream storage would most likely be used directly by agricultural users for non-potable irrigation use or could be used for release to meet downstream in-stream flow requirements (such as environmental or fish flow requirements) or downstream diversion rights.

It is assumed for cost estimation purposes that the minimum storage capacity for an off-stream reservoir is 2,000 AF, and if desired, increments could be added or removed to attain the desired storage potential given available supply and area available. This volume reservoir would allow for the water supply to be retained for future use.

Specific potential reservoir sites were not evaluated; however, based upon a visual analysis of aerial imagery, there are several sites along most major rivers and streams where a 2,000 AF facility could be constructed. For example, a potential site near Lake Cachuma near the point at which Hilton Creek joins the Santa Ynez River could potentially accommodate an off-stream reservoir that would capture flows from Lake Cachuma as well as Hilton Creek. These flows could then be used for re-release or use as fish flows, recharge or for non-potable use as flows from Lake Cachuma are used as a water supply. Another example is potentially siting the off-stream reservoir in Happy Canyon, which would capture excess Lake Cachuma water via an existing 36" State Water pipeline. These flows could then be used for re-release or use as fish flows, recharge or for non-potable use as flows from Lake Cachuma are used as a water supply. Note that any option that captures excess Cachuma flows may not need modification of water rights since the current right for Cachuma is underused.

The sizing and specific siting of these off-stream reservoirs will depend upon how much of the supply is intended for capture, the actual physical setting and its ultimate use. Note that since the unused local surface/stormwater supply potential estimates are an average of peak event availability over an average historical ten-year period, upward supply volumes may not be able to be attained due to facility constraints during peak events.

New Reservoir and Off-Stream Storage Cost Sensitivities and Implementation Considerations

For new reservoirs and off-stream storage, land acquisition and excavation costs make up a large part of the total facility unit cost.

The new reservoir and off-stream storage options described here may require coordinated resource management agreements with state and federal resource and land management agencies. Surface water rights will need to be considered given that downstream water rights or environmental flow requirements may impact the amount of water that can be attained from each alternative. As mentioned previously, note that any option that captures excess Cachuma flows may not need modification of water rights since the current right for Cachuma is underused.

The average supply yields estimated for each of these options could also vary based on how the reservoirs operated. Some wet years may provide large volumes of water supply in adjacent years; therefore, the supply in the reservoir must be used prior to the next wet season in order to capture the next year's supply. The supply yields described here should be considered the upward-bound of what can be captured as a supply.

Construction of new in-stream reservoirs is expected to have inundation impacts on large areas that could affect infrastructure, and could have adverse impacts to steelhead spawning and rearing habitat. Additional study will be necessary to evaluate the identified reservoir sites to assess these impacts as well as ensure the site is suitable from a geologic standpoint. In-stream reservoirs are also expected to require significant State or Federal funding as new dams are incredibly expensive today, and such dollars are very restricted.

Off-stream reservoir options are expected to require land acquisition or land use agreements. These options must also consider environmental interests associated with removing flow from streams, unless water rights are in place, particularly as it relates to steelhead spawning and rearing habitat. In addition, the high unit cost of these options may make them economically infeasible.

Conclusions

Figure 1-1, Figure 3-4 and Table 3-6 provide a summary of the supply volume, unit costs and implementation timeframe of each of the options that are within the Project's thresholds of having a unit cost below $3,000/AFY and able to produce additional supply volumes above 2,000 AFY (based on average yield). As a result, these are the more attractive supply options that are recommended for further consideration for implementation as they reflect the greatest potential at a regional level. Table 3-7 provides a summary of the options that were explored as part of this Project, but did not meet the higher level cost and volume thresholds.

As seen in the figure, the options identified that will increase reservoir storage capacity in the Region vary greatly in the volume of unused supply that can be captured, and also vary in terms of unit cost and implementation timeframe. Note that all supply volumes and unit costs are based on average supply estimates, as opposed to firm yield estimates which may be significantly lower in volume and therefore would have higher unit costs. For additional cost information, please see the Technical Memorandums prepared in support of this Report.

Notably, those options that involve dredging for Lake Cachuma and Gibraltar Reservoir fell outside of the unit cost threshold due to the high cost of physically removing the sediment. Flushing of sediment from these reservoirs may be more cost effective, but infeasible due to either the need to maintain the supply or the existing dam structures. As shown in Table 3-6, making dam modifications or operational modifications may be a more cost effective and feasible way of increasing storage in these reservoirs.

New reservoirs appear to be cost effective, while providing between 2,000 and 5,000 AFY average yield of additional supply, although implementation of new reservoirs are expected to take much longer than the implementation of options that involve existing reservoirs. Within California, new reservoir construction is extremely challenging given the concerns raised by the environmental community and regulators on the impacts to fish and other aquatic species. As a result, if a new in-stream reservoirs is attempted, it can be assumed to take well over 10 years to implement and will require mitigation.

As shown through the options described here, increasing reservoir storage capacity within the Region is a feasible way to capture more of the unused local surface/stormwater use within the Region. Improving existing reservoirs through sediment removal, physical modification or operational modifications could yield additional storage space for thousands of acre feet of water supply. In particular low cost adjustments to existing facility structures (such as increasing freeboard) can provide cost effective supplies.

New reservoirs options would likely take longer than 10 years and be more difficult to implement from a regulatory perspective, in addition to providing lower volumes and higher unit costs. The options plotted in Figure 3-4 indicate that generally, options that modify existing reservoir facilities and operations are shown to be the most cost-effective and implementable.

Figure 3-4: Increase Reservoir Storage Capacity Options for Regional Consideration

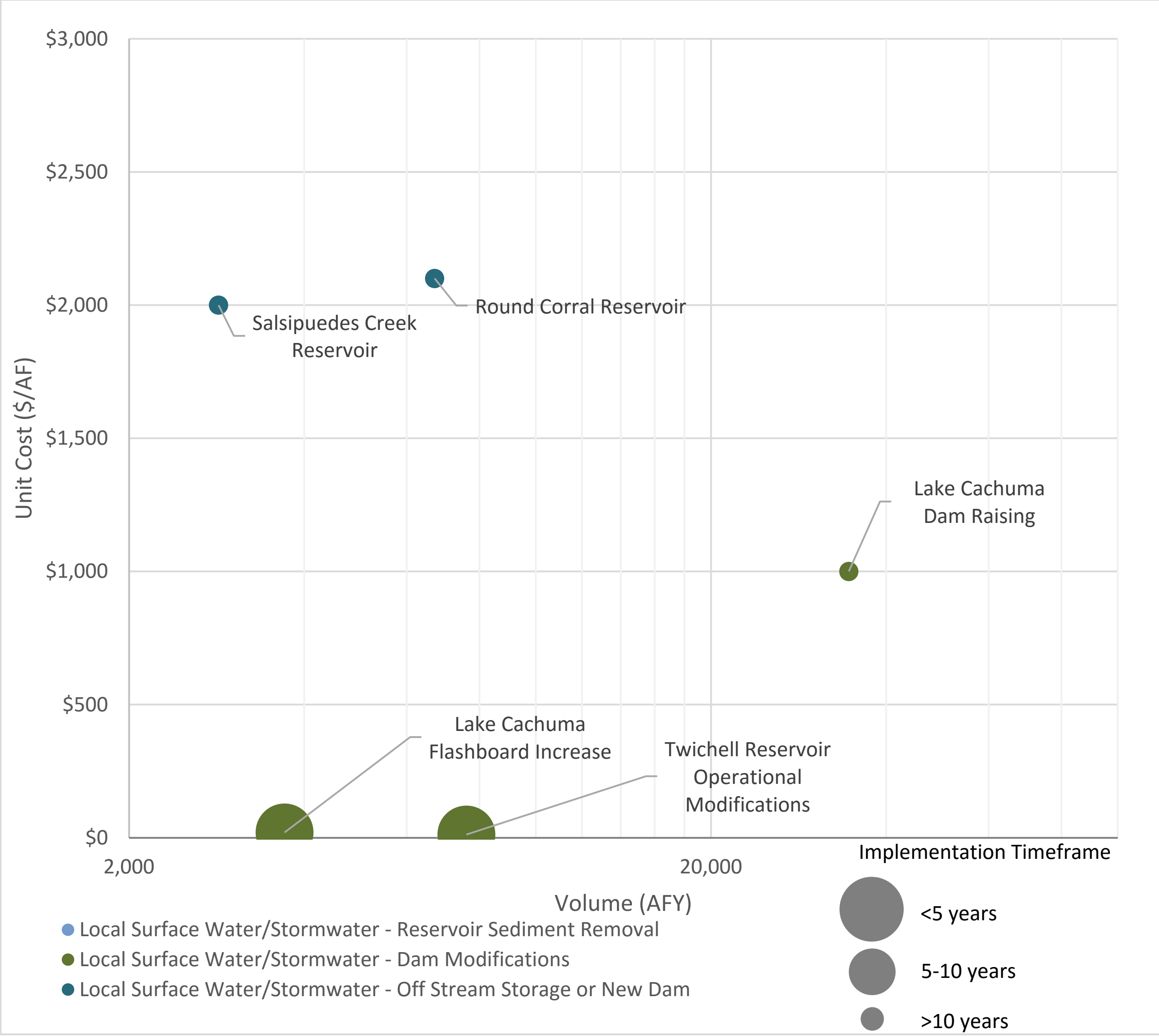


Table 3-6: Increase Reservoir Storage Capacity Options for Regional Consideration

Option	Supply, based on average yield (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Stormwater/Surface Water – Dam Modifications			
Twitchell Reservoir Operational Modifications	Up to Wet Year[1] – 58,000 Down to Dry Year[2] - 0 Average Annual[3] - 7,600	$12	<5 years
Lake Cachuma Dam Raising	Up to Wet Year[1] – 197,000 Down to Dry Year[2] - 0 Average Annual[3] - 34,500	$1,000	>10 years
Lake Cachuma Flashboard Increase	Up to Wet Year[1] – 9,300 Down to Dry Year[2] - 0 Average Annual[3] - 3,700	$20	<5 years
Stormwater/Surface Water – Off Stream Storage or New Dam			
Round Corral Reservoir	6,700[4]	$2,100	>10 years
Salsipuedes Creek Reservoir	2,850[4]	$2,000	>10 years

1. The "Up to Wet Year" potential increased supply volume represents the maximum volume that can be obtained from the option based on both wet year stormwater flow records and facility capacity.
2. The "Down to Dry Year" potential increased supply volume represents the minimum volume that can be expected from the option based on dry year stormwater flow records.
3. Average annual increased supply is estimated using past reservoir spill records to calculate the frequency of spill events over a 10-year rolling average and the average stormwater supply available for capture for each option, up to the capacity of each facility.
4. The potential increased supply for the Round Corral Reservoir and Salsipuedes Creek Reservoir options are the estimated yields provided in DWR's 1985 report: *Santa Barbara County State Water Project Alternatives.*

Table 3-7: Other Increase Surface Storage Capacity Options Considered, But Not Meeting Project Thresholds

Option	Supply, based on average yield (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Stormwater/Surface Water – Reservoir Sediment Removal			
Lake Cachuma Sediment Removal (dredging)	Up to Wet Year[1] – 20,900 Down to Dry Year[2] - 0 Average Annual[3] - 6,600	$9,200	<5 years
Lake Cachuma Sediment Removal (dry desilting)	Up to Wet Year[1] - 2,100 Down to Dry Year[2] - 0 Average Annual[3] - 700	$15,000	<5 years
Twitchell Reservoir Sediment Removal (dredging)	Up to Wet Year[1] - 43,000 Down to Dry Year[2] - 0 Average Annual[3] - 4,300	$37,000	<5 years
Twitchell Reservoir Sediment Removal (flushing)	Up to Wet Year[1] - 43,000 Down to Dry Year[2] - 0 Average Annual[3] - 4,300	$9,100	<5 years
Gibraltar Reservoir Sediment Removal (dredging)	Up to Wet Year[1] - 9,200 Down to Dry Year[2] - 0 Average Annual[3] - 3,700	$9,200	<5 years
Jameson Reservoir Sediment Removal (flushing)	Up to Wet Year[1] – 43,000 Down to Dry Year[2] - 0 Average Annual[3] – 850	$2,300	5-10 years
Jameson Reservoir Sediment Removal (dredging)	Up to Wet Year[1] – 43,000 Down to Dry Year[2] - 0 Average Annual[3] - 850	$9,200	5-10 years
Stormwater/Surface Water – Dam Modifications			
Jameson Reservoir Dam Raising	Up to Wet Year[1] – 5,000 Down to Dry Year[2] - 0 Average Annual[3] - 2,000	$3,200	>10 years
Jameson Reservoir Freeboard Optimization	Up to Wet Year[1] - 110 Down to Dry Year[2] - 0 Average Annual[3] - 40	$300	5-10 years
Twitchell Reservoir Freeboard Optimization	Up to Wet Year[1] - 90,000 Down to Dry Year[2] - 0 Average Annual[3] - 5,800	$9,100	5-10 years
Gibraltar Reservoir Freeboard Optimization	Up to Wet Year[1] - 280 Down to Dry Year[2] - 0 Average Annual[3] - 110	$280	5-10 years
Stormwater/Surface Water – Off Stream Storage or New Dam			
Lower Lompoc Reservoir	3,190[4]	$3,400	>10 years
San Antonio Creek Reservoir	1,400[4]	$2,400	>10 years
Santa Ynez River Off-Stream Storage	2,000[5]	$5,700	>10 years

1. The "Up to Wet Year" potential increased supply volume represents the maximum volume that can be obtained from the option based on both wet year stormwater flow records and facility capacity.
2. The "Down to Dry Year" potential increased supply volume represents the minimum volume that can be expected from the option based on dry year stormwater flow records.

3. Average annual increased supply is estimated using past reservoir spill records to calculate the frequency of spill events over a 10-year rolling average and the average stormwater supply available for capture for each option, up to the capacity of each facility.
4. The potential increased supply for the Lower Lompoc Reservoir and San Antonio Creek Reservoir options are the estimated yields provided in DWR's 1985 report: *Santa Barbara County State Water Project Alternatives.*
5. The Santa Ynez River Off-Stream Storage yield is based on the assumption that the 2,000 AF capacity reservoir would fill once per year.

3.2 Direct Recycled Water Use

Direct use of recycled water is one way of utilizing the unused recycled water supply discussed in Chapter 2. Recycled water is currently directly used in the Region only for non-potable uses, meaning it is not treated to drinking water standards, but there is potential to expand the use of this supply within the region

Non-Potable Direct Use

Non-potable, direct use of recycled water, often referred to as non-potable reuse or NPR, can be used to meet municipal, industrial and agricultural uses. Municipal and industrial non-potable uses typically include irrigation of lawns and landscaping, industrial or commercial cooling or air conditioning, flushing of toilets and urinals, industrial process water, commercial laundries, firefighting and dust control. Agricultural uses of recycled water can include irrigation of orchards, vineyards, non-food bearing trees, food-bearing trees (as long as the water does not come into contact with the food), crops, and ornamental nurseries and sod farms. These uses all require a minimum of tertiary treatment of the recycled water. The treatment levels of each of the WWTPs in the Region vary, as shown in Table 3-8, and therefore may require upgrades to allow for use of recycled water for these uses. For the purposes of this Report, only WWTPs with greater than 1 million gallons per day (MGD) of unused effluent are shown in the below table, as described in Section 2.3.

Table 3-8: Current WWTP Effluent Quality

WWTP Operator	Effluent Quality
Laguna County Sanitation District	Tertiary
City of Guadalupe	Secondary
Lompoc Regional Wastewater Reclamation Plant	Tertiary
Goleta Sanitary District	Secondary (50%) Tertiary (50%)
City of Santa Barbara	Secondary (85%) Tertiary (15%)
City of Summerland	Tertiary
Montecito Sanitary District	Secondary
Carpinteria Sanitary District	Secondary
Cuyama Community Services District	Secondary

Several municipal/industrial and agricultural options for use of the unused recycled water supply were developed based on a literature search of recycled water planning documents that identified non-potable demands and potential projects for each of the WWTPs. These demands are listed in Table 3-9. Although there may be additional WWTPs in the Region, only those with above 1,000 AFY of unused supply and/or those that have engaged in recycled water planning activities are included here. These uses will require construction of infrastructure to deliver the recycled water to the identified demands, including pipelines, storage tanks, and on-site conversions. The options listed in the below table represent the highest level of non-potable demand identified in the recycled water literature, but may include phasing that incorporates varying levels of recycled water demand.

Table 3-9: Non-Potable Reuse Options

WWTP Operator	Municipal & Industrial Demand (AFY)	Agricultural Demand (AFY)
Laguna County Sanitation District	2,900	5,000
City of Guadalupe	220	1,100
Lompoc Regional Wastewater Reclamation Plant	1,750	0
Goleta Sanitary District	210	0
City of Santa Barbara	270	0
City of Summerland	45	62
Montecito Sanitary District	300	440
Carpinteria Sanitary District	120	690
Cuyama Community Services District	0	<60

Cost Sensitivities and Implementation Considerations of Non-Potable Direct Use Options

The cost of non-potable, direct use of unused recycled water within the Region is primarily sensitive to the increment of recycled water to be used and the volume of recycled water demand. Often, higher volumes of non-potable recycled water use often require recycled water infrastructure to go a longer distance in order to reach the demands. For example, given the topography and urban setting of the South Coast subregion, meeting the last increments of identified potential recycled water demands through direct distribution are cost intensive. These additional increments of recycled water are also sometimes lower in volume, which increases unit costs further.

Non-potable direct use of recycled options also have a number of implementation considerations. All options will depend on the willingness of customers to implement the necessary on-site conversions to allow for recycled water use. In some service areas, customer agreements have historically been challenging to obtain as customers currently rely on groundwater, which is a less expensive source of supply, or due to strong opposition that could potentially be remedied through extensive public outreach. In addition, any benefits from implementation of non-potable direct use options will be realized over the long-term as customers participate. Some recycled water market refinement may also be necessary to ensure that recycled water customers identified in the studies are still viable.

Though some non-potable recycled water infrastructure is in place, it may be necessary to perform maintenance and increase capacity of facilities to ensure that higher volumes of recycled water can be conveyed to customers, particularly in the cities of Goleta and Santa Barbara.

In addition to the implementation considerations discussed above, recycled water use for agricultural fields must consider recycled water quality, particularly salinity and pathogens for both crop quality and regulatory purposes.

Finally, implementation of options that will use recycled water that is typically discharged to local creeks and rivers may need to consider potential impacts to groundwater recharge, particularly in the case of Lompoc Regional Wastewater Reclamation Plant.

NPR options are considered implementable within 5 years given that NPR is already occurring in the Region and therefore would be simpler to implement in terms of infrastructure, permitting and regulations.

Potable, Direct Use

Direct use of recycled water for potable use does not yet occur in the Region as there is not yet a regulatory framework for direct potable reuse (DPR) in California. However, it's anticipated that within 5-10 years, this framework will be in place along with allowable treatment levels and processes. Given the volume of potable demand currently in the Region, it's assumed that DPR options are only limited by effluent from each plant and could be connected directly to potable distribution systems with the addition of infrastructure such as pipelines, storage and pump stations. It is assumed that enhancing WWTPs to provide a level of advanced treatment allowable for DPR will result in a loss of 15% of total WWTP effluent as brine discharge. Table 3-10 provides the upward projected DPR supply options by WWTP.

Table 3-10: Direct Potable Reuse Options

WWTP Operator	Supply Available for DPR (AFY)
Laguna County Sanitation District	4,700
City of Guadalupe	930
Lompoc Regional Wastewater Reclamation Plant	3,700
Goleta Sanitary District	6,500
City of Santa Barbara	6,400
City of Summerland	135
Montecito Sanitary District	850
Carpinteria Sanitary District	1,530
Cuyama Community Services District	50

Cost Sensitivities and Implementation Considerations of Potable, Direct Use Options

The cost of potable, direct use of unused recycled water within the Region are based on upgrading WWTPs to advanced treatment, as well as adding infrastructure to allow for a connection of recycled water near where potable water currently enters the distribution system. Upgrades of the WWTPs to advanced treatment make up a large portion of the total cost. In addition, upgrading existing WWTPs will require brine discharge facilities/mechanisms with a range of costs. Those options that can utilize an existing WWTP ocean discharge outfall in the South Coast Subregion are assumed to do so. Given the distance from the coast, it was assumed that any brine removal in the Cuyama and Santa Ynez Subregions would not take place through an ocean outfall and instead need to be managed locally through injection, evaporation ponds or zero liquid discharge methods.

Direct potable reuse option costs are also sensitive to the Project's assumptions as to where the recycled water distribution system would connect to the potable water system. It was assumed that the recycled water system would connect to the approximate area where potable water enters the potable distribution system. For some options, this distance can be several miles, which drives up the unit costs of these options. If the connection can be made closer to the recycled water plant, then unit costs would be much lower. There is an efficiency of scale in the unit costs, where larger projects will generally have lower unit costs.

In order to implement these projects, they must be approved by DDW/RWQCB; however, a DPR regulatory framework does not yet exist and there are currently no permitted DPR projects in California. However, if a framework is developed, implementation of these options could occur within 10 years. In addition, potential public acceptance impediments would require an extensive public outreach program.

Graywater Use

The potential graywater supplies estimated in Chapter 2 already applied an assumed urban parcel owner participation rate to the urban area potential. Implementation of graywater use will require homeowners to install graywater systems that meet local regulatory requirements. Table 3-11 provides the graywater options, which summarize each subregion.

Table 3-11: Graywater Options

Subregion	Unused Graywater (AFY)
Santa Maria Subregion	1,928
San Antonio Subregion	39
Santa Ynez Subregion	1,151
South Coast Subregion	2,700
Cuyama Valley Subregion	25

Cost Sensitivities and Implementation Considerations of Graywater Options

The cost of implementing graywater will be primarily dependent on site-specific retrofit needs. For example, a new development could easily incorporate graywater systems into its design and construction, while a development already constructed would have a more difficult time incorporating a graywater system into the building.

In order to successfully implement graywater options, significant public outreach will be required to achieve implementation rate goals and may also require a subsidized incentive plan to achieve goals. The supply benefits of graywater options can be highly variable and dependent upon individual customer behavior, and are expected to require many years to achieve the supply goals set.

Conclusions

Figure 3-5 and Table 3-12 provide a summary of the supply volume, unit costs and implementation timeframe of each of the options that are within the Project's thresholds of having a unit cost below $3,000/AFY and able to produce additional supply volumes above 2,000 AFY (based on average yield). As a result, these are the more attractive supply options that are recommended for further consideration for implementation as they reflect the greatest potential at a regional level. Table 3-13 provides a summary of the options that were explored as part of this Project, but did not meet the higher level cost and volume thresholds. For additional cost information, please see the Technical Memorandums prepared in support of this Report.

The recycled options included on the chart primarily include DPR options and those NPR options that will provide high volumes of water. As shown on the figure, while DPR options are cost effective and would typically provide large volumes of water, DPR projects may require between five and ten years to implement given that regulations are not currently in place to allow this use of recycled water.

A number of the NPR options were not considered to be favorable for County implementation due to the low volumes of water supply that could be achieved, though these are individual NPR projects that could still be implemented on a local level and be cost effective (less than $3,000/AFY).

Graywater options do not appear on the figure due to the high unit cost of implementing the option, though like similar smaller-scale NPR options, graywater may still be implementable on a local level.

The Region is already utilizing recycled water for non-potable uses, however, potential supply is available to expand use. In the near-term, non-potable infrastructure could be expanded to deliver to additional recycled water users, while in the mid-term (5-10 years) direct potable use of recycled water could be possible to use higher volumes of recycled water. Not seen in Figure 3-5 are several potential increments of NPR and graywater systems options since they exceed the cost threshold of $3,000/AF. While graywater use should be encouraged and permitted, it is difficult to implement on a large-scale due to the need for individual property owners to install the necessary equipment. Although DPR could be a cost effective way to use larger volumes of recycled water, regulations are not currently in place and so it should be thought of as a longer term opportunity. Having said that, local agencies have begun including DPR as a consideration. As an example, Goleta Water District is currently exploring an opportunity to implement a DPR project within their service area.

Figure 3-5: Direct Recycled Water Use Options for Regional Consideration

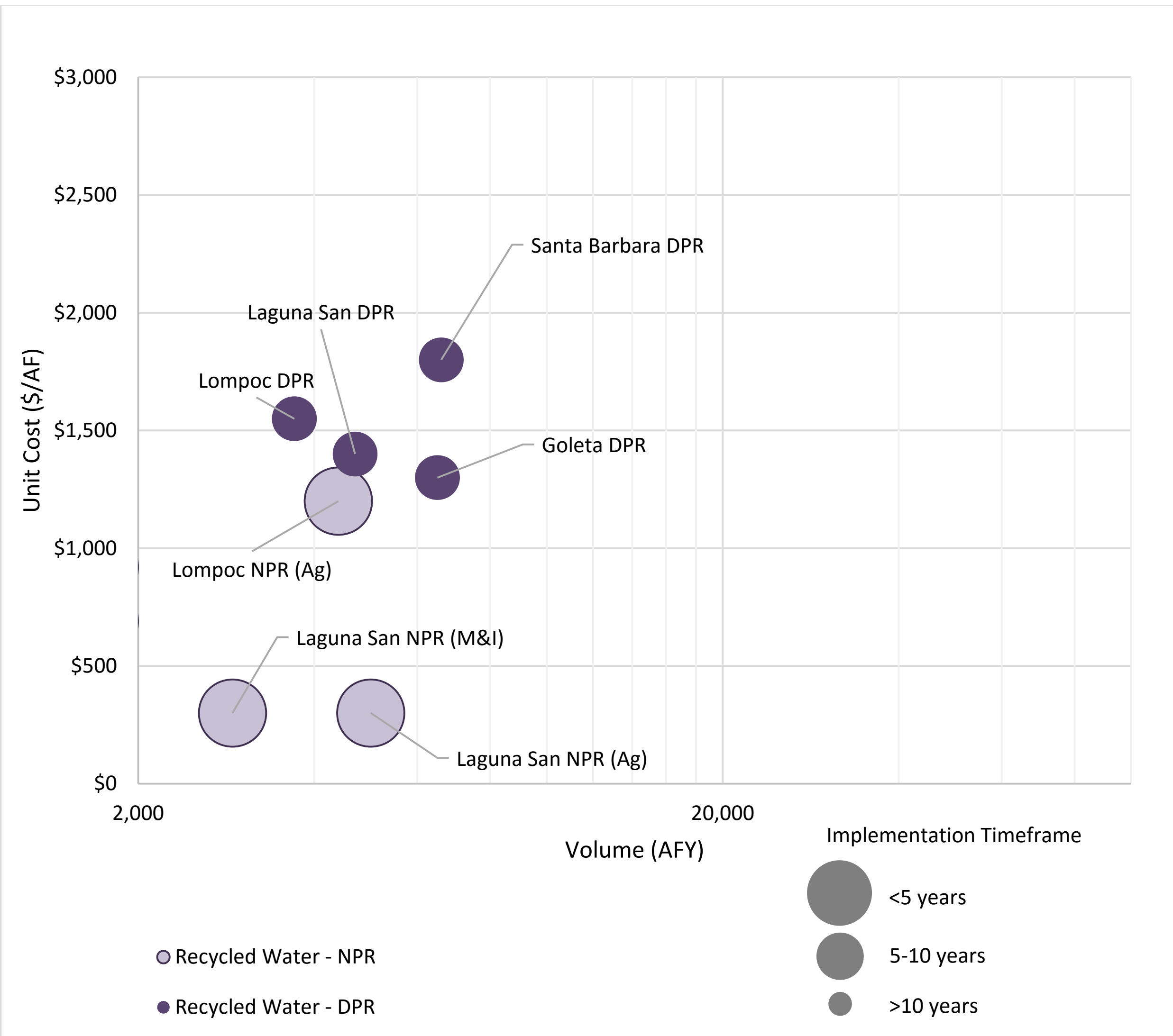


Table 3-12: Direct Recycled Water Use Options for Regional Consideration

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Recycled Water - NPR			
Laguna San NPR (M&I)	2,900	$300	<5 years
Laguna San NPR (Ag)	5,000	$300	<5 years
Lompoc NPR (Ag)	4,400	$1,200	<5 years
Recycled Water - DPR			
Lompoc DPR	3,700	$1,550	5-10 years
Laguna San DPR	4,700	$1,400	5-10 years
Santa Barbara DPR	6,600	$1,800	5-10 years
Goleta DPR	6,500	$1,300	5-10 years

Table 3-13: Other Direct Recycled Water Use Options Considered, But Not Meeting Project Thresholds

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Recycled Water - NPR			
Guadalupe NPR (M&I)	120	$2,000	<5 years
Guadalupe NPR (Ag)	1,100	$1,700	<5 years
Cuyama NPR (Ag)	60	$2,400	<5 years
Lompoc NPR (M&I)	1,750	$900	<5 years
Goleta NPR (M&I)	210	$5,900	<5 years
Santa Barbara NPR (M&I)	270	$3,000	<5 years
Montecito NPR (M&I)	300	$2,400	<5 years
Montecito NPR (Ag)	440	$2,300	<5 years
Summerland NPR (M&I)	16	$19,100	<5 years
Summerland NPR (Ag)	62	$1,400	<5 years
Carpinteria NPR (M&I)	120	$7,000	<5 years
Carpinteria NPR (Ag)	690	$2,200	<5 years
Recycled Water - DPR			
Guadalupe DPR	930	$1,500	5-10 years
Cuyama DPR	50	$2,200	5-10 years
Montecito DPR	850	$1,500	5-10 years
Summerland DPR	135	$2,100	5-10 years
Carpinteria DPR	1,530	$1,500	5-10 years
Graywater			
Santa Maria Graywater	790	$4,200	>10 years
San Antonio Graywater	160	$4,200	>10 years
Santa Ynez Graywater	4,600	$4,200	>10 years
South Coast Graywater	10,800	$4,200	>10 years
Cuyama Graywater	100	$4,200	>10 years

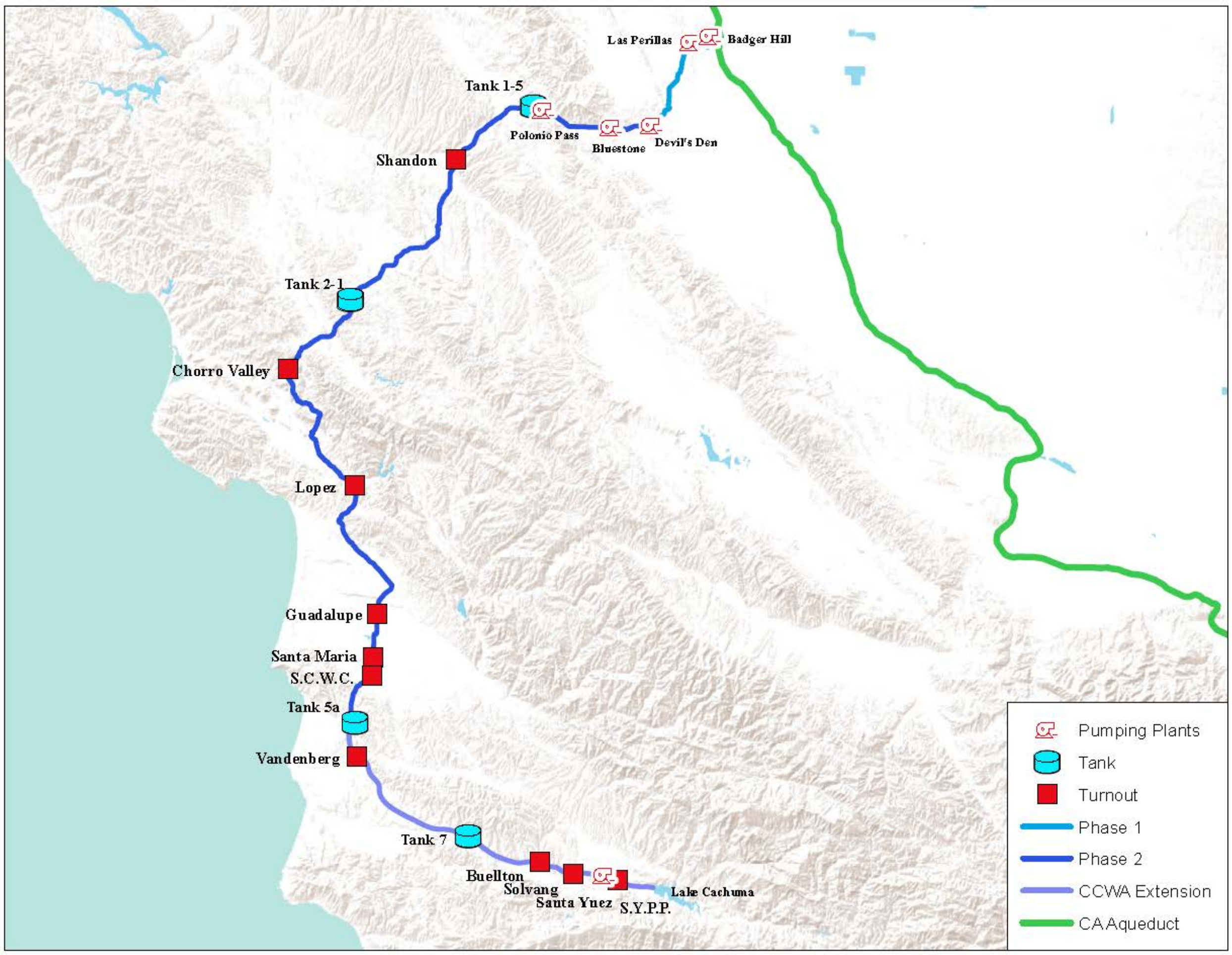
3.3 Importing Water from Outside the Region

This section focuses on the options to use existing imported water infrastructure systems to convey the additional increments of imported water for direct use throughout the Region.

State Water Project Unused Supply Options

In order to determine the potential for wheeling additional supplies through the SWP Coastal Branch system (shown in Figure 3-6), an analysis of its conveyance capacity potential was conducted using the Coastal Branch Capacity and Delivery model (CBCD Model) and compared to the available supply discussed in Chapter 2.

Figure 3-6: SWP Facilities Map



By comparing the capacity of the individual reaches and key pieces of infrastructure against the historical monthly deliveries from 2004 to 2013, the CBDC Model was used to develop estimates of available delivery capacity for the Coastal Branch. Available delivery capacity for the month of November was assumed to be zero as the Coastal Branch is typically shut-down this month for maintenance activities. The estimates of available delivery capacity were calculated for the average 10-year (2004-2013), 5-year (2009-2013), wet year (years when allocation is greater than 60%) and dry year (years when allocation is less than 60%) periods, and are summarized in Table 3-14. Calculations for available capacity considered all deliveries upstream of the point of delivery for that particular reach. Based on this analysis, it's recommended that the supply options implemented not exceed the excess capacity listed in the below table.

Table 3-14: SWP Coastal Branch Excess Capacity by Reach

Reach	10-Year Avg AFY)	5-Year Avg (AFY)	Dry Year Avg (AFY)	Wet Year Avg (AFY)
Chorro Valley Turnout	31,173	32,393	33,706	28,639
Lopez Turnout	30,742	31,857	33,262	28,222
Guadalupe Turnout	29,650	30,748	32,051	27,248
Santa Maria Turnout	29,204	30,224	31,490	26,919
Golden State Water Company	18,211	18,271	18,088	18,334
Vandenberg AFB Turnout	13,414	13,491	13,255	13,573
Buellton	9,512	8,971	8,527	10,497
Solvang	9,234	8,580	8,083	10,385
Santa Ynez	8,332	7,596	7,096	9,569
Santa Ynez PP	11,164	10,338	9,404	12,925
Cachuma	11,164	10,338	9,404	12,925

An analysis was also conducted for the available capacity in the South Coast Conduit, which provides imported water throughout the South Coast area using water that flows through the Tecolote Tunnel from Lake Cachuma, as well as deliveries from Gibraltar and Jameson Reservoirs. In order to estimate the available capacity of the South Coast Conduit, annual delivery data from Lake Cachuma to South Coast water suppliers for the period of October 2003 through October 2013 was compared against the capacity of the Tecolote Tunnel. The average excess capacity for this time period was estimated to be 45,962 AFY. The excess capacity of the South Coast Conduit downstream of the Tecolote Tunnel requires additional information on the capacity of each of the reaches and deliveries from Gibraltar and Jameson Reservoirs, which were not available for this analysis. For the purpose of this Report it is assumed that flows delivered through the Tecolote Tunnel may be routed to the various South Coast water agencies through the existing South Coast Conduit facilities and distribution system interties. It's recommended that imported supply options that will deliver water to the South Coast not exceed the 45,962 AFY of capacity available. It should also be noted that the timing of SWP deliveries must be considered as SWP water would not be delivered to Lake Cachuma during times with the Lake is spilling as the supply would be lost.

Based on the above analysis, capacity is available in the Coastal Branch for delivery of the unused SWP supplies discussed in Chapter 2, and are summarized in Table 3-15.

Table 3-15: State Water Project Unused Supply Options

Option	Supply Volume (AFY)
SB Undelivered SWP	7,500
SB Suspended Table A	8,000
SLO Undelivered SWP	3,400
SWP Article 21	5,000
SWP Turnback Pools	600

Cost Sensitivities and Implementation Considerations for State Water Project Unused Supply Options

The costs of importing additional water into the Region are based primarily on the assumed unit cost to purchase the water as well as the end use of the water (recharge or direct use). The options to access undelivered SWP water allocations to Santa Barbara and San Luis Obispo County agencies for direct use include only the fees charged by DWR to deliver imported water. The primary cost driver for unused SWP imported water is the assumed increase in DWR's SWP rates per year. The imported water costs for this Report assumed a 25-year average of escalated costs (at 3%) through 2040 (not including inflation) to better reflect anticipated costs relative to other option costs. Changes in the escalation rate assumptions would lead to changes in the estimated cost of imported water over the life of the project. It's assumed that existing infrastructure will be used for delivery, based on the capacity analysis described above. The cost of Suspended Table A undelivered water is the cost to be included by CCWA in a proposal letter to DWR for re-acquisition of Suspended Table A supplies. The cost of Article 21 and Turnback Pool undelivered water was assumed to be equal to the cost of undelivered SWP water to Santa Barbara County.

A number of implementation considerations apply to unused SWP supplies. First, if the Table A Allocation for a given year is not fully delivered to a SWP contractor, then the remaining volume may be stored in San Luis Reservoir as carryover water. However, if the reservoir spills, carryover water will be lost. In such a spill event, SWP Contractors may purchase Article 21 water with the condition that the contractor takes delivery of the Article 21 water during the spill event. The amount of Article 21 water available is the volume of the spill and will be allocated based on the Table A amount of the SWP Contractors requesting the Article 21 water.

In addition, the current SWP Contract prohibits a direct non-permanent sale of SWP water from one contractor to another. Exchanges between contractors are allowed, with approval from DWR. The exchange may be 1:1 or may be uneven exchanges, depending on the specific deal. Any unit cost needs to be based on an operational justification due to this prohibition.

In the case of the Turnback Pool, which facilitates water sales from one SWP Contractor to another. However, the revenue per acre-foot to the Contractor selling through the Turnback Pool is inconsequential when compared with direct Contractor to Contractor exchanges. Turnback Pool supplies are not expected to be available in the future as the value of water outweighs DWR's reimbursement for turning back supplies.

In the case of Suspended Table A water, CCWA is actively pursuing the reacquisition of this water, although DWR has not confirmed Santa Barbara County's exclusive rights to it. In the case that Suspended Table A supplies are acquired by Santa Barbara County in order to supply water to an entity that is not currently a SWP contractor, additional infrastructure considerations must be made. This requires the formation of a new SWP subcontractor and reimbursement to existing SWP subcontractors for a portion of their infrastructure and debt service to DWR and CCWA. Determination of costs for buying-in to the SWP and Coastal Branch systems will require negotiations between the new subcontractor and these entities.

Acquisition of SLO undelivered SWP water requires negotiations with San Luis Obispo Flood Control and Water Conservation District to develop exchange or a potential future transfer program, which will require DWR approval. The same considerations will apply to this option as applies to undelivered Santa Barbara County SWP supplies.

Finally, in all cases, timing must be considered for imported water deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply.

Note that all imported water options described in this will require treatment, and it's assumed that treatment will be available at existing WTPs. Should WTP expansion be necessary, unit costs will be increased.

Options that will import water from within the State could be implemented in less than 5 years.

Non-State Water Project Unused Supply Options

Non-SWP unused supply options fall under two categories: supplies from within the state and supplies from outside the state.

As discussed in Chapter 2, non-SWP imported water supplies from within the state can include transfers with SWP contractors, federal/Central Valley Project contractors, and individual water rights holders. Non-SWP supplies could potentially be obtained and wheeled through SWP facilities. Transfers are potentially available in annual, short-term, and long-term agreements. There are numerous examples of water transfers throughout the state, with both north of Delta and south of Delta water agencies. Given that opportunities for these types of supply transfers are dependent upon timing and negotiations with individual right holders as well as SWP capacity, it was not possible to determine a volume of unused supply that may be available through this imported water source. For comparison purposes however, 6,000 AFY is used as a volume in this report for comparison to other non-SWP imported water options.

The Colorado Basin Study (USBR, 2012) was used to make assumptions on the options for conveying various forms of imported supply from out of state areas into Southern California.

Alaskan Icebergs: This option would require a tugboat to physically tug an iceberg from Alaska to a port in California. At the port, facilities would be in place to capture the melt water, and tie-in to SWP infrastructure so water can be conveyed directly to the Region or indirectly through in-lieu SWP exchanges with other partners also on the SWP system.

Alaskan Rivers: Conveyance of fresh water from Alaska would require either tankers (or tugboats with water bags) to physically move supplies to a port in California. Water bag transport, or Spraggs Bags, involves storing diverted water in large inflatable bladders, then towing them on the ocean using tug boats. The water bags will float in the ocean since fresh water is lighter than sea water. At the port, facilities would be in place to capture the water, treat and tie-in to SWP infrastructure so water can be conveyed directly to the Region or indirectly through in-lieu SWP exchanges with other partners also on the SWP system.

Columbia River: Conveyance of water from the Columbia River would require either a 1,000 mile, 144-inch sub-ocean pipeline from Oregon or the use of water bag transport to a port in California to receive the water. At the port, facilities would be in place to capture the water and tie-in to the SWP infrastructure so water can be conveyed directly to the Region or indirectly through in-lieu SWP exchanges with other partners also on the SWP system.

Mississippi and Missouri Rivers: Conveyance of water from the Mississippi or Missouri Rivers would require construction of a 144-inch diameter pipeline between 700 miles (Missouri River) and 1,000 miles (Mississippi River) long and pump stations. Once in Southern California, the conveyance would connect to SWP infrastructure for wheeling through the system. This size pipeline could convey up to 600,000 AFY of water, but this could be increased by adding pipelines.

Table 3-16 provides a summary of the non-SWP imported water options and supply volumes.

Table 3-16: Non-State Water Project Imported Water Options

Option	Supply Volume (AFY)
Undelivered CA Imports (Direct use or GWR)	Not known
Alaskan River	6,000
Alaskan Icebergs	2,000
Columbia River	6,000
Missouri River	6,000
Mississippi River	6,000

Cost Sensitivities and Implementation Considerations for Non-SWP Unused Supply Options

The costs of importing additional water into the Region are based primarily on the assumed unit cost to purchase the water as well as the end use of the water (recharge or direct use). Cost estimates for California non-SWP imported water include the cost to lease (temporarily purchase water rights), transfer and treat the supply. Lease cost estimates are based on recent lease agreements but are expected to vary according to the water market and based on costs presented in DWR's *Bulletin 132* for the wheeling of water through the SWP system. The cost of options that use imported water from outside California, including water from the Alaskan icebergs and the Alaskan, Columbia, Missouri and Mississippi rivers are all based on costs developed as part of the *Colorado River Basin Water Supply and Demand Study.*

Implementation of in-state, non-SWP supply options will require identification and negotiation with water rights holders, and transfers may be subject to litigation through environmental review. In addition, these types of water transfers are typically from non-SWP Contractors, and are almost exclusively from agriculture operations north of the Delta. DWR has curtailment programs with senior water rights holders to limit the percentage of land that can be fallowed for water transfers.

Implementation of out-of-state imported water options will require extensive extra-regional participation due to the magnitude of supplies (up to 600,000 AFY) and capital costs (over $10 billion) to make these options economically viable. These projects would take decades of national and interstate planning, permitting, design and implementation. The technical feasibility of these options may also be characterized as relatively low since such operations at this scale are largely unprecedented.

Note that all imported water options described here will require treatment, and it's assumed that treatment will be available at existing WTPs. In addition, these options assume there will be demand for imported water for direct use in the future to take advantage of capacity in existing conveyance facilities.

Options that will import water from within the State could be easily implemented in less than 5 years. However importing water from outside of California is expected to include additional major transfer agreements and infrastructure and could not be expected to be completed within 10 years.

Conclusions

Figure 3-7 and Table 3-17 provide a summary of the supply volume, unit costs and implementation timeframe of each of the options that are within the Project's thresholds of having a unit cost below $3,000/AFY and able to produce additional supply volumes above 2,000 AFY (based on average yield). As a result, these are the more attractive supply options that are recommended for further consideration for implementation as they reflect the greatest potential at a regional level. Table 3-18 provides a summary of the options that were explored as part of this Project, but did not meet the higher level cost and volume thresholds. For additional cost information, please see the Technical Memorandums prepared in support of this Report.

Visible on the figure are some options that appear to have similar volumes, including the Santa Barbara undelivered SWP for Direct Use option and three undelivered California import options. These similar volumes are due to the assumption that, for the purposes of cost estimation, the same volume of undelivered California imports (which represent non-SWP imported water from within the state) will be obtained in volumes similar to the volume of water available through undelivered Santa Barbara County SWP water supplies. These supplies could, however, be obtained in higher or lower volumes depending on the imported water market.

Options that will import water from outside the state were not included in these featured options due to the high unit cost of implementation, all of which exceed the $3,000/AF threshold.

Based on historical deliveries of water and research of other potential supplies, the Region has opportunities to maximize its imported water use. Historically, the Region hasn't imported the full amount of Table A water that it was allocated, which could potentially be available to the Region in the future as supply in wet years or available now as carry-over supply in the San Luis Reservoir. In addition, the Region could take advantage of Article 21 or Turnback Pool water from the SWP. Acquiring suspended Table A water is the most expensive form of in-state imported water and should probably be considered as a latter increment of supply.

Importing water from outside the state has significant implementation challenges and cost impacts. Acquiring out-of-state water will require significant infrastructure as well permitting and regulatory requirements that may vary from state to state. Finally, the acquisition of out-of-state supplies is only cost-effective if very large quantities are imported (up to 600,000 AFY, according to USBR's Colorado Basin Study) with significant capital costs, and shared among a number of project partners. The supply would also assume to have significant reliability challenges.

Figure 3-7: Imported Water Options for Regional Consideration

Note: These options assume there will be demand for imported water for direct use in the future.

Table 3-17: Imported Water Options for Regional Consideration

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
SB Undelivered SWP for Direct Use	7,500	$1,700	<5 years
SB Suspended Table A	8,000	$600	<5 years
SLO Undelivered SWP	3,400	$650	<5 years
SWP Article 21	5,000	$400	<5 years
Undelivered CA Imports, Short-Term Agreement	6,300	$1,800	<5 years
Undelivered CA Imports, High Cost Long-Term Agreement	6,300	$1,600	<5 years
Undelivered CA Imports, Low Cost Long-Term Agreement	6,300	$1,000	<5 years

Table 3-18: Other Imported Water Options Considered, But Not Meeting Project Thresholds

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Undelivered Non-SWP CA Imports	Not known	$900-$1,700	<5 years
Alaskan River	6,000	$4,600-$4,900	>10 years
Alaskan Icebergs	2,000	$4,600	>10 years
Columbia River	6,000	$5,600	>10 years
Missouri River	6,000	$3,100	>10 years
Mississippi River	6,000	$4,000	>10 years

3.4 Groundwater Recharge and Storage

Groundwater recharge and storage is a common way to store unused recycled water, stormwater and imported water for later use, this can include conjunctive use, which is the storage of surface water in a groundwater basin in wet years and withdrawing it in dry years. Two methods are available for recharge of groundwater basins: spreading and injection. To recharge through spreading, water supply is spread over an area (often a basin with embankments to allow for more water to be captured) and allowed to percolate through the soil to the aquifer. To recharge through injection, a well is drilled down to the aquifer, and water is injected into the well to directly enter the aquifer. All groundwater recharge projects must either maintain or improve upon existing groundwater water quality. Water that is injected into an aquifer must be treated prior to recharge. Water that is recharged through spreading allows for soil aquifer treatment as it infiltrates naturally into an aquifer and does not require as high a level of water quality or treatment.

In addition, some groundwater basins or some areas of groundwater basins are not suitable for recharge due to a number of factors such as geology, high groundwater levels, and groundwater quality. To help refine potential groundwater recharge options, the Project conducted an analysis to determine areas with the highest potential for favorable groundwater spreading by looking at existing groundwater basin storage potential and recharge zones.

Basin Storage Potential

An analysis of groundwater storage potential was performed based on previous studies of each groundwater basin within the County. In cases where storage potential could not be characterized based on previous studies, an analysis of historic groundwater levels was conducted to estimate this potential based on the following equation:

Storage Potential = Historical Maximum Storage – Current Storage

For the purpose of this Project, groundwater storage potential is characterized based on the following factors and summarized in Table 3-19:

- Total basin storage capacity
- Useable basin storage capacity based on well depths and/or sea level
- Dewatered basin storage
- Safe yield and perennial yield

Table 3-19: Groundwater Storage Potential

Storage Potential	Groundwater Basins
High >100,000 AF	Santa Maria, San Antonio, Cuyama, Santa Ynez Upland
Medium 10,000 – 100,000 AF	Lompoc Plain, Santa Rita Upland, Santa Ynez River Alluvium, Goleta Basins, Montecito Basins
Low <10,000 AF	Lompoc Terrace, Buellton Upland, Santa Barbara Basins, Carpinteria Basins

Recharge Potential Zone Analysis

The volume of the unused supply available for groundwater recharge varies greatly relative to its source. The maximum potential size of the recharge facilities will, therefore, need to be correlated to the peak timing of the supply that is intended to be recharged. The largest variability occurs with local surface/stormwater peak flow unused supply, where in some years there could be only one or two days of large peak flows. As a result, recharge facility siting and sizing is the primary consideration in determining the volume of water than may be captured and stored within the basin.

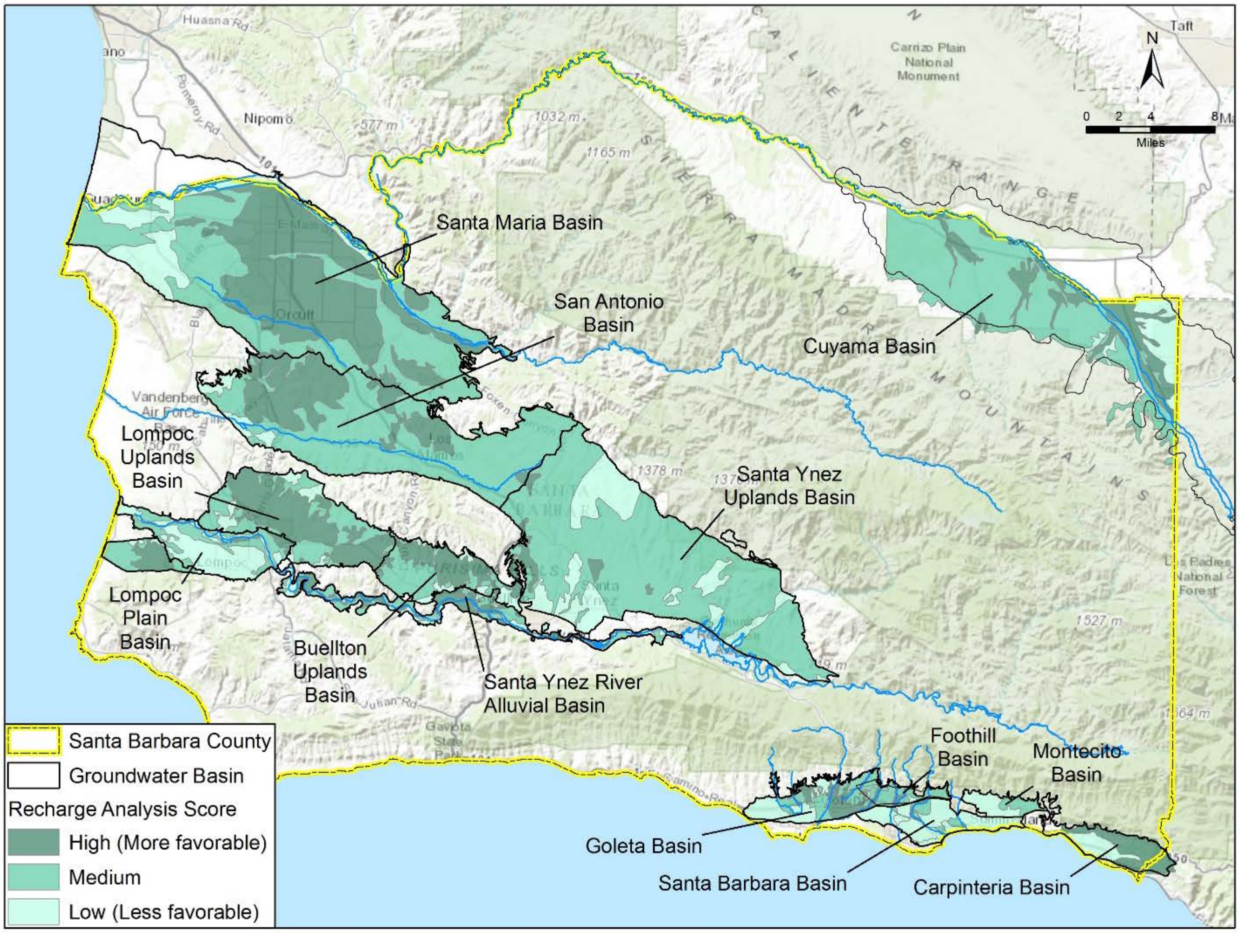
In order to determine areas suitable for surface spreading for groundwater recharge, the Project conducted a recharge zone analysis. The recharge zone analysis used GIS layers representing two main criteria (groundwater depth and hydrologic soil type) to determine areas of high, medium and low recharge potential. Recharge potential characterized through previous studies of groundwater basins was incorporated into this analysis when possible. Figure 3-8 provides the resulting map of basin recharge potential for the Region. It should be noted that the Figure represents a high level analysis and that a more detailed site specific analysis would need to be conducted prior to selecting any site for a recharge facility.

For this analysis, infiltration rates were applied to the recharge areas based on relative infiltration rate for hydrologic soil groups utilized in the Stormwater Capture Potential in Urban and Suburban California Natural Resources Defense Council (NRDC) Study (NRDC, 2014). Table 3-20 provides a summary of these infiltration rates. Though not considered here, the timing of supply availability relative to basin capacity will need to be defined in future specific feasibility studies.

Table 3-20: Recharge Zone Infiltration Rates

Recharge Zone Potential	Infiltration Rate (ft/day)	Associated Hydrologic Soils Group
High	0.6	A/B
Medium	0.3	B/C
Low	0.1	C/D

Figure 3-8: Recharge Zone Analysis Results



Spreading Facilities

In order to better characterize spreading facility options, particularly unit cost, the sizing and general locations of spreading ground facilities were determined based on the above described analysis in conjunction with available supplies. Generally, imported water and recycled water were assumed to be available for recharge for a majority of the year, allowing for spreading ground facilities to be sized based on average annual flows. Since stormwater flows occur mainly as peak event flows, spreading facilities would need to be sized to accommodate as much of the peak flows when they occur as possible. Therefore, each river system requires a separate and specific analysis based on the event type such as flood release, spill event, or storm event to determine spreading facility needs as shown in Table 3-21.

Table 3-21: Event Type Characterization

Event Type	Event Duration Definition	Event Duration (days)	Event Intensity Definition	Event Intensity (AFD)
Twitchell Flood Release	Average flood release duration	3	Average flood release	19,000
Cachuma Spill Event	Average Spill Event duration	60	Average spill event	2,700
Other River/Stream Storm Flows	Duration of month with largest unused supply	28-31	Average monthly unused supply	varies

A spreading facility size was calculated based on the average event duration and unused supply, the required recharge capacity to capture an entire event's flow, and the infiltration rate of the area of recharge. A high level siting analysis was performed to identify potential areas for groundwater recharge and establish its associated infiltration rate. The following factors were considered:

- **Recharge Potential:** Prioritizing high recharge potential
- **Topography:** Only relatively flat areas were considered
- **Land Use:** Open space, pasture land, and farm land were considered in this order of priority
- **Proximity to Diversion:** Prioritizing close proximity

In several cases physical constraints such as available land and associated infiltration rate limited the volume that could be captured from an event. A detailed siting analysis must be performed in order to determine the feasibly of implementing a spreading ground facility since the potential for acquiring land for this use is unknown. An alternative to developing spreading basins is to remove concrete from lined river channels to allow stormwater to percolate in the stream beds, as has been studied on Santa Monica Creek. Another alternative to developing spreading basins is to implement "mini-dams" to slow the flow for in-stream recharge, however, this would need to be evaluated on a stream by stream basis to quantify its potential.

As an alternative to constructing spreading grounds, agricultural farm land may be utilized for groundwater recharge by over-irrigation during the winter months or non-irrigation season. Implementing such a program provides the benefit of maximizing the use of large plots of land for a period during which they would otherwise remain unused. It is assumed that the combination of pressurized conveyance and gravity canal distribution systems must be constructed as well as site specific modifications to irrigation systems in order for farmers to receive this new surface water source. Since much of the land identified for use as potential spreading grounds lies within agricultural land use zones, it assumed that either engineered spreading grounds and/or agricultural over irrigation programs may be implemented to capture unused supplies.

Injection Wells

Relative to spreading facilities, injection wells have a small footprint and do not depend on a favorable recharge zone location. Given that a higher quality of water is required for injection, it is assumed that injection wells will be only used for recharging advanced treated recycled water or treated imported water, but not for raw stormwater recharge.

Maximum Recharge Facility Estimates and Groundwater Recharge Options

Based on the above analyses, the maximum recharge facility sizes and groundwater recharge options were developed. The following is a discussion of the stormwater recharge options and recycled water/imported water options.

Stormwater Recharge Options

Table 3-22 shows the maximum stormwater spreading options that could be implemented to capture unused stormwater supplies within each river watershed. These options reflect the maximum size needed for recharge facilities within the Region based on the unused stormwater supply described in Chapter 2 as well as any physical limitations of the facilities required to capture such supplies.

Table 3-22: Stormwater Recharge Options

Source	Event Year Frequency	Maximum Event Year Supply Available	Area Required to Capture Supply Volume	Supply Capture
Santa Maria River	1 in 10 years	58,000 AF	18,000 acres	5,800 AFY
Sisquoc River	3 in 10 years	31,000 AF	800 acres	9,500 AFY
San Antonio Creek	3 in 10 years	4,800 AF	250 acres	1,400 AFY
Cuyama River	3 in 10 years	14,700 AF	300 acres	4,400 AFY
Santa Ynez River	4 in 10 years	140,000	5,000 acres	40,000 AFY[1]
San Jose Creek	3 in 10 years	7,080	100 acres	1,000 AFY[1]
Carpinteria Creek	3 in 10 years	10,100	200 acres	3,000 AFY
Santa Monica Creek (concrete channel delining)	n/a	n/a	n/a	200 AFY

1. Recharge assumed limited by available acreage.

It should be noted that recharge facilities are sized for the total available unused supply unless constrained by physical limitations on lands overlying the targeted groundwater basins with storage potential. Facilities could be sized to capture lower volumes, which would therefore yield lower annual average supplies. This analysis is intended to represent the upper limit of what may be achieved through groundwater recharge regardless of cost or other considerations that may further constrain the potential for implementation.

Cost Sensitivities and Implementation Considerations for Stormwater Recharge Options

The unit costs estimated for the surface water spreading options include river diversion structures, spreading grounds, land purchase, canals and pump stations. Given the peaky and infrequent nature of storm events, the ability to capture and recharge the maximum levels of unused storm flows identified will require even greater areas of land and therefore have an increased unit costs since the land purchased will not be used for supply purposes the majority of the time. Cost estimates for a range of recharge volumes were estimated to allow for less water to be recharged and therefore less land to be required.

All spreading basin costs first estimated the acreage needed to recharge the given volume of water supply and then applied a unit cost estimate for the construction of spreading basins. An assumed cost of land per acre was then applied to that acreage.

This Report assumes that existing well capacity is available to recover the water that has been recharged. Costs for additional wells or treatment are not included in the unit costs described below.

The primary cost drivers for groundwater recharge include the volume and type of water to be recharged, and land cost. Excess stormwater flows present in isolated and infrequent peak events can greatly impact the unit costs of the supply – particularly in the case of diversions, pump stations and spreading grounds. Land cost for spreading is a major cost driver for these options as well. Recharging thousands of acre feet of water requires hundreds of acres of spreading basins. The cost of agricultural and vacant land, which are assumed to be purchased for spreading basins, is four to five times higher in the South Coast than other subregions.

In addition to the above cost considerations, implementation of stormwater could require securing water rights for diversion, particularly for those rivers that may provide passage for steelhead spawning and rearing habitat, such as the Sisquoc River and Santa Ynez River. Land agreements must also be secured for those options that will spread stormwater in agricultural areas during the non-irrigation season, though this could be challenging given that some agricultural land owners grow crops year-round. For larger increments of recharge, particularly in the case of the Santa Maria River, large infrastructure is needed and will be used infrequently.

The implementation timeframe for groundwater recharge options is dependent on the size of the project and the type of supply. Recharge of low volumes of stormwater are assumed to be implementable within five years given that less construction will be necessary and that stormwater recharge is also common in the State. Higher volumes of stormwater that will require significant facility construction and potential land purchase are assumed to take longer, 5-10 years for mid-range supply volumes and over 10 years to implement recharge of maximum supply volumes.

Recycled Water and Imported Water Recharge Options

To determine the area of spreading facilities necessary to use recycled water for IPR, it is assumed that a total recharge volume of up to five times the tertiary recycled water used must be infiltrated to allow for the diluent (either local or imported surface) water blending requirements equal to 1 part recycled water to 4 parts diluent water. It is assumed that if the recycled water is injected it will have already been advanced treated and therefore can be injected without diluent requirements. Recharge facility volumes for unused recycled water and imported water supplies are summarized in Table 3-23.

Table 3-23: Recycled Water and Imported Water Recharge Options

Treatment Plant Operator	Supply for Surface Spreading (AFY)	Supply for Injection Wells (AFY)
Recycled Water		
Laguna County Sanitation District	5,540	4,700
City of Guadalupe	1,100	930
Lompoc Regional Wastewater Reclamation Plant	4,400	3,700
Goleta Sanitary District	7,600	6,500
City of Santa Barbara	7,500	6,600
Montecito Sanitary District	1,000	850
Carpinteria Sanitary District	1,800	1,530
Cuyama Community Services District	0	50
Imported Water		
Unused SWP supplies	7,500	75

Cost Sensitivities and Implementation Considerations for Recycled Water and Imported Water Recharge Options

The unit costs estimated for recycled water recharge include: wastewater treatment plant (WWTP) upgrades, brine disposal, conveyance to brine disposal, injection wells or spreading basins, conveyance to injection wells or spreading basins, and land purchases. The WWTPs in the Region treat to varying levels, ranging from secondary to tertiary treatment. Given that the recycled water options were organized according to WWTP, each recycled water option cost varied according to the need to upgrade the WWTP and where possible was scaled by the volume of recycled water to be produced.

The unit costs estimated for imported water include: water supply costs, conveyance to injection wells or spreading basins, and land purchases.

All spreading basin costs first estimated the acreage needed to recharge the given volume of water supply and then applied a unit cost estimate for the construction of spreading basins. An assumed cost of land per acre was then applied to that acreage.

New injection wells to recharge the groundwater basins were assumed to be needed for all these options Based on standard costs for wells and connections to existing facilities.

This Report also assumes that existing well capacity is available to recover the water that has been recharged. If existing recovery capacity is not available and new wells need to be constructed, this would increase costs by approximately $200/AFY.

Implementation of options that will recharge groundwater with recycled water must also consider regulatory issues, including groundwater travel time between recharge areas (spreading or injection) and groundwater pumping wells, dilution requirements for spreading grounds (not required for injection wells given that the water will be advanced treated), and the need to ensure additional groundwater pumping is approved within the management structure of groundwater agreements or a greater understanding of groundwater basins in those areas where detailed agreements aren't in place. In the case of injection with recycled water, the regulatory approval process entails extensive requirements and may take up to 2 years to complete. The environmental impacts of reducing effluent flow to local rivers must also be considered in some areas, such as San Miguelito Creek in Lompoc.

Implementation of options that will recharge imported water require the use of SWP infrastructure to convey banked groundwater when Table A SWP supply is unavailable, and a basin management framework (supported by the Sustainable Groundwater Management Act [SGMA]) will be needed to secure a local water bank. Banking of undelivered imported water supplies closer to demands may be more secure than banking undelivered supplies at a remote location.

Recharge of recycled and imported water must also consider available capacity in the groundwater basins, particularly during wet years, and would be defined in future specific feasibility studies.

The implementation timeframe for groundwater recharge options is dependent on the size of the project and the type of supply. For imported water and recycled water recharge projects, it is assumed that projects can be implemented within five years given that recharge of these types of supplies is already common in the State.

Conclusions

Figure 3-9 and Table 3-24 provide a summary of the supply volume, unit costs and implementation timeframe of each of the options that are within the Project's thresholds of having a unit cost below $3,000/AFY and able to produce additional supply volumes above 2,000 AFY (based on average yield). As a result, these are the more attractive supply options that are recommended for further consideration for implementation as they reflect the greatest potential at a regional level. Table 3-25 provides a summary of the options that were explored as part of this Project, but did not meet the higher level cost and volume thresholds. For additional cost information, please see the Technical Memorandums prepared in support of this Report.

Some stormwater recharge options do not appear on Figure 3-9 due to the high unit cost of recharging higher volumes of water. This is due to the cost for purchasing significant acres of land for recharge or the distance needed to convey the water to reach a suitable recharge area which may require significant infrastructure construction, particularly recharge of water from the Santa Maria River.

A majority of the groundwater recharge options discussed previously fall within the unit cost and volume thresholds to be considered featured projects. This is due to the great potential in the area for use of groundwater basins for recharge. These costs include the assumption that stormwater can be obtained for no cost, while imported water supply will cost the same as it costs to acquire it for direct use, and recycled water supplies include the cost of treatment. This is evident in the figure as some of the lowest cost options are those that will recharge stormwater. Stormwater options that will recharge in agricultural fields have particularly low unit costs as these options do not require land purchase and are assumed to require no excavation (as is required for construction of spreading basins).

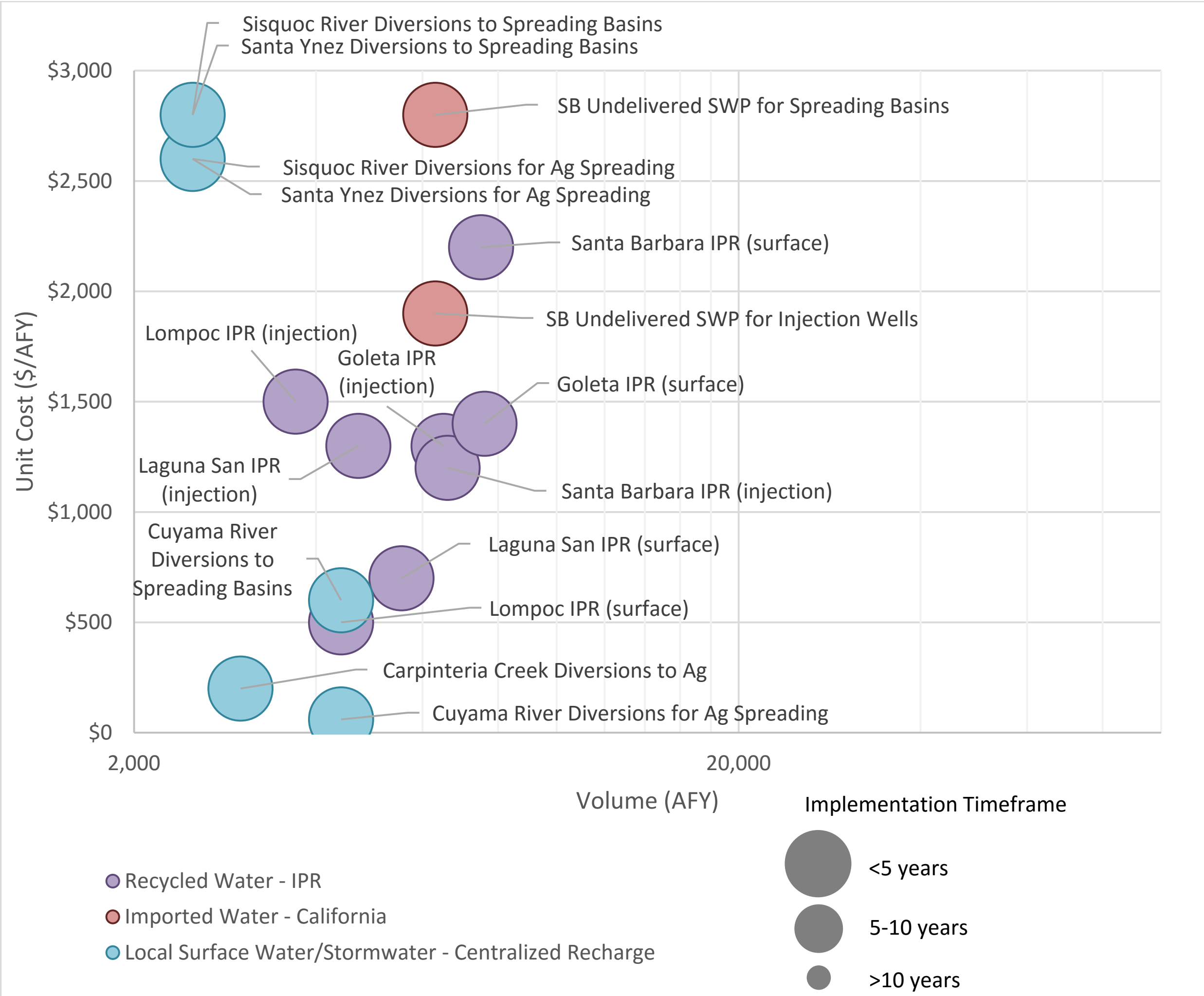
As shown in Figure 3-9, groundwater recharge options could be implemented within five years, but options that may recharge larger volumes of water could take a longer time period due to the need to acquire large areas of land and construct extensive infrastructure to convey the water to recharge areas.

As is evident above, the Region has a number of opportunities for recharge and storage of local stormwater, imported water and recycled water. Not only do these types of options provide a general supply benefit that allows the Region to utilize its unused supplies, but they help to provide a drought-resistant supply that will allow the Region to pump from groundwater storage during times of long-term drought that reduce local surface water and imported water supplies. These options will also help to comply with SGMA sustainability goals and eliminate evaporative losses associated with surface storage.

There are, however, some significant implementation considerations that will need to be addressed prior to implementing a recharge project. The recharge of stormwater will require acquisition of diversion rights, recycled water will require permitting and monitoring to ensure water quality requirements are met and imported water availability may be difficult to predict. Hydrogeological studies will also be needed to ensure that local groundwater basins have the ability to retain stored water. Finally, to allow for water storage and recovery in local groundwater basins, a basin management framework (supported by SGMA) will be needed to secure a local water bank.

Recharge of local water supplies could also open up opportunities for imported water exchanges, which will be discussed further in Chapter 4. Overall, the recharge of each type of water supply can be accomplished for a reasonable unit cost and within a reasonable timeframe, and will help the Region to prepare for future droughts and create supply exchange opportunities.

Figure 3-9: Groundwater Recharge and Storage Options for Regional Consideration



Note: Costs do not include additional groundwater wells or treatment.

Table 3-24: Groundwater Recharge and Storage Options for Regional Consideration

Option	Supply (AFY)	Unit Cost ($/AF)[1]	Implementation Timeframe
Recycled Water – IPR			
Laguna San IPR (injection)	4,700	$1,300	<5 years
Laguna San IPR (surface)	5,540	$700	<5 years
Lompoc IPR (injection)	3,700	$1,500	<5 years
Lompoc IPR (surface)	4,400	$500	<5 years
Goleta IPR (injection)	6,500	$1,300	<5 years
Goleta IPR (surface)	7,600	$1,400	<5 years
Santa Barbara IPR (injection)	6,600	$1,200	<5 years
Santa Barbara IPR (surface)	7,500	$2,200	<5 years
Stormwater/Surface Water – Centralized Recharge			
Sisquoc River Diversions to Spreading Basins	2,500	$2,800	<5 years
Sisquoc River Diversions for Ag Spreading	2,500	$2,600	<5 years
Carpinteria Creek Diversions to Ag	3,000	$200	<5 years
Santa Ynez Diversions to Spreading Basins	2,500	$2,800	<5 years
Santa Ynez Diversions to Ag Spreading	2,500	$2,600	<5 years
Cuyama River Diversions for Spreading Basins	4,400	$600	<5 years
Cuyama River Diversions for Ag Spreading	4,400	$60	<5 years
Imported Water – California (Recharge)			
SB Undelivered SWP for Spreading Basins	6,300	$2,800	<5 years
SB Undelivered SWP for Injection Wells	6,300	$1,900	<5 years

1. Costs do not include additional groundwater wells or treatment.

Table 3-25: Other Increase Groundwater Recharge and Storage Options Considered, But Not Meeting Project Thresholds

Option	Supply (AFY)	Unit Cost ($/AF)[1]	Implementation Timeframe
Recycled Water – IPR			
Guadalupe IPR (injection)	930	$1,500 - $1,900	<5 years
Guadalupe IPR (surface)	1,100	$1,900	<5 years
Cuyama IPR (injection)	50	$6,900-$9,700	<5 years
Montecito IPR (injection)	850	$1,400	<5 years
Montecito IPR (surface)	1,000	$2,300	<5 years
Carpinteria IPR (injection)	1,530	$1,200	<5 years
Carpinteria IPR (surface)	1,800	$2,200	<5 years
Stormwater/Surface Water – Centralized Recharge			
Santa Maria Diversions to Spreading Basins	400-3,300	$15,300-$45,700	Varies depending on volume recharged
Santa Maria Diversion for Ag Spreading	3,300	$5,500-$35,900	Varies depending on volume recharged
Santa Maria River In-Stream Recharge Enhancements	Unknown	No costs estimated	<5 years
San Antonio Creek Diversions to Spreading Basins	1,400	$1,000	<5 years
San Antonio Creek Diversions for Ag Spreading	1,400	$80	<5 years
San Antonio Creek In-Stream Recharge Enhancements	Unknown	No costs estimated	<5 years
San Jose Creek Diversions to Spreading Basins	1,000	$6,200	5-10 years
San Jose Creek Diversions for Ag spreading	1,000	$2,900	5-10 years
Carpinteria Creek Diversions to Spreading Basins	3,000	$4,800	5-10 years
Santa Monica Creek concrete channel de-lining	200	No costs estimated	<5 years

1. Costs do not include additional groundwater wells or treatment.

3.5 Ocean Desalination Plants

The primary facilities required for ocean water desalination are an intake, a brine outfall, a treatment plant, and a product water tie-in to a potable water distribution system. To develop desalination plant options, previous ocean desalination studies were researched and potential new plant siting analyses were conducted. Identification of potentially favorable zones for ocean desalination plant construction looked at leveraging existing WWTP outfalls and/or optimal geologic conditions for subsurface ocean water intakes. A summary of potential ocean desalination plant concepts developed as part of this Report is provided in Table 3-26.

Table 3-26: Potential Ocean Desalination Plants

Plant Description	Plant Capacity (MGD)	Average Annual Supply (AFY)	Additional Information
Southern San Luis Obispo Local Desalination Plant	8	6,300	• New plant concept based on previous water supply alternatives study by Nipomo Community Services District • Supply generated would free up Santa Maria supplies for local use, transfer, and/or exchange • Capacity based on projected Nipomo local demands
Southern San Luis Obispo Regional Desalination Plant	23	26,000	• Derived from Nipomo local concept • Capacity based on constraint imposed by Nipomo Pipeline capacity and Nipomo local demands
San Antonio Regional Desalination Plant	13	14,400	• New Plant concept based on central location for regional distribution • Capacity is constrained by SWP pipeline capacity and VAFB local demand
Gaviota Chevron Desalination Plant	0.41	460	Limited information exists on operational status, expansion potential and brine outfall capacity
Existing Santa Barbara Desalination Plant	9	3,100	• Permitted for up to 10,000 AFY • Local policy is currently limited to emergency use • Improvements required for operation • Improvements currently in design
Santa Barbara Desalination Plant	9	10,000	• Potential supply based on hydraulic capacity • Additional equipment/improvements required for ultimate capacity
Santa Barbara Regional Desalination Plant	29	33,000	• Maximum regional capacity of 33,000 AFY is based on local M&I demands • Potential significant improvements required for ultimate capacity • New intake system • Plant site expansion
Montecito Local Desalination Plant	2.5	2,800	• Based on Montecito Water District Feasibility Study • Various sites and facilities evaluated • Potential opportunity to utilize Montecito Sanitary District outfall
Mobile Marine Desalination Plant	Not available	56,000	• Capacity based on previous study concept under development by Water Standard • Not yet operational but claims to be ready for service within 14 months • Proposal prepared for Monterey

Ocean desalination plants require an ocean intake for conveying ocean water to the treatment plant and an outfall for discharge of concentrated brine that is produced as a byproduct of treatment. Utilizing an existing WWTP effluent outfall for discharge of brine is a preferred alternative to constructing a dedicated outfall, since blending brine with effluent provides dilution of relatively high salt concentrations. Dilution brings concentrations to a level that may be closer to that of ambient seawater, therefore limiting potential impacts to the marine environment.

Another option for achieving preferred dilution levels is to implement subsurface outfalls, which involve injecting the brine underground instead of releasing it to the ocean. Subsurface outfalls are generally used in areas where fresh water aquifer systems extend beneath the ocean floor to a point where subsurface discharge of brine may mix with this fresh water at the aquifer system's interface with seawater.

An analysis of existing wastewater effluent outfalls was conducted in order to assess the potential for leveraging existing facilities for dilution. Table 3-27 provides a summary of potential outfall options based on this analysis.

Table 3-27: Potential Desalination Outfall Capacities

Plant	Outfall Description	Outfall Capacity (MGD)	Excess Capacity[1,2] (MGD)	Outfall Size (inches)
Southern SLO Local	New outfall	7[3]	N/A	16
Southern SLO Regional	New outfall	23[3]	N/A	20
San Antonio Regional Desal	Potential dedicated brine outfall	15[3]	N/A	20
Gaviota Chevron Desal	Existing	Unknown	Unknown	Unknown
Santa Barbara	Existing dual outfall	28	21	24
Montecito Local Desal	Proposed dedicated brine outfall	5[3]	N/A	16
Montecito Local Desal	Existing sanitary sewer outfall	3	2	18
Goleta	Existing	Unknown	Unknown	36
Summerland	Existing	Unknown	Unknown	Unknown
Carpinteria	Existing	Unknown	Unknown	Unknown

Notes:

1. Several WWTP outfalls exist within the County for which excess capacity could not be determined due to a lack of information.
2. Excess capacities are based on nominal flows and do not account for diurnal flow patterns. Brine storage may be necessary during peak wastewater flows periods if outfall capacity is limited.
3. Plant does not exist, therefore outfall capacity is expressed as the required capacity for the plant concept listed in Table 3-26.

Ocean desalination plant intake systems fall into two major categories: open-ocean and subsurface intakes. Subsurface intakes generally pose less threat to marine life than open-ocean intakes; however, screens installed on open-ocean intakes aid in limiting such potentially adverse impacts (Water Research Foundation, 2011). Subsurface intakes may provide an added benefit of treating brackish water instead of seawater directly captured from an open ocean intake. Coastal or offshore brackish water may be present where fresh water aquifer systems interface with seawater, resulting in lower salt concentrations and therefore lower treatment costs.

Several alternatives exist for subsurface intakes including slant wells, vertical wells, horizontal collector wells, and various infiltration gallery systems. Site specific analyses are required to determine the optimal intake system and assess the feasibility for implementation. For the purpose of this Report, an analysis was performed to estimate the required intake capacity for the plant concepts listed in Table 3-28 based on each plant's assumed capacity. It is assumed that a 45% recovery rate is achieved through the reverse osmosis treatment process and 55% is discharged as brine. The volume of seawater required to produce the desired plant capacity is approximately 220% of the desired plant capacity. Intake capacities for the plant concept listed in Table 3-26 are summarized in Table 3-28.

Table 3-28: Ocean Desalination Intake Capacities (MGD)

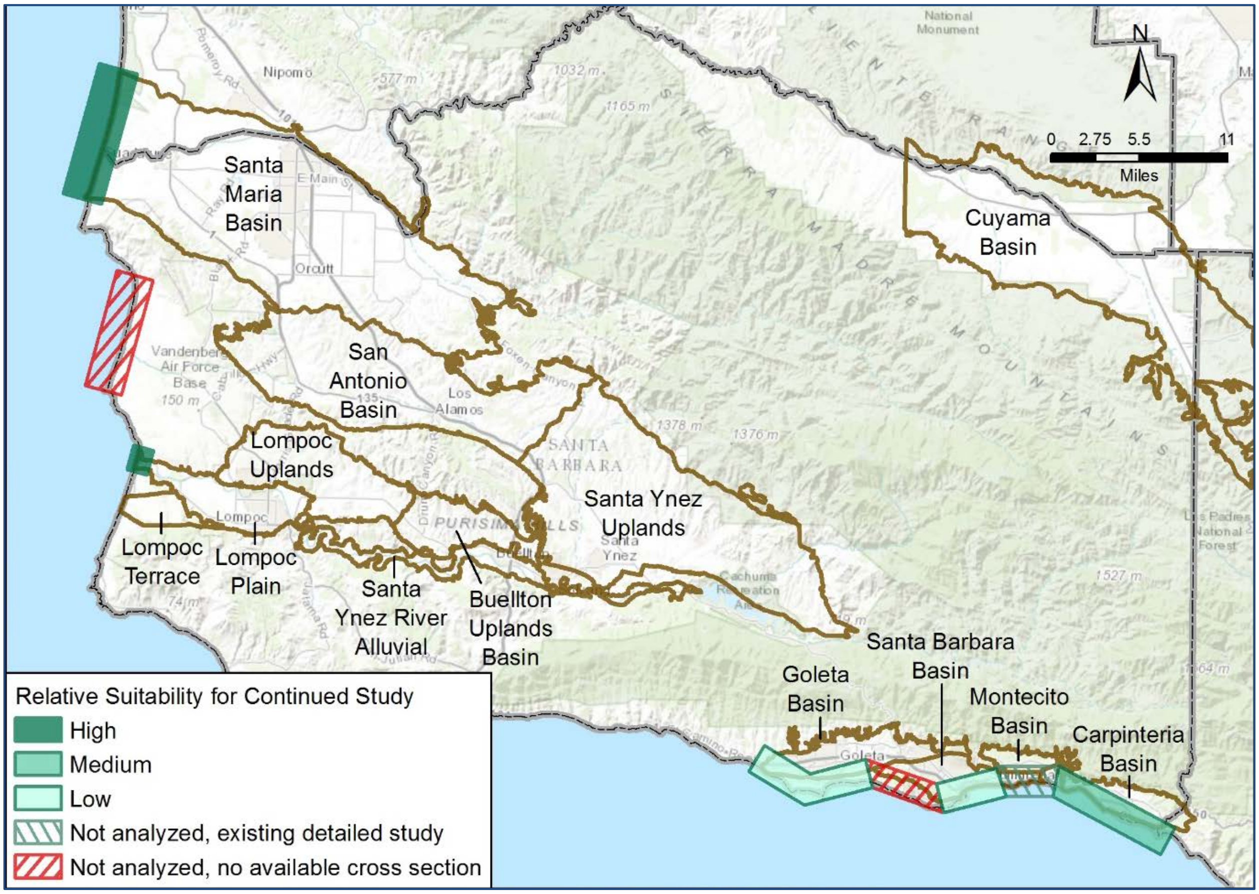
Plant Description	Intake Description	Plant Capacity	Intake Capacity
Santa Barbara Local Desal	Existing repurposed outfall	9	23
Santa Barbara Regional Desal	Existing repurposed outfall	9	23
Santa Barbara Regional Desal	New Intake	29	65
Montecito Local Desal	New Intake	2.5	8.9
Gaviota Chevron Desal	Existing	0.41	1
San Antonio Regional Desal	New Intake	13	27
Southern SLO (Nipomo) Local	New Intake	8	13
Southern SLO (Nipomo) Regional	New Intake	23	42

In order to capitalize on potential benefits from a subsurface intake system, specific coastal geologic conditions must be present. Given these limitations and that brackish groundwater is less expensive to treat, it is preferable to site an ocean desalination plant where a subsurface intake system may be implemented. An analysis of coastal geology was performed in order to identify zones where the feasibility of subsurface intake facilities warrants further investigation.

Coastal groundwater basins have a range of suitability for locating a subsurface desalination intake as shown in Figure 3-10**.** Notably, the Santa Maria and Lompoc Basins show a greater thickness and extent of unconsolidated materials, compared to the other basins, increasing the potential favorability for a subsurface intake.

Based on the methodology used in this analysis, the City of Santa Barbara area coastline is characterized as "low" suitability for continued study. Per direction of Santa Barbara's City Council and the RWQCB, the city is conducting a feasibility study for potable reuse and subsurface intakes for the plant.

Figure 3-10: Ocean Desalination Plant Subsurface Intake Suitability



Note: A study was conducted for the Montecito Basin, but highlighted the need for a more detailed study that could potentially locate viable sites.

Cost Sensitivities and Implementation Considerations for Ocean Desalination Plants

The cost of ocean desalination plants depends primarily on the volume of water to be treated, where larger volumes of water provide a better economy of scale. Unit costs were calculated based on costs to construct a new ocean desalination plant, brine disposal, intake facilities, conveyance to brine disposal, injection wells, conveyance to injection wells and land purchases. These costs were scaled based on the volume of water to be produced.

It was assumed that ocean desalination plants would be located along the coast in general areas but no specific sites were selected unless they have already been identified through previous efforts. Site conditions and the type of intake (such as slant wells or ocean intakes) can also affect costs. Since assessments to determine which intakes are viable cannot be conducted as part of this Report (unless already completed) an average cost of a variety of intakes previously estimated were scaled by supply volume to provide an estimate of intake cost. Costs for pipelines to convey desalinated water to distribution systems were estimated based on approximate distance from the ocean to the distribution system to receive the water. For those options that are intended to deliver water regionally, it was assumed that the desalinated water would be delivered into the regional imported water pipeline, and delivered through existing facilities.

Ocean desalination plants and intakes could have a lower unit cost as they increase in size due to economies of scale, indicating that larger, regional ocean desalination plants would be more cost effective than multiple, smaller ocean desalination plants.

Though this Report did not consider the use of existing brine disposal wells, if there is an existing well in place, there is potential to use it for additional brine disposal to further reduce costs.

Conveyance of supply from ocean desalination plants to existing infrastructure may require several miles of pipeline and pump stations, so it was assumed that local demands would be met first with the desalination supply in-lieu of imported or groundwater supplies that could be used by others through exchanges.

Implementation of ocean desalination plant options will require feasibility studies to evaluate water quality, and the impacts of different brine disposal options and intake options, and impacts to existing water distribution facilities. It's anticipated that there will be potential challenges from the environmental community concerned about marine and energy consumption impacts, as well. Regional ocean desalination plant options will also require water supply agreements with participating agencies, and agreements with CCWA for the use of the SWP Coastal Branch CCWA extension to convey the water.

The implementation timeframe required for planning, permitting, designing and constructing an ocean desalination plant is highly dependent upon specific conditions. From an engineering perspective, it is possible for a plant could be completed and operating within 10 years. However, the size and complexity of the plant, and potential use of existing intake or outfalls greatly impacts the regulatory and environmental acceptance process which is the main schedule indicator for ocean desalination projects. Since the City of Santa Barbara already has a site, permits and is moving along in an active implementation process, their local ocean desalination plant project is assumed to be on-line within five years.

Conclusions

Figure 3-11 and Table 3-29 provides a summary plot of the unit costs and implementation timeframe of each of the options described above. Only those options with costs below $3,000/AF and volumes above 2,000 AFY are shown in this plot. As seen in the figure, those options that provide higher volumes of water supply have lower unit costs. In addition, the cost of the Local Santa Barbara Desalination Plant is lower given that it has already been constructed, and costs are related only to rehabilitation required to bring it back online. Table 3-30 provides a summary of the ocean desalination options that were explored as part of this Project, but did not meet the higher level cost and volume thresholds. For additional cost information, please see the Technical Memorandums prepared in support of this Report.

Ocean desalination plants would allow the Region to access an unlimited and highly reliable source of supply, however, cost and other implementation considerations moderate these benefits. With the City of Santa Barbara's plant in the process of reactivation, it provides the Region an opportunity to learn from that process and determine how best to move forward with any additional plants. In addition, it is possible that this plant can be expanded to serve regional needs simply by operating it during normal conditions. An additional plant would require additional feasibility and facilities alternative analysis to determine optimal locations, operational strategies and partnerships. This upfront process could itself take most of the assumed ten year implementation timeframe window.

Figure 3-11: Ocean Desalination Plant Options for Regional Consideration

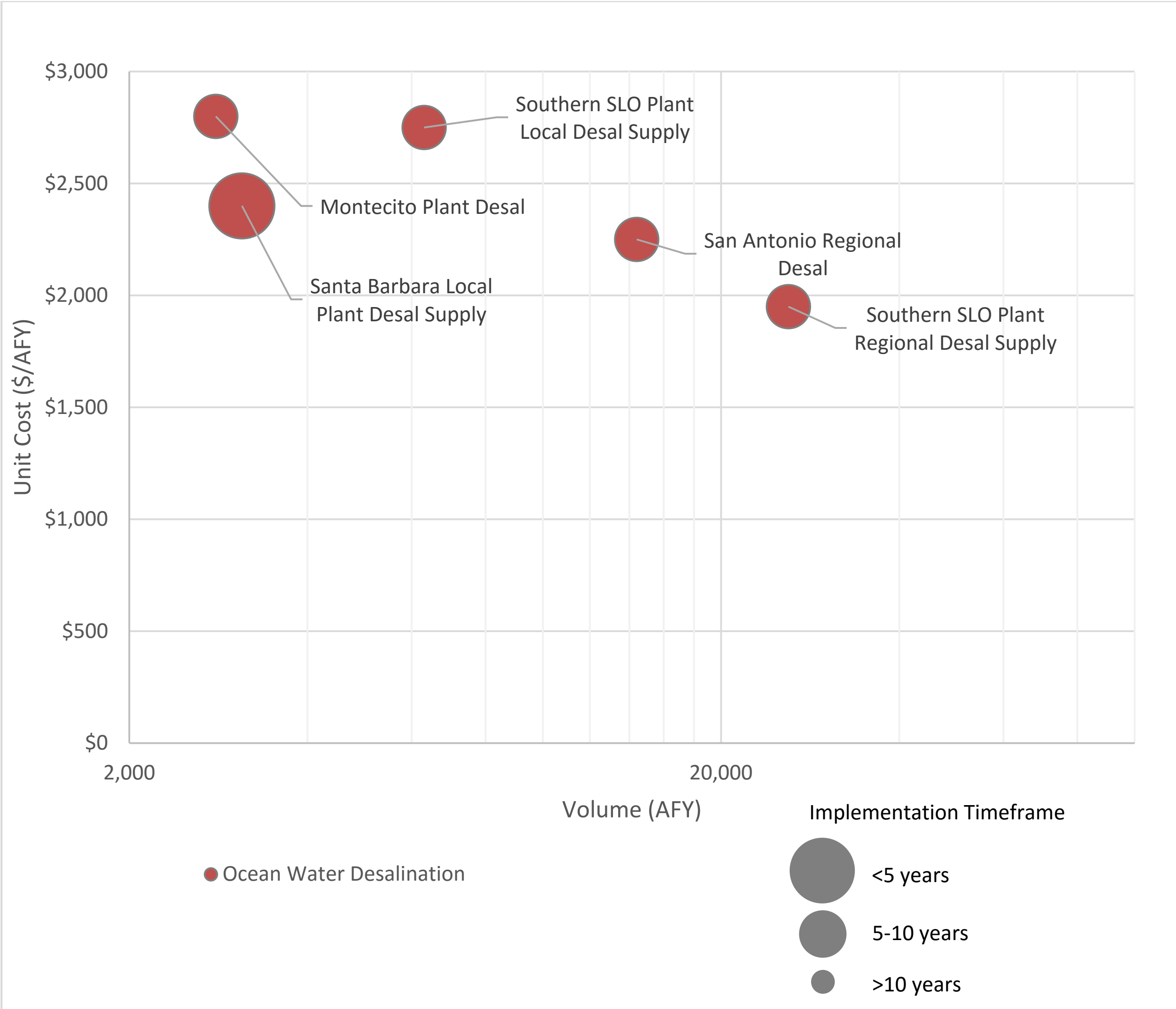


Table 3-29: Ocean Desalination Plant Options for Regional Consideration

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Southern SLO Plant Local Desal	6,300	$2,700-$2,800	5-10 years
Southern SLO Plant Regional Desal	26,000	$1,900-$2,000	5-10 years
San Antonio Regional Desal	14,400	$2,200-$2,300	5-10 years
Montecito Plant Desal	2,800	$2,700-$2,900	5-10 years
Santa Barbara Local Plant Desal	3,100	$2,400	5-10 years

Table 3-30: Other Ocean Desalination Plant Options Considered, But Not Meeting Project Thresholds

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Santa Barbara Plant Regional Desal	10,000	$3,100	5-10 years
Gaviota Plant Desal	460	$4,500	5-10 years

3.6 Overall Supply Option Conclusions

It is evident that Santa Barbara County has a number of water supply options available to it, each with its own unique benefits and considerations. Table 3-31 provides a summary of each options' unit cost and volume of those options that are less than $3,000/AF but provide more than 2,000 AFY. These higher volume, lower cost options were highlighted as those with the most potential to meet the greatest regional needs. Options that provide lower volumes of water or have a higher unit cost, such as decentralized stormwater capture, graywater use or NPR, should still be considered, however, as viable opportunities to provide supply as well as other benefits to local communities. Furthermore, decentralized stormwater capture represents a potential supply option that will be a continuing area of focus for local water purveyors and County-wide planning efforts.

Even though an option is within the volume and cost thresholds used in this Report, the implementation considerations associated with that option may be too difficult to overcome in the near-term and could be better implemented later in the planning horizon or may not be able to be implemented at all. As examples, changes to flows as a result of increased stormwater capture could result in significant challenges from environmental or other interests. Since many of the region's basins are not adjudicated, implementation of groundwater recharge projects could prove challenging until those management frameworks are created. Ocean water desalination options, though of higher unit cost, are no longer that far off from alternative supplies but would have a lengthy regulatory upfront process.

The options identified that would import water from outside of the state may be appear somewhat cost effective when examined at the massive scale needed to supply the Colorado River Basin or even Southern California. If these facilities were built to just meet the Region's demands, then they would be completely cost-infeasible. Even if a large scale project were viable, importing water from out of state would require well over ten years of negotiations, environmental reviews, and regulatory permitting on top of alternative planning and final design and construction.

It should be noted that the above described options look at taking full advantage of each supply, but may overlap in terms of supply availability. For example, the recycled water recharge options attempt to maximize supply use, but if NPR options were implemented, less supply would be available for IPR. Therefore, it would not be feasible to implement all options and most likely, even within individual options, an incremental analysis would be beneficial to determine if there are initial phases that could be implemented more effectively before others.

Taken as individual projects, the options discussed in this chapter represent a wide variety of potential supply solutions for consideration by the County and local water purveyors. While all 120 options explored by this Project are provided in Appendix A, Table 3-31 below provides a listing of all options that meet the thresholds of $3,000/AFY in unit cost and 2,000 AFY in volume.

Table 3-31: Options More Attractive for Regional Consideration

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Direct Recycled Water Use			
Recycled Water - NPR			
Laguna San NPR (M&I)	2,900	$300	<5 years
Laguna San NPR (Ag)	5,000	$300	<5 years
Lompoc NPR (Ag)	4,400	$1,200	<5 years
Recycled Water - DPR			
Laguna San DPR	4,700	$1,400	5-10 years
Lompoc DPR	3,700	$1,550	5-10 years
Goleta DPR	6,500	$1,300	5-10 years
Santa Barbara DPR	6,600	$1,800	5-10 years
Groundwater Recharge and Storage			
Recycled Water - IPR			
Laguna San IPR (injection)	4,700	$1,300	<5 years
Laguna San IPR (surface)	5,540	$700	<5 years
Lompoc IPR (injection)	3,700	$1,500	<5 years
Lompoc IPR (surface)	4,400	$500	<5 years
Goleta IPR (injection)	6,500	$1,300	<5 years
Goleta IPR (surface)	7,600	$1,400	<5 years
Santa Barbara IPR (injection)	6,600	$1,200	<5 years
Santa Barbara IPR (surface)	7,500	$2,200	<5 years
Stormwater/Surface Water – Centralized Recharge			
Sisquoc River Diversions to Spreading Basins	2,500	$2,800	<5 years
Sisquoc River Diversions for Ag Spreading	2,500	$2,600	<5 years
Carpinteria Creek Diversions to Ag	3,000	$200	<5 years
Santa Ynez Diversions to Spreading Basins	2,500	$2,800	<5 years
Santa Ynez Diversions to Ag Spreading	2,500	$2,600	<5 years
Cuyama River Diversions for Spreading Basins	4,400	$600	<5 years
Cuyama River Diversions for Ag Spreading	4,400	$60	<5 years
Imported Water – California (Recharge)			
SB Undelivered SWP for Spreading Basins	6,300	$2,800	<5 years
SB Undelivered SWP for Injection Wells	6,300	$1,900	<5 years
Ocean Desalination Plants			
Southern SLO Plant Local Desal Supply	6,300	$2,700-$2,800	5-10 years
Southern SLO Plant Regional Desal Supply	26,000	$1,900-$2,000	5-10 years
San Antonio Regional Desal	14,400	$2,200-$2,300	5-10 years
Montecito Plant Desal	2,800	$2,700-$2,900	5-10 years
Santa Barbara Local Plant Desal Supply	3,100	$2,400	5-10 years

Option	Supply (AFY)	Unit Cost ($/AF)	Implementation Timeframe
Increase Surface Storage Capacity			
Stormwater/Surface Water – Dam Modifications			
Twitchell Operational Modifications	7,600	$12	<5 years
Cachuma Dam Modifications (Dam Raise)	34,500	$1,000	>10 years
Cachuma Dam Modifications (Flashboard Increase)	3,700	$20	<5 years
Stormwater/Surface Water – Offstream Storage or New Dam			
Round Corral Reservoir	6,700	$2,100	>10 years
Salsipuedes Creek Reservoir	2,850	$2,000	>10 years
Importing Water from Outside the Region			
Imported Water – California (Direct Use)			
SB Undelivered SWP for Direct Use	6,300	$1,700	<5 years
SB Suspended Table A	8,000	$600	<5 years
SLO Undelivered SWP	3,400	$650	<5 years
SWP Article 21	5,000	$400	<5 years
Undelivered CA Imports, Short-Term Agreement	6,300	$1,800	<5 years
Undelivered CA Imports, High Cost Long-Term Agreement	6,300	$1,600	<5 years
Undelivered CA Imports, Low Cost Long-Term Agreement	6,300	$1,000	<5 years
Groundwater Cleanup			
Santa Ynez Uplands Basin Chrom-6 Treatment	9,800	$900	<5 years
Santa Maria Basin TDS Treatment	12,000	$1,400	<5 years

Chapter 4 Regional Supply Project Concepts

As Chapter 3 showed, there are numerous supply options potentially available for implementation. These individual options have a wide range of sizes, costs, and implementation considerations. Given the regional nature of this planning exercise, it is also important to highlight opportunities where individual supply options could be linked into larger regional supply programs benefiting multiple communities, interests and even subregions.

These larger regional project concepts would require multiple partnerships working together regionally to develop larger more cost effective units of supply that can be stored and shared through transfer, in-lieu, banking and cost sharing agreements. Although the institutional arrangements necessary to implement these programs can be challenging, the potential benefits to improved regional supply reliability and cost-effectiveness are substantial and worth exploring.

Given that the planning horizon for this project is 2040, the regional supply concepts described below are not necessarily limited by current agreements, regulations and operations. It is understood that some aspects of these concepts may not be able to be implemented under these current conditions but could provide a vision by which further concept development could precipitate changes necessary for implementation. It is also assumed that the costs of these programs will be distributed according to the benefits received as a result of the project - meaning that project partners could be throughout the Region.

4.1 Regional Desalination

Ocean desalination can provide a seemingly limitless source of local water supply. However, as discussed in Chapter 3, there are considerable costs and implementation hurdles associated with bringing a project on-line. It is these characteristics that support consideration of larger-scale regional ocean desalination efforts over the implementation of multiple smaller-scale projects within the Santa Barbara Region. Regional desalination projects can provide opportunities for regional supply through the following mechanisms:

- Transfers and exchanges of imported water facilitated by offset of local demands
- Direct use of product water conveyed through the SWP Coastal Branch

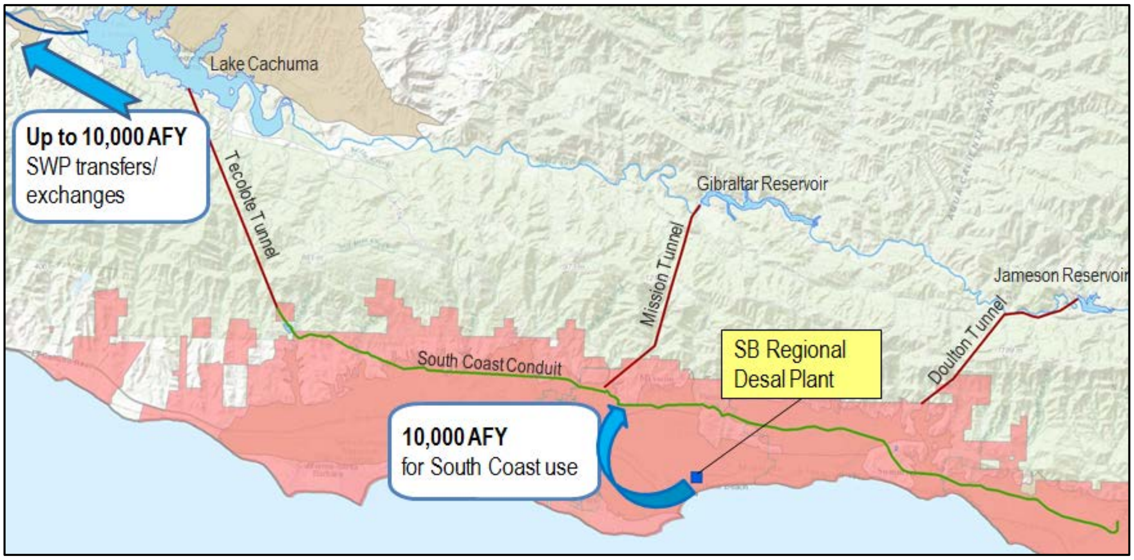
The three areas with the greatest potential for regional project development that would enhance local supplies include the South Coast, San Antonio and Southern San Luis Obispo County.

South Coast Regional Desalination

By operating the City of Santa Barbara Desalination Plant year round, it could provide approximately one third of the South Coast Subregion's local demands annually. This highly reliable 10,000 AFY would be able to offset South Coast imported water use by an equivalent amount, providing that supply to upstream users. This Regional concept would be in lieu of having one or two separate and smaller ocean desalination projects operated by the cities of Santa Barbara and Montecito.

Given that ocean desalination has a higher level of reliability than imported water, it is assumed that those receiving imported supply may also look for opportunities to bank those supplies when available as part of the total project cost and concept as shown in Figure 4-1.

Figure 4-1: South Coast Regional Desalination

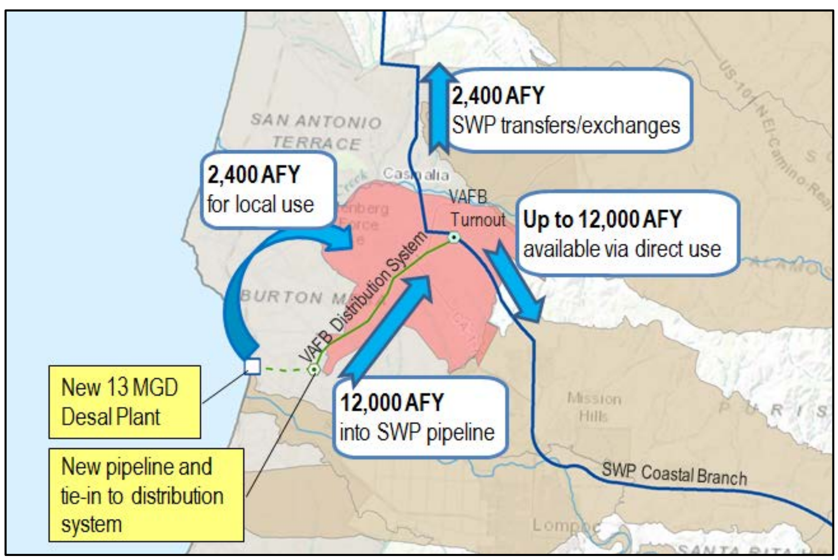


Conceivably, a regional Santa Barbara ocean desalination plant could be sized to meet all 33,000 AFY of South Coast municipal and industrial demands, reserving all groundwater supplies for other uses. This concept would also eliminate the need for delivery of surface water supplies diverted from the Santa Ynez River, reserving these supplies for downstream releases and/or direct delivery through new distribution facilities in the Santa Ynez Valley. This more ambitious effort would require considerable cost and restructuring of current water conveyance systems, so it is probably best to consider after an initial plant is operational.

San Antonio Regional Desalination

A 13 MGD ocean desalination plant along the coast of the San Antonio Subregion could provide up to 14,400 AFY for regional distribution: 2,400 AFY through SWP transfers and exchanges to offset local imported water use and 12,000 AFY for direct use in the South Coast. As shown in Figure 4-2, flows could be conveyed to turnouts north of Vandenberg Air Force Base turnout for direct use by gravity and/or surcharging the system, which may warrant additional desalination plant capacity.

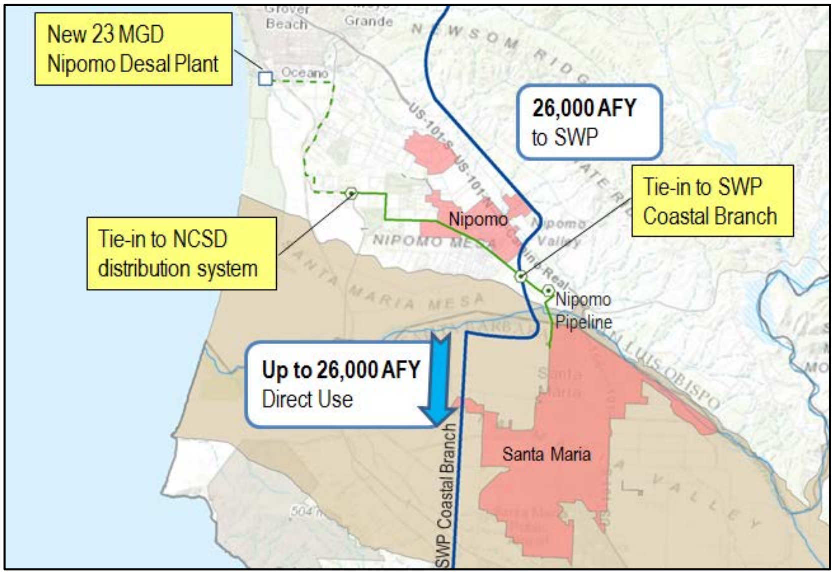
Figure 4-2: San Antonio Regional Desalination



Southern SLO Regional Desalination

Nipomo Community Services District (NCSD) evaluated the feasibility of implementing a 3 MGD ocean desalination to meet NCSD's local demands allowing for the transfer and exchange of up to 3,000 AFY of imported supply for downstream users. An 8 MGD ocean desalination plant could also be implemented to maximize the capacity within the newly constructed Nipomo Pipeline between Nipomo and Santa Maria and provide up to 9,000 AFY of imported water offsets for downstream users. With the addition of a direct connection between the Nipomo Pipeline and the SWP Coastal Branch (and other system upgrades), the maximum useful size of a regional ocean desalination plant is 23 MGD which is equivalent to the approximate 26,000 AFY of remaining capacity (wet year) of the Coastal Branch south of that connection.

Figure 4-3: Maximum Southern SLO Regional Desalination



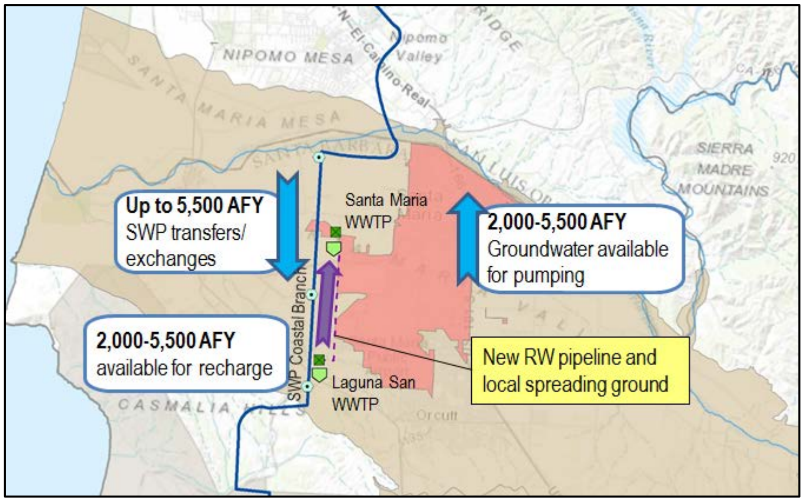
4.2 Regional Recycled Water

Similar to ocean desalination, locally produced recycled water can be used as an in-lieu of imported water allocations, thereby freeing up those allocations for other SWP system users in the Region. Recycled water use is already occurring in the Region so a new regional project would most likely expand existing system NPR use or increase supply through IPR or DPR. These latter increments of recycled water production may not be considered viable on a local scale, but could be implemented through the help of regional partnerships. Within the Region, the Santa Maria and South Coast subregions are the only areas where enough additional recycled water supplies could be produced to justify a regional project.

Santa Maria Regional Recycled Water

The primary source of potential recycled water that could be used to offset imported water use in the Santa Maria Subregion is effluent from the Laguna County Sanitation District (LCSD). LCSD is projected to produce up to 5,500 AFY of recycled water that could be used for supply by 2040 but has limited interest from local users due to higher costs. Recharging the recycled water into the Santa Maria Basin would provide an equivalent amount of additional groundwater supply for use by a project partner (e.g. City of Santa Maria) in lieu of imported supplies. The unused imported water allocation can then be transferred to another project partner downstream of the SWP system. Though Figure 4-4 shows recycled water recharge occurring near the Santa Maria WWTP, there is potential

Figure 4-4: Santa Maria Regional Recycled Water



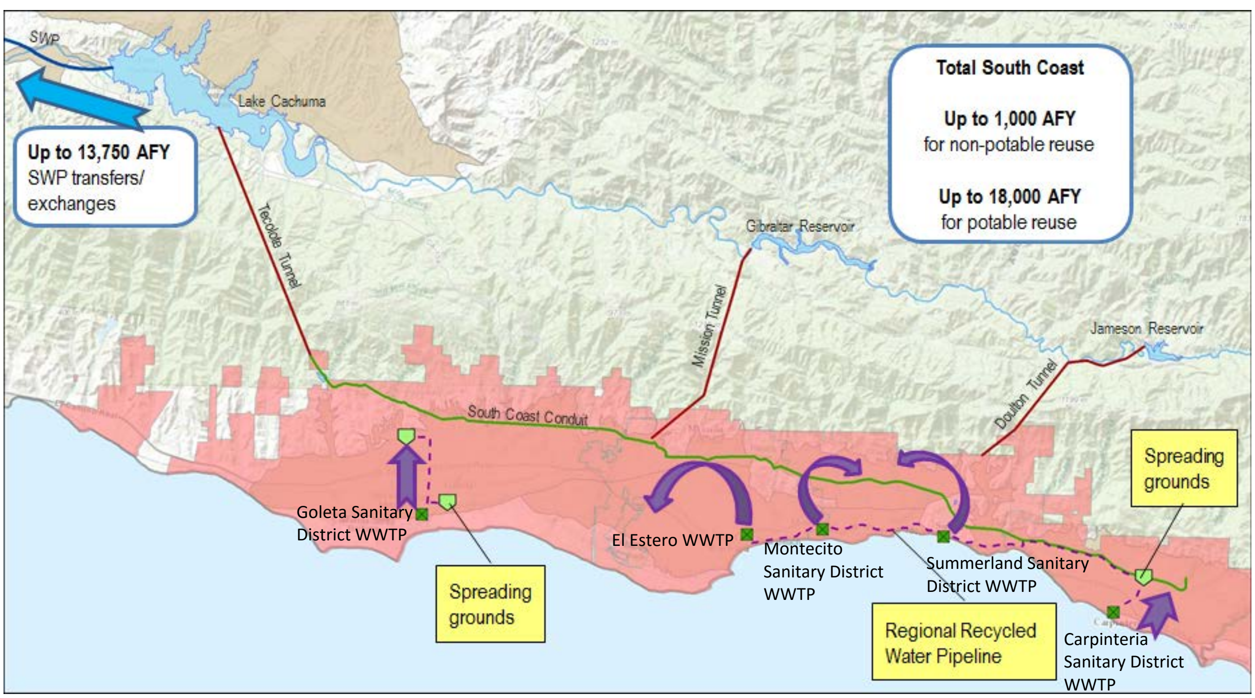
for an option that would site and construct new spreading grounds in favorable areas around the region.

Note that the use of existing spreading basins must consider percolation limitations during high groundwater years. In addition, Santa Maria's increased reliance on groundwater will require groundwater treatment to reduce TDS as they currently blend SWP water with groundwater to manage basin salt loading through existing effluent management practices. This treatment can be a part of a regional solution.

South Coast Regional Recycled Water

Similarly, the combined WWTPs in the South Coast Subregion could produce up to 18,000 AFY of additional recycled water to meet potable demands by 2040. In order to leverage this unused supply to offset potable demands a combination of NPR, IPR, and/or DPR projects may be implemented. The use of a subregional conveyance intertie may be advantageous to reduce redundancy in treatment and/or leverage groundwater basins with greater storage potential. Of the 18,000 AFY of recycled water that could be leveraged in the South Coast, only 13,750 AFY (the average allocation of SWP supply currently used in the South Coast Subregion) would be considered a regional supply.

Figure 4-5: South Coast Regional Recycled Water



4.3 Regional Storage

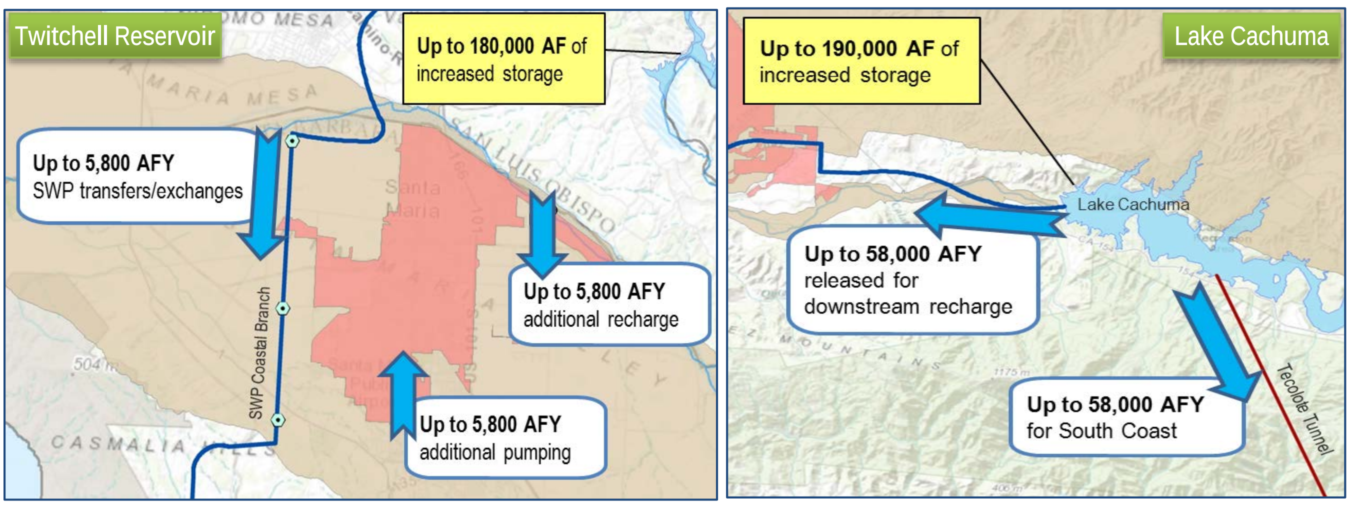
Surface Storage

Implementing any of the options described in Section 3.1 that increase surface storage capacity at Twitchell or Cachuma reservoirs could provide regional benefits through increased local supply, making imported supplies available for regional transfers and exchanges.

The maximum supply that may be generated through Twitchell Reservoir improvements is approximately 5,800 AFY. Assuming this additional supply would be accessed through existing recharge operations, groundwater pumping could increase by an equal volume, freeing up that same volume of SWP water for regional transfers and exchanges.

The maximum supply that may be generated through Lake Cachuma capacity improvements is approximately 58,000 AFY. This additional supply could be accessed for direct use through existing operations in the form of releases to the South Coast through the Tecolote Tunnel and/or releases for downstream water rights or environmental flows in the Santa Ynez Valley.

Figure 4-6: Twitchell and Cachuma Reservoir Regional Surface Storage



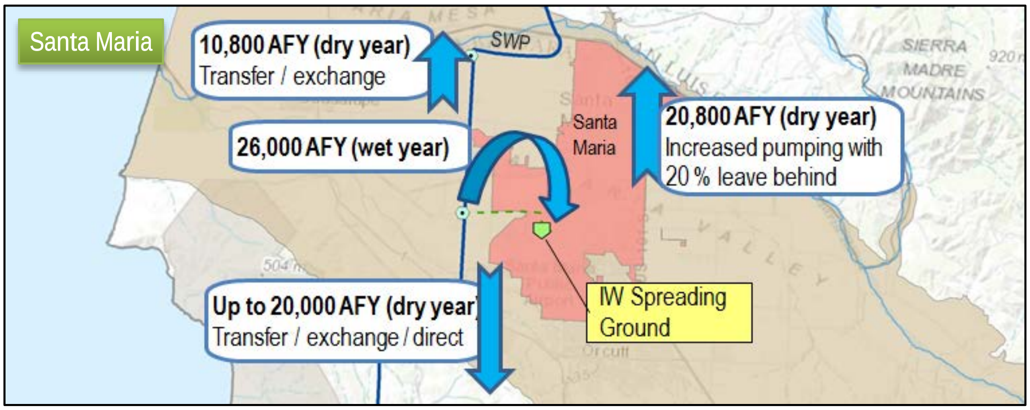
Conjunctive Use

Unused imported water supplies (primarily available in wet years) may provide an additional increment of supply in average and dry years as long as there is a suitable place for long-term storage. Regional conjunctive use projects allow water purveyors without access to suitable local groundwater storage to bank their unused SWP in areas that do; accessing them through in-lieu exchanges or direct pumping and distribution when needed. It is assumed that 10-20% of imported water banked within a basin would be left behind to account for potential losses, which may provide additional benefit to the bank operators in the form of long term basin recharge and improved water quality.

It is assumed that the maximum supply that can be banked is equivalent to existing SWP Coastal branch capacity and that additional supplies up to this amount may be available through transfer/exchange in wet years. It is also assumed upstream transfer opportunities are constrained by the difference between upstream and downstream excess capacity in dry years (assuming that full use of downstream capacity is utilized and no local SWP water is taken). This type of concept could be implemented in any number of ways. For example, as an exchange concept, water could be pumped from a groundwater basin when needed, and then repaid in the future either through direct recharge or in-lieu use.

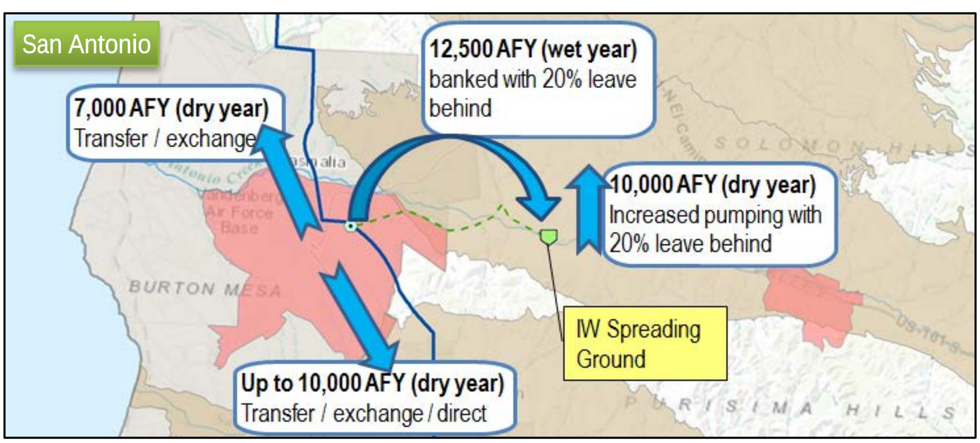
Santa Maria Groundwater Basin: Based on system capacities, it is estimated that 26,000 AFY of imported water could be recharged into the Basin (assumed wet year), resulting in about 20,800 AFY for withdrawal and use (assumed dry year). Up to 10,800 AFY of the in-lieu imported water can be allocated to upstream users with 20,000 AFY available downstream based on system capacities. The Santa Maria Groundwater Basin is not a closed basin, which must be considered in determining appropriate leave behind ratios.

Figure 4-7: Santa Maria Groundwater Basin Regional Conjunctive Use



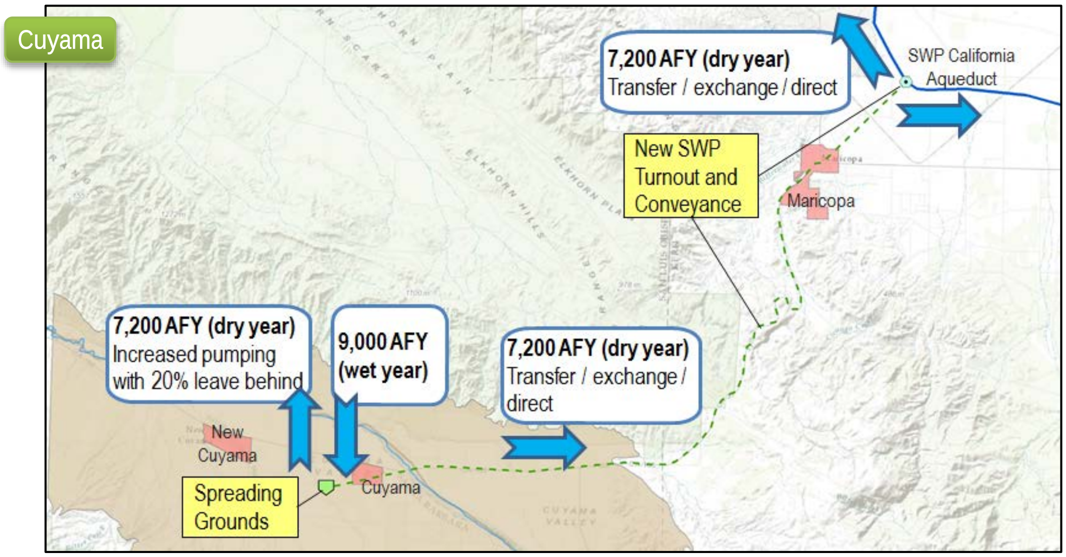
San Antonio Groundwater Basin: Based upon system capacities, it is estimated that 12,500 AFY of imported water could be recharged into the Basin (assumed wet year). When withdrawn (dry year), pumping may be increased and up to 10,000 AFY may be transferred to downstream SWP contractors that have banked water. Up to 7,000 AFY of banked water may be transferred upstream in dry years, based on system capacities. Additional facilities will be required for direct recharge and/or withdrawal including pipelines, spreading grounds, injection wells, production wells, and/or pump stations.

Figure 4-8: San Antonio Groundwater Basin Regional Conjunctive Use



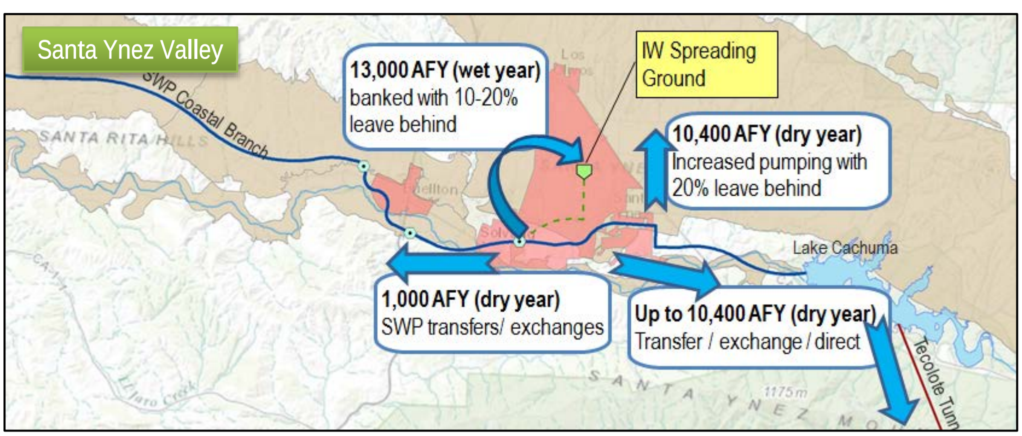
Cuyama Groundwater Basin: With no useable existing infrastructure, a regional conjunctive use program in the Cuyama Basin would be limited by the amount of supply that could be routed to this area. This concept assumes that Cuyama Valley users would buy into the SWP program and obtains all or some portion of the Suspended Table A allocation, and that about 9,000 AFY of SWP wet year water would be available for recharge in the Cuyama Basin. When withdrawn (dry year), local pumping would increase by up to 7,200 AFY and pumped water may be transferred or exchanged to County SWP contractors by diverting Cuyama allocations to the SWP Coastal Branch. In the case that additional supplies are banked by SWP contractors south of Cuyama on the California Aqueduct System, pumped groundwater may be directly delivered via this system.

Figure 4-9: Cuyama Groundwater Basin Regional Conjunctive Use



Santa Ynez Valley Groundwater Basin: Based upon system capacity, about 13,000 AFY of imported water could be recharged into the Basin (assumed wet year). When withdrawn (dry year), local pumping may increase and up to 10,400 AFY may be transferred to downstream SWP contractors that have banked water. Up to 1,000 AFY of banked water may be transferred upstream in dry years, based on system capacities. Additional facilities may be required for direct recharge and/or withdrawal including pipelines, spreading grounds, injection wells, production wells, and/or pump stations.

Figure 4-10: Santa Ynez Valley Groundwater Basin Regional Conjunctive Use



Chapter 5 Recommendations and Next Steps

The Long-Term Supplemental Water Supply Alternatives Project was intended to meet the following objectives:

- Identify options to access new supplies for the Region by 2040
- Identify comprehensive list of subregional, regional and inter-regional supply options
- Characterize feasibility, reliability, cost, and implementation considerations for options
- Involve technical planning partners and public in the process
- Provide technical basis for future decision making and implementation
- Begin collaboration on regional projects for future implementation

With the completion of this Report, the Region is closer to determining a pathway to improved regional water supply reliability. There are, however, several next steps are recommended in order for the Region to achieve this goal.

5.1 Further Option Development

The options and regional concepts presented in this Report are in various stages of development, with some projects already being implemented and others completely conceptual. There have been several planning efforts occurring in parallel with this Project within the Region. Through coordination with the Planning Partners, some of the results from these efforts were captured in this Report, however, as these efforts continue to progress and new planning is conducted, the information contained in the Report may no longer represent the latest supply option information.

Examples of ongoing option development in the Region include:

- The City of Santa Barbara has awarded a contract to re-activate Charles E. Meyer Desalination Plant and is expected to be on-line in Fall of 2016.
- The Central Coast Water Authority is currently pursuing reacquisition of Table A water.
- The Santa Barbara County Water Agency completed a Cuyama Valley Groundwater Study with the United States Geological Survey that documented the condition of the Cuyama Valley Groundwater Basin and is doing a similar study for the San Antonio Groundwater Basin.
- Water purveyors and the Santa Barbara County Water Agency are pursuing options for stormwater capture projects and resource plans to qualify for state grant funding for stormwater.
- Many local agencies have recently started or are interested in starting collaborative recycled water feasibility and facilities plans that examine specific NPR, IPR and even DPR options, including: Carpinteria Valley Water District, Goleta Water District, Santa Ynez Community Services District and the cities of Santa Barbara and Montecito.
- Water purveyors across the County continue to implement conservation and efficiency measures to reduce overall water demand.

Although many of these efforts are being conducted locally, it benefits all agencies and communities in the region to support the further development of options throughout the Region as it can offset the need for shared supplies (in particular imported water) by increasing the total volume of water available to the region thereby improving overall supply reliability.

The Santa Barbara IRWM Program offers a particularly useful platform for furthering the development of the more conceptual and/or regional options highlighted in this Report in three key ways:

- Has an existing mechanism for bringing key stakeholders together from across the Region
- Focuses on the development of integrated and regional planning and project development
- Provides a significant vehicle for funding both project planning and implementation

Including the options identified in this Report as projects in the current IRWMP would allow for regional stakeholders to collectively consider which options to develop further by individual agencies, or through regional partnerships. Once added to the IRWMP, projects/options also become eligible for planning and implementation funds through DWR's IRWM Grant Program.

5.2 Demand and Water Use Efficiency Planning

As noted at the beginning of the Report, this planning process specifically did not include two key elements necessary in determining a complete pathway to water resources sustainability. It is recommended that the Region consider taking the following next steps:

- Complete a regional and subregional demand assessments to determine current water resources needs and project future needs through 2040. Once demand projections are completed based upon historical patterns, it would also be valuable to modify that assessment given potential changes to climate.
- Identify and characterize water use efficiency options in a similar manner to the supply options developed through this Project. The aforementioned demand assessment would reflect demands without additional water use efficiency programming. Developing water use efficiency measures that would produce "conserved supply" with comparable unit costs and implementation considerations to supply options will allow for regional stakeholders to look at comprehensive solutions to meeting demand projections.

By completing a demand assessment and identifying water use efficiency options, the Region will be able to facilitate a comprehensive integrated resources planning exercise whereby groupings of supply and demand options can be compiled to meet the Region's needs over time. Coupled with a stakeholder driven decision process, the Region would then be able to determine which options and/or full scale alternative portfolios to implement as well as how and when to implement them.

5.3 Funding and Financing

There are many funding and financing opportunities available for implementing the various options identified and developed in this Report. Local funding is likely to come from individual agencies' capital improvements plans. The regional concepts and supply options can leverage resources through partnerships between local agencies that contribute funds for project implementation relative to the benefits received. Other potential funding partnerships with entities outside of the Region should also be considered. For example as local agencies begin implementing projects to develop local resources and offset some of the need for imported water supplies, SWP allocations could be made available to other contractors on a regular basis, benefiting DWR and SWP contractors. It is, therefore, possible that other contractors could potentially participate in funding local resource development within the Region. For example, if a large regional desalination plant were to be brought on-line that would completely offset all SWP water allocations for Santa Barbara County (and even San Luis Obispo County), DWR and the State Water Contractors may be interested in funding this project as a means of increasing supply reliability for the remaining contractors.

Funding may also be supplemented through a variety of grant and loan programs that are available at a State and Federal level – including IRWM program funding previously discussed. A summary of current and anticipated grant and loan programs are summarized in Table 5-1.

Table 5-1: Grant and Loan Programs

Program / Agency	Status	Summary	Project Types
Proposition 1, the Water Bond DWR & SWRCB	Awaiting Authorization	**Regional Water Reliability:** • $810 million overall • $510 million of the funds will be administered through IRWM • $200 million for stormwater capture • $100 million for water conservation • Funding mid-late 2016	• Any water supply projects (included in the IRWM Plan) • Stormwater capture • Water conservation
	Active	**Safe Drinking Water:** • $520 million for water quality improvements projects • $260 million of funds administered through the State Water Pollution Control Revolving Fund – Small Community Grant Fund • $260 million in grants and loans for infrastructure • Final guidelines available for FY 15-16 funding ($136 million)	• Groundwater quality improvement
	Active	**Recycled Water:** • $725 million in grants and low interest loans for treatment, storage, conveyance, distribution, desal projects • Grants require 50% match that may be met with federal grant funds • Final guidelines available for FY 15-16 funding ($137.2 million)	• Recycled Water (SWRCB) o DPR o IPR o NPR o Treatment • Desalination (DWR)
	Awaiting Authorization	**Groundwater Sustainability:** • $900 million for groundwater projects with an emphasis on groundwater quality and groundwater management planning • $22M expected for FY 15-16	• Groundwater quality improvement • Groundwater management planning

Program / Agency	Status	Summary	Project Types
	Awaiting Authorization	**Watershed Protection/ Ecosystem:** • $1.5 billion for conservancies and State obligations • Potential projects include urban creek protection, watershed and urban river enhancement, watershed restoration, Delta restoration, urban river enhancements that increase local water self sufficiency • $178 million expected for FY 15-16	• Urban river enhancements that increase local water self-sufficiency
	Awaiting Authorization	**Storage:** • 2.7 billion for surface & groundwater storage and remediation, conjunctive use, and reservoir reoperation projects • Funding anticipated in 2017	• Surface storage • Groundwater recharge • Reservoir reoperation
WaterSMART Grants Program USBR	Active	• $3 million in Drought Resiliency Project Grants • Projects must increase supply reliability, improve water management, facilitate transfer/exchange, and/or provide benefit to fish and wildlife	• System interties • Conveyance to increase flexibility • Barriers or facilities to prevent saltwater intrusion • Recharge basins • Injection wells • Off-stream storage • Groundwater wells • Stormwater capture & reuse • Graywater • Urban stormwater capture
	Active	• $2 million in Drought Contingency Planning Grants • Projects involve multiple stakeholders to encourage more comprehensive planning for all sectors (agricultural, municipal, and environmental)	• Drought Contingency Plan preparation
	Awaiting Reauthorization	• Title XVI Program for water reuse and recycled projects • Construction funds only for projects specifically authorized by US Congress • Program is awaiting reauthorization	• Recycled water facilities planning • Recycled water facilities construction

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Appendix A - Supply Options

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Table A-1: Recycled Water Supply Option Characterization

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Guadalupe WWTP Unused Supply = 1,100 AFY (High Reliability)				
Guadalupe IPR (injection)	930	$1,500 - $1,900	• Brine disposal method since Guadalupe has no outfall	• Short distances between existing wells and aquifer characteristics could present challenges in meeting required subsurface retention times[1] • Full advanced treatment and brine management requirements were deemed not economically viable for the City[1] • The regulatory approval process entails extensive requirements and may take up to 2 years • Rights to additional groundwater must be approved within the management structure of the Santa Maria Groundwater Basin Stipulation [1] • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Guadalupe DPR	930	$1,500 - $1,900	• Brine disposal method since Guadalupe has no outfall • Unknown impact of regulations on treatment process	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Full advanced treatment and brine management requirements are not economically viable for the City at this time[1] • Public acceptance may be challenging and require extensive public outreach
Guadalupe NPR (M&I)	120	$2,000	• Distribution system requirements based on previously identified customers	• Customer assurance challenges are anticipated due to the high cost of complex on-site retrofits[1] • Low demand periods would require storage and/or resorting to current spray field disposal methods[1] • Cost of treatment and distribution were deemed not economically feasible at this time • Potential customer Apio may need to reduce water usage and/or relocate operations to support new 800 home residential development • Supply volumes are highly dependent upon individual customer behavior

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Guadalupe NPR (Ag)	1,100	$1,700	• Distribution system requirements based on participating customers	• Ag customers rely on groundwater and are not likely to purchase higher cost recycled water[1] • City may only receive water supply benefit through a water transfer agreement where ag customers exchange groundwater for recycled water. Well water may require treatment prior to introduction into the potable system [1] • Non-irrigation periods would require resorting to current spray field disposal methods[1] • Cost of treatment and distribution was not deemed economically feasible[1] • Water quality, particularly salinity and pathogens, is a concern for agricultural use
Guadalupe IPR (surface)	1,100	$1,900	• Conveyance requirements based on recharge facility siting	• Short distances between existing wells and aquifer characteristics may present challenges in meeting required subsurface retention times[1] • Full advanced treatment and brine management requirements were deemed not economically viable for the City at this time[1] • The regulatory approval process entails extensive requirements and may take up to 2 years • Rights to additional groundwater must be approved within the management structure of the Santa Maria Groundwater Basin Stipulation [1] • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Laguna Sanitary District Unused Supply = 5,540 AFY (High Reliability)				
Laguna San IPR (injection)	4,700	$1,300	• Conveyance requirements based on recharge facility siting • Incremental cost based on current tertiary treatment	• The regulatory approval process entails extensive requirements and may take up to 2 years • Requires partnering water purveyor interested in receiving additional groundwater rights, which must be approved within the management structure of the Santa Maria Groundwater Basin Stipulation. • Many abandoned oil wells and faults in the area present potential artificial pathways through which injected recycled water could travel. Extensive study of these pathways is required to evaluate feasibly for regulatory compliance[2] • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Laguna San DPR	4,700	$1,400	• Conveyance requirements to tie into existing system • Incremental cost based on current tertiary treatment	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Requires partnering with an interested potable water purveyor • Public acceptance may be challenging and require extensive public outreach
Laguna San IPR (surface)	5,540	$700	• Conveyance to recharge facility identified near Santa Maria WWTP[2] • Incremental cost based on current tertiary treatment	• The regulatory approval process entails extensive requirements and may take up to 2 years • Geologic conditions and environmental concerns limit the potential for recharge near the WWRP, which requires significant conveyance facilities to recharge at a favorable site[2] • Requires partnering water purveyor interested in receiving additional groundwater rights, which must be approved within the management structure of the Santa Maria Groundwater Basin Stipulation • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Laguna San NPR (M&I)	2,900	$300	• Distribution requirements for demands near WWTP	• Customer assurance has been historically challenging to obtain • Customers relying on groundwater currently have a less expensive source of supply • May require partnering with a water purveyor in order to offset potable use and make implementation economically feasible • Supply volumes are highly dependent upon individual customer behavior
Laguna San NPR (Ag)	5,000	$300	• Distribution requirements for demands near WWTP	• Customer assurance has been historically challenging to obtain • Customers relying on groundwater currently have a less expensive source of supply • May require partnering with a water purveyor in order to offset potable use and make implementation economically feasible • Water quality, particularly salinity and pathogens, is a concern for agricultural use
Cuyama Community Services District Unused Supply = 60 AFY (High Reliability)				
Cuyama IPR (injection)	50	$6,900-$9,700	• Brine disposal method	• The regulatory approval process entails extensive requirements and may take up to 2 years • No formal recycled water planning has been done to date • High unit cost makes for unlikely economic feasibility • Water supply benefit from IPR alone will have very little impact on the current groundwater conditions •
Cuyama DPR	50	$2,200-$4,000	• Brine disposal method	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Relative high unit cost makes for unlikely economic feasibility • Public acceptance may be challenging and require extensive public outreach
Cuyama NPR (Ag)	60	$2,400	• Distribution system to nearby potential customer identified by Cuyama CSD	• California recently ordered changes to effluent management practices to reduce percolation and increase evaporation • Potential customer identified in nursery neighboring the WWTP • No formal recycled water planning has been done to date • Benefits are long-term and realized over time as customers participate

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Lompoc Regional Wastewater Reclamation Plant Unused Supply = 4,400 AFY				
Lompoc IPR (injection)	3,700	$1,500	• Brine disposal method since effluent is discharged to Santa Ynez River	• The regulatory approval process entails extensive requirements and may take up to 2 years • Previous investigation of injection in Lompoc Upland Basin was removed from further consideration due to cost and resulted in developing surface spreading concept in the Lompoc Plain Basin[3] • Potential water rights issue based on Section 1211 of California Water Code due to change in point of effluent discharge. • Subject to analysis and mitigation of potential impacts to groundwater recharge associated with reduced effluent discharges to San Miguelito Creek The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Lompoc DPR	3,700	$1,550	• Brine disposal method since effluent is discharged to Santa Ynez River	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Public acceptance may be challenging and require extensive public outreach • Subject to analysis and mitigation of potential impacts to groundwater recharge associated with reduced effluent discharges to San Miguelito Creek
Lompoc NPR (M&I)	1,750	$900	• Distribution requirements for various previous identified demands[3]	• Cost of implementation requires a 20-year payback period to economically feasible, which may be too long of a planning horizon for the City[3] • Recycled water market refinement is needed to determine service pressures, delivery restrictions, and rates[3] • Subject to analysis and mitigation of potential impacts to groundwater recharge associated with reduced effluent discharges to San Miguelito Creek • Benefits are long-term and realized over time as customers participate • Supply volumes are highly dependent upon individual customer behavior

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Lompoc NPR (Ag)	4,400	$1,200	• Distribution requirements for various previously identified demands[3]	• Would require a groundwater basin management framework in order for the City to obtain pumping rights in exchange for recycled water service[3] • Obtaining customer assurance may be challenging due to water quality concerns (TDS) and cost of water versus groundwater production[3] • Subject to analysis and mitigation of potential impacts to groundwater recharge associated with reduced effluent discharges to San Miguelito Creek • Water quality, particularly salinity and pathogens, is a concern for agricultural use
Lompoc IPR (surface)	4,400	$500	• Conveyance to potential recharge facility site • Incremental cost based on current tertiary treatment	• The regulatory approval process entails extensive requirements and may take up to 2 years • Previous investigation of surface spreading in the Lompoc Plain Basin was limited to 50 AFY based on available diluent constrained by Santa Ynez River Diversion rights[3] • Investigation of alternate diluent water source such as Santa Ynez River Underflow may be warranted • Subject to analysis and mitigation of potential impacts to groundwater recharge associated with reduced effluent discharges to San Miguelito Creek • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Goleta Sanitary District Unused Supply = 7,610 AFY (High Reliability)				
Goleta IPR (injection)	6,500	$1,300	• Conveyance to potential recharge facility site	• The regulatory approval process entails extensive requirements and may take up to 2 years • Goleta Sanitary District (GSD) is able to produce more recycled water than non-potable demands can utilize • GSD could benefit from a 24-hour recycled water demand • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Goleta DPR	6,500	$1,300	• Conveyance requirements to tie into existing distribution system • Unknown impact of regulations on treatment process	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Public acceptance may be challenging and require extensive public outreach
Goleta NPR (M&I)	210	$5,900	• Distribution requirements based on previously identified demands • Includes maintenance costs required to expand existing system	• NPR distribution system requires extensive maintenance and repair • Limited economically viable demands exist within the service area • Storage is needed in order to delivery at night for irrigation • Supply volumes are highly dependent upon individual customer behavior
Goleta IPR (surface)	7,600	$1,400	• Conveyance to potential recharge facility site • Incremental cost based on current tertiary treatment	• The regulatory approval process entails extensive requirements and may take up to 2 years • Goleta Sanitary District (GSD) is able to produce more recycled water than non-potable demands can utilize • GSD could benefit from a 24-hour recycled water demand • Requires strategy for accessing diluent water • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Santa Barbara's El Estero Wastewater Treatment Plant Unused Supply = 7,500 AFY (High Reliability)				
Santa Barbara IPR (injection)	6,600	$1,200	• Conveyance to potential recharge facility site	• The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies • If the ocean desalination plant were to use the effluent pipeline from El Estero for the discharge of brine, some yield of wastewater effluent may be needed for blending

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Santa Barbara DPR	6,600	$1,800	• Conveyance requirements to tie into distribution existing system • Unknown impact of regulations on treatment process	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Public acceptance may be challenging and require extensive public outreach • If the ocean desalination plant were to use the effluent pipeline from El Estero for the discharge of brine, some yield of wastewater effluent may be needed for blending
Santa Barbara NPR (M&I)	270	$3,000	• Distribution requirements based on previously identified demands • Includes maintenance costs required to expand existing system	• NPR distribution system required extensive maintenance • Limited demand sites that can be connected cost effectively within service area • La Cumbre golf course is a potential customer, however provides no water supply benefit to the City since irrigation water is currently provided by La Cumbre water company • Supply volumes are highly dependent upon individual customer behavior • If the ocean desalination plant were to use the effluent pipeline from El Estero for the discharge of brine, some yield of wastewater effluent may be needed for blending

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Santa Barbara IPR (surface)	7,500	$2,200	• Conveyance to potential recharge facility site • Incremental cost based on current tertiary treatment	• The regulatory approval process entails extensive requirements and may take up to 2 years • The City is currently conducting a study to evaluate IPR feasibility. • Requires strategy for accessing diluent water. • Santa Barbara IPR may require regional implementation/cooperation to maximize recycled water recharge. • The use of large areas of land for use as spreading basins may be unrealistic in the City of Santa Barbara. • The City of Santa Barbara has stated that it is more feasible to recharge groundwater using spreading basins in the Foothill Basin. • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies • If the ocean desalination plant were to use the effluent pipeline from El Estero for the discharge of brine, some yield of wastewater effluent may be needed for blending
Montecito Sanitary District Unused Supply = 1,000 AFY (High Reliability)				
Montecito IPR (injection)	850	$1,400	• Conveyance to potential recharge facility site	• The regulatory approval process entails extensive requirements and may take up to 2 years • Requires greater understanding and management of groundwater basin • Strong opposition to recycled water use in the service area would necessitate an extensive public outreach program • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Montecito DPR	850	$1,500	• Conveyance requirements to tie into existing distribution system • Unknown impact of regulations on treatment process	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Strong opposition to recycled water use in the service area would necessitate an extensive public outreach program

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Montecito NPR (M&I)	300	$2,400	• Distribution requirements based on previously identified demands • Includes maintenance costs required to expand existing system	• Anticipated challenges obtaining customer assurance • Many customers irrigate with groundwater, a less expensive source of supply • Strong opposition to recycled water use in the service area would necessitate an extensive public outreach program • Supply volumes are highly dependent upon individual customer behavior
Montecito NPR (Ag)	440	$2,300	• Distribution requirements to potential customers	• Anticipated challenges obtaining customer assurance • Many customers irrigate with groundwater, a less expensive source of supply • Strong opposition to recycled water use in the service area would necessitate an extensive public outreach program • Water quality, particularly salinity and pathogens, is a concern for agricultural use
Montecito IPR (surface)	1,000	$2,300	• Conveyance to potential recharge facility site	• The regulatory approval process entails extensive requirements and may take up to 2 years • Requires greater understanding of groundwater basin • Requires strategy for accessing diluent water • Strong opposition to recycled water use in the service area would necessitate an extensive public outreach program • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Summerland Sanitary District Unused Supply = 160 AFY (High Reliability)				
Summerland DPR	135	$2,100	• Conveyance requirements to tie into existing distribution system • Unknown impact of regulations on treatment process	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Public acceptance may be challenging and require extensive public outreach

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Summerland NPR (M&I)	16	$19,100	• Distribution requirements based on previously identified demands • Includes maintenance costs required to expand existing system	• High unit cost and limited demand may make this economically infeasible • Supply volumes are highly dependent upon individual customer behavior
Summerland NPR (Ag)	62	$1,400	• Distribution requirements for various previous identified demands	• Many customers irrigate with groundwater, a less expensive source of supply • Benefits are long-term and realized over time as customers participate • Water quality, particularly salinity and pathogens, is a concern for agricultural use
Carpinteria Sanitary District Unused Supply = 1,800 AFY (High Reliability)				
Carpinteria IPR (injection)	1,530	$1,200	• Conveyance to potential recharge facility site	• The regulatory approval process entails extensive requirements and may take up to 2 years. • May be a feasible means of managing suspected seawater intrusion • Ag community outreach may be required to manage the perception that only wells nearest to injection point receive benefits • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Carpinteria DPR	1,530	$1,500	• Conveyance requirements to tie into existing distribution system • Unknown impact of regulations on treatment process	• There are currently no permitted DPR projects in California • Project must be approved by DDW/RWQCB, however DPR regulatory framework does not currently exist • Potential public acceptance impediments require extensive public outreach program
Carpinteria NPR (M&I)	120	$7,000	• Distribution requirements based on previously identified demands	• Limited number of potential customers and high unit cost may make NPR economically infeasible • Storage may be required to serve night time irrigation customers • Supply volumes are highly dependent upon individual customer behavior

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Carpinteria NPR (Ag)	690	$2,200	• Distribution requirements based on previously identified demands	• It is less expensive for farmers to pump groundwater • Customer assurance may be challenging due to irrigation water quality requirements (TDS) associated with specific crop types • Potential customers are located a considerable distance from the WWTP making for costly construction and operation of infrastructure • Water quality, particularly salinity and pathogens, is a concern for agricultural use
Carpinteria IPR (surface)	1,800	$2,200	• Conveyance to potential recharge facility site	• The regulatory approval process entails extensive requirements and may take up to 2 years. • Groundwater basin recharge zone has several wells in relatively close proximity to each other, which may require relocation per regulations • Ag community outreach may be required to manage the perception that only wells nearest to recharge facilities receive benefits • The timing of recharge of recycled water would depend on available capacity in the basin, which would be defined in future specific feasibility studies
Sub-regional Graywater Supply = 4,700 AFY (Low Reliability)				
Santa Maria Graywater	790	$4,200	• Site specific retrofit needs	• Significant public outreach is required to achieve implementation rate goals • May require subsidized incentive plan to achieve goals • May require many years of program management to achieve goals • Supply benefits highly variable and dependent upon individual customer behavior
San Antonio Graywater	160	$4,200	• Site specific retrofit needs	
Santa Ynez Graywater	4,600	$4,200	• Site specific retrofit needs	
South Coast Graywater	10,800	$4,200	• Site specific retrofit needs	
Cuyama Graywater	100	$4,200	• Site specific retrofit needs	

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2. CH2M HILL, 2008. Feasibility Study of Treatment Wastewater Discharge Options. Prepared for County of Public Works Department – Laguna County Sanitation District, May 2008.
3. Lee & RO, Inc., 2010. Recycled Water Feasibility Study. Prepared for the City of Lompoc.

Table A-2: Ocean Desalination Supply Option Characterization

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
Southern SLO Plant Local Desal Supply	6,300	$2,700-$2,800	• Brine Disposal Method • Intake type and feasibility	• Nipomo Community Services District (NCSD) did not consider alternative due to cost and schedule and chose to construct the Nipomo pipeline • Requires hydrogeologic study & system feasibility study and alternatives analysis • Anticipated potential challenges from environmental community concerned about marine and energy consumptions impacts • Requires new brine outfall • Requires evaluation of NCSD distribution system and product water conveyance facility alternatives • Requires extensive regulatory approval process over a period of several years involving multiple regulatory agencies • Requires modifying long-term transfer agreement with Santa Maria in order to receive water supply benefit • May require additional transfer agreements between Santa Maria and participating agencies • Costs could be further reduced if there is an existing brine disposal well that could be used for brine disposal
Southern SLO Plant Regional Desal Supply	26,000	$1,900-$2,000	• Brine Disposal Method • Intake type and feasibility	• Same as above • Requires feasibility study to evaluate water quality and the impact from injecting desalinated ocean water • Requires agreement with CCWA for use of regional conveyance facilities
San Antonio Regional Desal	14,400	$2,200-$2,300	• Brine Disposal Method • Intake type and feasibility	• Vandenberg Air Force Base (VAFB) has indicated that they may consider partnering with the County/State in the future, for the construction of a desalination plant, should the Air Force mission ever require it. VAFB has also indicated that a desalination plant is not currently needed. • Requires hydrogeologic & intake system feasibility study and alternatives analysis • Anticipated potential challenges from environmental community concerned about marine and energy consumptions impacts. • Requires new brine outfall • Requires evaluation of VAFB distribution system and conveyance facility alternatives • Requires extensive regulatory approval process over a period of several years involving multiple regulatory agencies • Requires regional water supply agreements with participating agencies

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
				• Requires agreements with CCWA for use of the SWP Coastal Branch CCWA extension • Requires feasibility study to evaluate water quality and the impact from injecting desalinated ocean water in the SWP facilities • Water could potentially be delivered north using existing storage facilities. • Costs could be further reduced if there is an existing brine disposal well that could be used for brine disposal
Gaviota Plant Desal	460	$4,500	• Conveyance to nearest potable demand	• Requires understanding of Gaviota Plant's current and planned use • Requires agreement with Goleta Water District • Requires conveyance system to deliver water to Goleta • Anticipated potential challenges from environmental community concerned about marine and energy consumptions impacts. • Requires extensive regulatory approval process over a period of several years involving multiple regulatory agencies • Costs could be further reduced if there is an existing brine disposal well that could be used for brine disposal
Montecito Plant Desal	2,800	$2,700-$2,900	• Brine Disposal Method • Intake type and feasibility	• Feasibility study is being conducted • Requires detailed intake system feasibility study and alternatives analysis • Requires analysis for the use of Montecito Sanitary District's (MSD) existing outfall for brine disposal • Requires extensive regulatory approval process over a period of several years involving multiple regulatory agencies • Anticipated potential challenges from environmental community concerned about marine and energy consumptions impacts • Close proximity to Santa Barbara plant may impact permitting and acceptance • Costs could be further reduced if there is an existing brine disposal well that could be used for brine disposal
Santa Barbara Local Plant Desal Supply	3,100	$2,400	• Equipment needed to bring online	• Requires rehabilitation of existing plant
Santa Barbara Plant Regional Desal Supply	10,000	$3,100	• Equipment needed to reach capacity	• Requires additional equipment for expanded treatment capacity • May require additional permitting/environmental efforts • Requires agreements between participating agencies • Will invalidate Montecito individual plant option

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Drivers	Implementation Considerations
				• Potential for lack of support from environmental community concerned about increasing use above "emergency" needs. • Costs could be further reduced if there is an existing brine disposal well that could be used for brine disposal

Table A-3: Stormwater / Surface Water Supply Option Characterization

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Santa Maria River – Twitchell Reservoir Flood Release Unused Supply = 7,600 AFY (Lower Reliability)				
Twitchell Sediment Removal	4,300	$9,100-$37,000	Sediment removal method	• Requires feasibility study of sediment removal and disposal method • Requires consideration of sediment impacts on existing outlet works • Requires extensive environmental considerations and permitting requirements • Implementing a watershed management plan may help limit sedimentation • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Twitchell Dam Modifications	5,800	$4,600 - $10,700	Spillway raise method	• Requires study to assess feasibility of raising spillway • Potential inundation impacts to vegetation, structures, and roadways including the California State Highway 166 • Requires updated catastrophic failure analysis and inundation mapping • Could have sedimentation impacts on upstream reaches as water level increases • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Twitchell Operational Modifications	7,600	$12	Operational modification Study	• Requires reservoir modeling study to assess the potential for modifying the existing operational rule curve • Requires coordination with and approval from the US Army Corps of Engineers • Water has gone above the rule curve three times in the past and surcharged conservation water in the flood pool • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Santa Maria Diversions to Spreading Basins	400-5,600	$15,300-$45,700	• Land cost • Conveyance to higher elevation recharge	• River has historically provided passage for steelhead spawning and rearing habitat in the upper reaches of the Sisquoc River[1] • Securing water rights for diversion could challenging due to fish habitat • Requires acquisition of significant land to construct spreading grounds • More costly increments of supply require extending spreading facilities to land located at higher elevation • Large infrastructure is needed and will be used infrequently

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Santa Maria Diversion for Ag Spreading	3,300	$5,500-$35,900	Conveyance to higher elevation recharge	• River has historically provided passage for steelhead spawning and rearing habitat in the upper reaches of the Sisquoc River[1] • Securing water rights for diversion could challenging due to fish habitat • Requires land use agreements for spreading in non-irrigation season • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • More costly increments of supply require extending the ag spreading program to land located at higher elevation • Large infrastructure is needed and will be used infrequently • Recharge using agricultural lands could trigger food safety and water quality concerns
Santa Maria Diversions to Off Stream Storage (Ag)	9	$20,500	Supply is too small relative to costs	• River has historically provided passage for steelhead spawning and rearing habitat in the upper reaches of the Sisquoc River[1] • Securing water rights for diversion could challenging due to fish habitat • Requires land use agreements for spreading in non-irrigation season
Santa Maria River In-Stream Recharge Enhancements	Unknown	No costs estimated	No costs estimated	• Volume and cost cannot be determined at this time • May require securing water rights with SWRCB for use of water as recharge and permitting to allow for installation of rubber dams
Sisquoc River – Wet Weather Unused Supply = 9,500 AFY (Lower Reliability)				
Sisquoc River Diversions to Spreading Basins	2,500	$2,800	• Land cost • Conveyance to recharge facilities	• The Sisquoc River provides passage for steelhead spawning and rearing habitat[1] • Securing water rights for diversion could challenging due to fish habitat • Requires acquisition of significant land to construct spreading grounds • Potential opportunity for reuse of graveling mining pits for spreading grounds
Sisquoc River Diversions for Ag Spreading	2,500	$2,600	Conveyance to recharge facilities	• The Sisquoc River provides passage for steelhead spawning and rearing habitat[1] • Securing water rights for diversion could challenging due to fish habitat • Requires land use agreements for spreading in non-irrigation season • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • Recharge using agricultural lands could trigger food safety and water quality concerns
Sisquoc River Diversions to Off Stream Storage	30	$9,500	Supply is too small relative to costs	• The Sisquoc River provides passage for steelhead spawning and rearing habitat[1] • Securing water rights for diversion could challenging due to fish habitat • Requires land use agreements for spreading in non-irrigation season

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Round Corral Reservoir	6,700	$2,100	Reservoir capacity	• May require downstream spreading facilities since Twitchell releases utilize Santa Maria in-stream recharge capacity[2] • Could have adverse impacts to steelhead spawning and rearing habitat[1] • The project site is owned by Sisquoc Ranch[2] • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Santa Maria River – Increased Supply = 12,290 AFY (Lower Reliability)				
Santa Maria Watershed Management	530	$500	Extent of vegetation management	• Vegetation removal through controlled burns may have adverse impacts on wildlife habitat • There is limited analysis that can correlate vegetation removal to new water supply • Requires coordinated resource management agreement with state and federal resource and land management agencies
Santa Maria Phreatophyte Removal	60	$5,200	Extent of phreatophyte invasion	• Vegetation removal, focusing on invasive species such as arundo and tamarisk, may have adverse impacts on wildlife habitat • There is limited analysis that can correlate phreatophyte removal to new water supply[3]
Santa Maria Antitranspirant	30	$9,900	Extent of phreatophyte invasion	• Antitranspirant application may have adverse impacts on riparian habitat and surface water quality • Public acceptance challenges are anticipated
Twitchell Reservoir Cover	11,700	$300	Coverage area	• Operating level is highly variable and reservoir frequently runs dry • Size and operations of reservoir present cover maintenance challenges so costs are not really knows to secure supply
Santa Maria Surfactant	6,600	$100	Application method	• Manufacturers claim no adverse impacts on habitat or water quality • Is not currently widely used in drinking water supply evaporation reduction • Public acceptance challenges are anticipated • Requires developing a plan for application maintenance
Santa Maria River – Increased Urban Stormwater Unused Supply = 1,100 AFY (Lower Reliability)				
Santa Maria Rain Barrels	5-15	$5,500	Favorability of site specific conditions	• Significant public outreach is require to achieve implementation rate goals • Supply volumes are highly dependent upon individual customer behavior • May require subsidized incentive plan to achieve goals • May require many years of program management to achieve goals • Benefits are long-term and realized over time as customers participate
Santa Maria Cisterns	150-380	$5,500	Favorability of site specific conditions	

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Santa Antonio Creek – Wet Weather Unused Supply = 1,400 AFY (Lower Reliability)				
San Antonio Creek Diversions to Spreading Basins	1,400	$1,000	• Land cost • Conveyance to recharge facilities	• Requires securing water rights for diversion with SWRCB • Requires acquisition of significant land to construct spreading grounds
San Antonio Creek Diversions for Ag Spreading	1,400	$80	Conveyance to recharge facilities	• Requires securing water rights for diversion with SWRCB • Requires land use agreements for spreading in non-irrigation season • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • Recharge using agricultural lands could trigger food safety and water quality concerns
San Antonio Creek Diversions to Off Stream Storage	2,000	$5,700	• Land cost • Conveyance to storage	• Requires securing water rights for diversion with SWRCB • High unit cost may make this option economically infeasible
San Antonio Creek Reservoir	1,400	$2,400	Reservoir capacity	• Previously identified sites are not ideal for dam construction[2] • Reservoir would overly highly permeable alluvium[2] • Option was screened out of previous alternatives analysis[2]
San Antonio Creek In-Stream Recharge Enhancements	Unknown	No costs estimated	No costs estimated	• Volume and cost cannot be determined at this time • May require securing water rights with SWRCB for use of water as recharge and permitting to allow for installation of rubber dams
San Antonio Creek – Urban Stormwater Unused Supply = 40 AFY (Lower Reliability)				
San Antonio Rain Barrels	1	$5,500	Favorability of site specific conditions	• Significant public outreach is require to achieve implementation rate goals • Supply volumes are highly dependent upon individual customer behavior • May require subsidized incentive plan to achieve goals • May require many years of program management to achieve goals • Benefits are long-term and realized over time as customers participate
San Antonio Cisterns	3-7	$5,500	Favorability of site specific conditions	
San Antonio Urban Runoff for Recharge	3-7	$2,000	Favorability of site specific conditions	

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
San Antonio Creek – Increased Supply = 400 AFY (Lower Reliability)				
San Antonio Phreatophyte Removal	400	$5,200	Extent of phreatophyte invasion	• Vegetation removal, focusing on invasive species such as arundo and tamarisk, may have adverse impacts on wildlife habitat • There is limited analysis that can correlate phreatophyte removal to new water supply[3]
San Antonio Antitranspirant	200	$9,900	Extent of phreatophyte invasion	• Antitranspirant application may have adverse impacts on riparian habitat and surface water quality • Public acceptance challenges are anticipated
Cuyama River– Wet Weather Unused Supply = 4,400 AFY (Lower Reliability)				
Cuyama River Diversions to Spreading Basins	4,400	$600	• Land cost • Conveyance to recharge facilities	• Requires securing water rights for diversion with SWRCB • Requires acquisition of significant land to construct spreading grounds • Potential opportunity for reuse of gravel mining pits for spreading grounds
Cuyama River Diversions for Ag Spreading	4,400	$60	Conveyance to recharge facilities	• Requires securing water rights for diversion with SWRCB • Requires land use agreements for spreading in non-irrigation season • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • Recharge using agricultural lands could trigger food safety and water quality concerns
Cuyama River Diversions to Off Stream Storage	28	$9,600	Supply is too small relative to costs	• Requires securing water rights for diversion with SWRCB • High unit cost may make this option economically infeasible
Cuyama River – Urban Stormwater Unused Supply = 14 AFY (Lower Reliability)				
Cuyama Rain Barrels	1	$5,500	Favorability of site specific conditions	• Significant public outreach is require to achieve implementation rate goals • Supply volumes are highly dependent upon individual customer behavior • May require subsidized incentive plan to achieve goals • May require many years of program management to achieve goals • Benefits are long-term and realized over time as customers participate
Cuyama Cisterns	1-2	$5,500	Favorability of site specific conditions	
Cuyama Urban Runoff for Recharge	1-3	$2,000	Favorability of site specific conditions	

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Santa Ynez River– Cachuma Spill Unused Supply = 56,000 AFY (Lower Reliability)				
Cachuma Sediment Removal	700-6,600	$9,200-$15,000	Sediment removal method	• Requires feasibility study of sediment removal and disposal method • Requires extensive environmental considerations and permitting requirements • Implementing a watershed management plan may help limit sedimentation • May require coordinated resource management agreement with state and federal resource and land management agencies • Flushing is not considered a feasible option for Lake Cachuma due to the need to drain the reservoir and dependence on the supply • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Cachuma Flashboard Increase	3,700	$20	Flashboard Increase	• Requires surveying to evaluate potential inundation to Cachuma Lake Park boat ramp, restaurant, water treatment plant, and vegetation • Potential incremental improvement project to further optimize existing freeboard when no risk of probably maximum flood • Requires updated catastrophic failure analysis and inundation mapping • May require coordinated resource management agreement with state and federal resource and land management agencies • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Lower Lompoc Reservoir	3,190	$3,400	Reservoir capacity	• Requires auxiliary dam, dike, and relocation of 4.5 miles of State Highway 1[2] • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Gibraltar Sediment Removal	3,700	$9,200	Sediment removal method	• Requires sediment disposal strategy • May require analysis of downstream sediment transport and effect on to Cachuma for certain removal strategies • Requires extensive environmental considerations and permitting requirements • Watershed management plan may limit future accumulation of sediment, but the size and topography of the watershed makes implementation challenging[4] • Flushing is not considered a feasible option for sediment removal in Gibraltar Reservoir due to the existing dam structure • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Gibraltar Dam Modifications	110	$280	Spillway raise	• Impacts of higher water levels to surrounding land and infrastructure will need to be evaluated.

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
				• Santa Barbara working to store Gibraltar water in Cachuma as part of the Pass Through Agreement rather than expanding capacity[4] • Requires modification of Pass Through Agreement • Requires establishment of yield obligations based on prior rights[2] • Requires updated catastrophic failure analysis and inundation mapping • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Salsipuedes Creek Reservoir	2,850	$2,000	Reservoir capacity	• Inundation impacts on 1,000 acres of farmland, diatomite deposits, and requires relocation of State Highway 1 and Jalama Road[2] • Two large landslides have been mapped near the site[2] • Requires establishment of yield obligations based on prior rights[2] • Recharge operations could improve groundwater quality in the Lompoc Plain • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Jameson Sediment Removal	850	$2,300 - $9,200	Sediment removal method	• Requires sediment disposal strategy • May require analysis of downstream sediment transport and effect on sediment transport to Gibraltar for certain removal strategies • Requires extensive environmental considerations and permitting • Watershed management plan may help limit future accumulation of sediment • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Jameson Dam Modifications	40-2,000	$300-$3,200	Dam raise method	• Requires establishment of yield obligations based on prior rights • Requires updated catastrophic failure analysis and inundation mapping • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Santa Ynez Diversions to Spreading Basins	Up to 40,000	$2,800-$85,100	• Land cost • Conveyance to recharge facilities	• Must consider NMFS biological opinion for future River operations • Challenges in securing diversion rights given potential impact to fish passage • Requires acquisition of significant land to construct spreading grounds • Upland groundwater basins must be used for storage, which requires pumping to spreading grounds
Santa Ynez Diversions for Ag Spreading	Up to 40,000	$2,600-$85,000	Conveyance to recharge facilities	• NMFS prepared a biological opinion for Cachuma operations, which must be considered in future Santa Ynez River operations • Challenges in securing diversion rights given potential impact to fish passage

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
				• Upland groundwater basins must be used for storage, which requires pumping to spreading grounds • Requires land use agreements for spreading in non-irrigation season • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • Recharge using agricultural lands could trigger food safety and water quality concerns
Santa Ynez Diversions to Off Stream Storage	37-4,800	$9,400	• Storage type • Storage capacity	• Must consider NMFS biological opinion for future River operations • Challenges in securing diversion rights given potential impact to fish passage • Requires land acquisition
Glenn Annie Reservoir Improvements	40	$4,800	Seismic upgrade method	• Previous study determined that the cost of seismic retrofit ($2.8M in 2003) makes this supply option economically infeasible. A capital cost of $2M would result in a benefit to cost ratio greater than 1.[5] • Lower cost methods for seismic upgrades should be evaluated in order to provide an acceptable factor of safety.[5] • Implementing options in in-stream reservoirs will continue to be challenging to implement given past and current environmental and regulatory issues
Santa Ynez River– Urban Stormwater Unused Supply = 2,800 AFY (Lower Reliability)				
Santa Ynez Rain Barrels	3-7	$5,500	Favorability of site specific conditions	• Significant public outreach is require to achieve implementation rate goals • Supply volumes are highly dependent upon individual customer behavior • May require subsidized incentive plan to achieve goals • May require many years of program management to achieve goals • Benefits are long-term and realized over time as customers participate
Santa Ynez Cisterns	95-240	$5,500	Favorability of site specific conditions	
Santa Ynez Urban Runoff for Recharge	90-220	$2,000	Favorability of site specific conditions	
Santa Ynez River– Increased Supply = 15,310 AFY (Lower Reliability)				
Santa Ynez Watershed Management	1,810	$540	Extent of vegetation management	• Vegetation removal through controlled burns may have adverse impacts on wildlife habitat • There is limited analysis that can correlate vegetation removal to new water supply • Requires coordinated resource management agreement with state and federal resource and land management agencies

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Santa Ynez Phreatophyte Removal	2,400	$5,200	Extent of phreatophyte invasion	• Vegetation removal, focusing on invasive species such as arundo and tamarisk, may have adverse impacts on wildlife habitat • There is limited analysis that can correlate phreatophyte removal to new water supply[3] • Requires coordinated resource management agreement with state and federal resource and land management agencies
Santa Ynez Antitranspirant	600	$9,800	Extent of phreatophyte invasion	• Antitranspirant application may have adverse impacts on riparian habitat and surface water quality • Public acceptance challenges are anticipated in use of antitranspirant • Requires coordinated resource management agreement with state and federal resource and land management agencies
Cachuma Reservoir Cover	10,000	$300	Coverage area	• Operating level is highly variable and reservoir frequently runs dry • Size and operations of reservoir present cover maintenance challenges so costs are not really knows to secure supply • Requires coordinated resource management agreement with state and federal resource and land management agencies
Cachuma Surfactant	5,600	$100	Application method	• Manufacturers claim no adverse impacts on habitat or water quality • Is not currently widely used in drinking water supply evaporation reduction • Public acceptance challenges are anticipated • Requires developing a plan for application maintenance • Requires coordinated resource management agreement with state and federal resource and land management agencies
South Coast Streams – Wet Weather Unused Supply = 5,000 AFY (Lower Reliability)				
San Jose Creek Diversions to Spreading Basins	1,000	$4,400-$6,200	• Land cost • Conveyance to recharge facilities	• Challenges in securing diversion rights given potential impact to fish passage • Requires acquisition of adjacent land parcels to construct spreading grounds • Topography in rural upland areas is not conducive for spreading grounds • Limited agricultural land in lowland areas overlying basin
San Jose Creek Diversions for Ag spreading	1,000	$700-$2,900	Conveyance to recharge facilities	• Challenges in securing diversion rights given potential impact to fish passage • Requires land use agreements for spreading in non-irrigation season • Topography in rural upland areas is not conducive for spreading grounds • Limited agricultural land in lowland areas overlying basin • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • Recharge using agricultural lands could trigger food safety and water quality concerns

Supply Option	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Carpinteria Creek Diversions to Spreading Basins	3,000	$4,800	• Land cost • Conveyance to recharge facilities	• Challenges in securing diversion rights given potential impact to fish passage • Requires acquisition of adjacent land parcels to construct spreading grounds
Carpinteria Creek Diversions to Ag spreading	3,000	$200	Conveyance to recharge facilities	• Challenges in securing diversion rights given potential impact to fish passage • Requires agreements with farmers for spreading in non-irrigation season • Orchards crops adjacent to Creek can be sensitive to over irrigation practices • Some agricultural land owners grow crops year-round, and therefore have no non-irrigation season • Recharge using agricultural lands could trigger food safety and water quality concerns
Santa Monica Creek concrete channel de-lining	200	No costs estimated	No costs estimated	• Challenges in securing diversion rights given potential impact to fish passage • Requires permits for stream channel alteration
South Coast – Urban Stormwater Unused Supply = 7,000 AFY				
South Coast Rain Barrels	5-15	$5,500	Favorability of site specific conditions	• Significant public outreach is require to achieve implementation rate goals • Supply volumes are highly dependent upon individual customer behavior • May require subsidized incentive plan to achieve goals • May require many years of program management to achieve goals
South Coast Cisterns	220-550	$5,500	Favorability of site specific conditions	
South Coast Urban Runoff for Recharge	90-210	$2,000	Favorability of site specific conditions	

References:

1. Stillwater Sciences, 2012. Potential for aquifer storage and recovery in the Santa Maria River basin – Technical Memorandum. Prepared for Ocean Protection Council, April 9, 2012
2. DWR, 1985. Santa Barbara County State Water Alternatives.
3. Warner, Richard E., and Kathleen M. Hendrix, editors California Riparian Systems: Ecology, Conservation, and Productive Management. Berkeley: University of California Press, 1984.
4. Stetson Engineers Inc., 2013. Hydrologic Analyses of the Pass Through Operations at Gibraltar Reservoir. Prepared for the City of Santa Barbara, July 2013
5. Goleta Water District, 2002. Glen Annie Reservoir Conceptual Analysis of Beneficial Uses. July, 2002.

Table A-4: Imported Water Supply Option Characterization

Description	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
State Water Project Unused Supplies = 30,200 AFY (Moderate Reliability)				
SB Undelivered SWP for Direct Use	7,500	$1,700	Variable cost of energy for SWP system O&M	• If the Table A Allocation for a given year is not fully delivered to a SWP contractor, then the remaining volume may be stored in San Luis Reservoir as carryover water. However, if San Luis Reservoir spills, carryover water will be lost. • Storage of carryover water in San Luis Reservoir is typically part of a sound water management plan. • In a spill event at San Luis Reservoir, SWP Contractors may purchase Article 21 water, with the condition that the SWP Contractor takes delivery of the Article 21 water during the spill event. The amount of Article 21 water available is the volume of the spill and will be allocated based on the Table A amount of the SWP Contractors requesting Article 21 water • Local use or exchange of undelivered supply avoids potential loss of carryover, exchange or transfer water. • The current SWP Contract prohibits a direct non-permanent sale of SWP water from one contractor to another. Exchanges between contractors are allowed, with approval from DWR (contract is executed). The exchange may be 1:1 or may be uneven exchanges, depending on the specific deal. Any cost per AF needs to be based on an operational justification, due to the prohibition of selling water from one contractor to another. • The SWP Contract has provisions for a Turnback Pool, which facilitates water sales from one SWP Contractor to another. However, the revenue per acre-foot to the Contractor selling through the Turnback Pool is inconsequential when compared with direct Contractor to Contract exchanges. • Exchange requirements preclude non-contractors from participation • Timing must be considered for imported water deliveries as deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply

Description	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
SB Undelivered SWP for Spreading Basins	6,300	$2,800	• Conveyance to recharge facility • Variable cost of energy for SWP system O&M	• Banking undelivered supplies closer to demands may be more secure than banking undelivered supplies at a remote location. • Banking program will require use of SWP infrastructure to convey groundwater when SWP supply is inaccessible for participant's withdrawal • CCWA is actively pursuing potential participation in groundwater banking operations with other SWP Contractors. • Concerns for loss of water have been raised regarding the security of groundwater banking. • Basin management framework (supported by the Sustainable Groundwater Management Act) will be needed to secure a local bank • Timing must be considered for imported water deliveries as deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply
SB Undelivered SWP for Injection Wells	6,300	$1,900		
SB Suspended Table A	8,000	$600	Variable cost of energy for SWP system O&M	• CCWA is pursuing the reacquisition of Suspended Table A Water. Anticipated cost of $2,500/AF for infrastructure back pay (approximately $30M) plus $150/AFY for ongoing costs until 2035 • Timing must be considered for imported water deliveries as deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply • DWR has not confirmed Santa Barbara County's exclusive rights to Suspended Table A water
SLO Undelivered SWP	3,400	$650	• Variable cost of energy for SWP system O&M • Base price of water	• Requires negotiations with SLOCFC&WCD to develop exchange or potential future transfer program. DWR approval is also required. • Same considerations as SB Undelivered SWP supplies apply. • Timing must be considered for imported water deliveries as deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply
SWP Article 21	5,000	$400	Variable cost of energy for SWP system O&M	• Additional water beyond Table A allocations are stored in SWP system, such as carryover water, transfer water and exchange water. • Delivery of Article 21 supplies occurs only during a spill event at San Luis Reservoir, at which time all non-current year Table A allocation water is lost, depending on priority and volume of spill.

Description	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
				• Timing must be considered for imported water deliveries as deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply
SWP Turnback Pools	600	$400	Variable cost of energy for SWP system O&M	• Turnback pool supplies are not expected to be available in the future as the value of water outweighs DWR's reimbursement for turning back supplies • Timing must be considered for imported water deliveries as deliveries made to Lake Cachuma during wet years (when Lake Cachuma is spilling) would result in a loss of supply
Non-SWP Unused Supplies = Indeterminable (Unknown Reliability)				
Undelivered CA Imports (Direct use or GWR)	Not known	$900-$1,700	• SWP wheeling charges • Base price of water	• Required identification and nego tiations with water rights holders • Wheeling charges and Delta carriage losses apply • Transfers may be subject to litigation through environmental review • DWR has curtailment programs with senior water rights holders to limit percentage of land to fallow • Transfers are typically from non-SWP Contractors, almost exclusively from agriculture operations north of the Delta. Due to transporting this source of water through the Delta, carriages losses will occur.
Alaskan River	6,000	$4,600-$4,900	Conveyance method (bags vs tanker)	• Requires extra-regional participation due to magnitude of supplies (up to 600,000 AFY) and capital costs (over $10 billion) to make economically viable[1] • Projects may take up to 40 years for planning, permitting, design, and implementation[1] • Technical feasibility may be characterized as relatively low since such operations at this scale are largely unprecedented. [1]
Alaskan Icebergs	2,000	$4,600	Conveyance Distance	
Columbia River	6,000	$5,600	Conveyance Distance	
Missouri River	6,000	$3,100	Conveyance Distance	
Mississippi River	6,000	$4,000	Conveyance Distance	

References:

1. U.S. Department of Interior, Bureau of Reclamation (USBR), 2012. Colorado River Basin Water Supply and Demand Study.

Table A-5: Groundwater Supply Option Characterization

Description	Supply (AFY)	Unit Cost ($/AF)	Cost Sensitivity Driver	Implementation Considerations
Santa Ynez Uplands Basin Chrom-6 Treatment	9,800	$400 - $900	Chosen treatment/ blending scenario	• 500 AFY is new supply while the remaining volume is re-acquired supply that was lost due to new 2014 MCLs[1]
Santa Maria Basin TDS Treatment	12,000	$1,100 - $1,400	Brine disposal method[2]	• Groundwater desalting limits the need for Santa Maria to blend imported water to manage TDS for potable use • Groundwater basin yield must be considered when evaluating treatment/blending scenarios

References:

1. Dudek, 2014b. Water Supply Alternatives Analysis / Feasibility Study Report. Compliance Program – Hexavalent Chromium Maximum Contaminant Level. Prepared for Santa Ynez Water Conservation District Improvements District No. 1.
2. CH2M HILL, 2009. Evaluation of Groundwater Treatment Reverse Osmosis Concentrate Disposal. Prepared for City of Santa Maria Utilities Department.

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