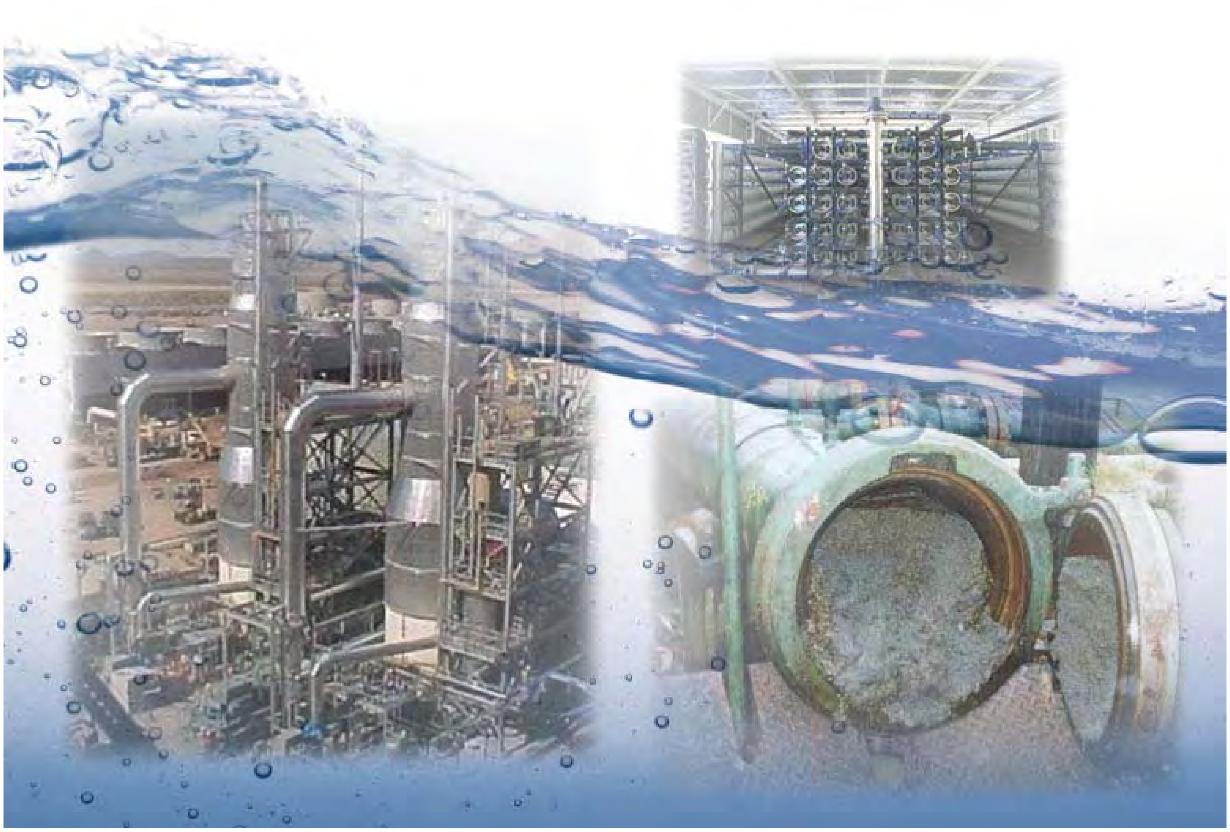
RECLAMATION

Managing Water in the West

Pilot / Demonstration Projects Evaluation Report

Southern California Regional Brine-Concentrate Management Study – Phase I
Lower Colorado Region



U.S. Department of the Interior
Bureau of Reclamation

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Abbreviations and Acronyms

ACP	alternative compliance plan
AF	acre-feet
afy	acre-feet per year
AOP	advanced oxidation process
ATF	advanced treatment facility
AWPF	advanced water purification facility
AWTF	advanced water treatment facility
AWT	advanced water treatment
AWS	automatic water softeners
BBARWA	Big Bear Area Regional Wastewater Agency
BEMT	brine executive management team
BMP	best management practice
BOD	biochemical oxygen demand
CBDA	Chino Basin Desalter Authority
CCWMP	Calleguas Creek Watershed Management Plan
CDPH	California Department of Public Health
CEC	constituent of concern
CEQA	California Environmental Quality Act
CIP	Capital Improvement Plan
CLWA	Castaic Lake Water Agency
CTR	California toxic rule
CSD	Community Service District
DWI	deep well injection
EDR	electrodialysis reversal
EIR	Environmental Impact Report
EMWD	Eastern Municipal Water District

ft^2	square feet
FO	forward osmosis
gpd	gallons per day
gpm	gallons per minute
GREAT	Groundwater Recovery Enhancement and Treatment
GSWIM	groundwater/surface water interaction model
IEUA	Inland Empire Utilities Agency
IPR	indirect potable reuse
IX	ion exchange
JOS	Joint Outfall System
JPA	Joint Powers Authority
JWPCP	Joint Water Pollution Control Plant
kgal	kilogallon
kW-hr	kilowatt-hour
LVL	Leo Vander Lans Advanced Water Treatment Facility
MCA	multicriteria analysis
MD	membrane deionization
MF	microfiltration
MFP	master facilities plan
mgd	million gallons per day
mg/L	milligrams per liter
MM	management measures
MNWD	Moulton Niguel Water District
MWD	Municipal Water District
MWDSC	Metropolitan Water District of Southern California
MW	megawatt
NF	nanofiltration
NPDES	National Pollutant Discharge Elimination System
No.	Number

NRWRP	Newhall Ranch Water Reclamation Plant
NSMP	Nitrogen Selenium Management Plan
O&M	operations and maintenance
OCWD	Orange County Water District
OCSD	Orange County Sanitation District
PS	precipitative softening
PV	photovoltaic
RCWD	Rancho California Water District
Reclamation	United States Department of the Interior Bureau of Reclamation
RO	reverse osmosis
RWQCB	Regional Water Quality Control Board
SALT_PROC	Salt Solidification and Sequestration
Sanitation Districts	Sanitation Districts of Los Angeles County
SARI	Santa Ana Regional Interceptor
SAWPA	Santa Ana Watershed Project Authority
SBOO	South Bay Ocean Outfall
SCADA	Supervisory Control and Data Acquisition
SCVSD	Santa Clarita Valley Sanitation District
SCWD	South Coast Water Distirct
SDCWA	San Diego County Water Authority
Semitropic	Semitropic Water Storage District
SMP	Salinity Management Pipeline
SOCWA	South Orange County Wastewater Authority
SONGS	San Onofre Nuclear Generating Station
SPARRO	Slurry Precipitation and Recycle Reverse Osmosis
SS	suspended solids
SSO	site-specific objectives
SWP	State Water Project
SWRP	Saugus Water Reclamation Plant

TDS	total dissolved solids
TIRE	Terminal Island Renewable Energy
TMDL	total maximum daily load
TOC	total organic carbon
TVRI	Temecula Valley Regional Interceptor
µg/L	micrograms per liter
U.S.	United States
USCR	Upper Santa Clara River
USDW	Underground Source of Drinking Water
USEPA	United States Environmental Protection Agency
USGVMWD	Upper San Gabriel Valley Municipal Water District
UV	ultraviolet
VSEP	Vibratory Shear Enhanced Process
VWRP	Valencia Water Reclamation Plant
WDR	water discharge requirement
WIN	Water Independence Now
WPCP	water pollution control plant
WQO	water quality objective
WRD	Water Replenishment District of Southern California
WRP	water reclamation plant
WTP	water treatment plant
WWRF	wastewater reclamation facility
WWTP	wastewater treatment plant
ZLD	zero liquid discharge

1 Introduction and Study Objectives

This section of the report has the following subsections:

- Introduction
- Study Objectives
- Study Components
- Report Objectives

1.1 Introduction

The Southern California Regional Brine-Concentrate Management Study is a collaboration between the United States (U.S.) Department of the Interior Bureau of Reclamation (Reclamation) and 14 local and state agency partners. Table 1.1 provides a list of the agencies represented on the Brine Executive Management Team (BEMT). The project is funded on a 50/50 cost-sharing basis between Reclamation and the cost-sharing partners, who together form the BEMT. The purpose of the BEMT is to formulate, guide, and manage technical activities of the study. Figure 1.1 shows a map of the study area.

TABLE 1.1
LIST OF BEMT MEMBERS

List of BEMT Members	
City of San Bernardino	Orange County Sanitation District
California Department of Water Resources	Otay Water District
City of San Diego	Rancho California Water District
Inland Empire Utilities Agency	San Diego County Water Authority
Sanitation Districts of Los Angeles County	Santa Ana Watershed Project Authority
Los Angeles Department of Water and Power	U.S. Department of the Interior Bureau of Reclamation
Metropolitan Water District of Southern California	Western Municipal Water District
National Water Resources Institute/ Southern California Salinity Coalition	

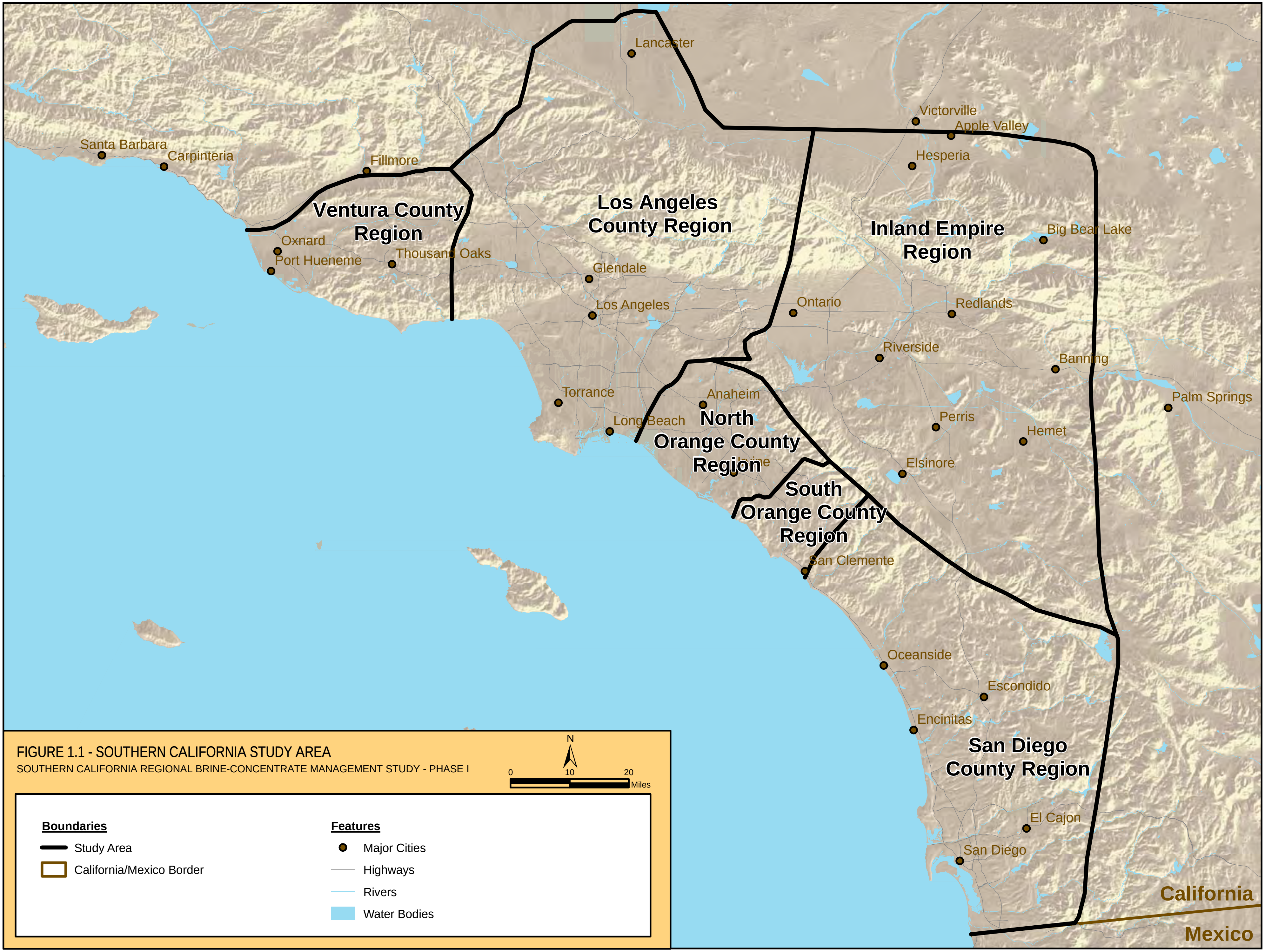

FIGURE 1.1 - SOUTHERN CALIFORNIA STUDY AREA
SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

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1.2 Study Objectives

The objectives of this study are twofold:

- To assess the brine-concentrate landscape in southern California including brine-concentrate management technologies, regulatory environment, existing infrastructure, and future needs
- To make recommendations for Phase II pilot/demonstration projects

To accomplish these objectives, the study will develop six reports that ultimately will be incorporated into a final report.

1.3 Study Components

The Southern California Regional Brine-Concentrate Management Study has six major components. Each component is focused on providing a piece of the southern California brine-concentrate management landscape. Each component will be summarized in a draft report that will be incorporated into the Final Study Report. The six components of the study are:

- Survey Report – A regional survey to collect data from local agencies about the brine-concentrate landscape in southern California
- Regulatory Issue and Trends Report – A summary of regulatory issues and trends associated with implementing a brine-concentrate project in southern California
- CECs Report – A summary of constituents of emerging concern (CECs) and how regulation of CECs might affect brine-concentrate management in southern California
- Institutional Issues Report – A summary of organizational structures that can be used to foster collaborative relationships between agencies implementing brine-concentrate management projects
- Brine-Concentrate Management Treatment and Disposal Options Report – A summary of brine-concentrate technologies and identification of potential local and regional solutions
- Pilot/Demonstration Project Recommendations Report – A list of recommended pilot/demonstration projects that could be implemented in the inland and coastal areas southern California

These six reports will be incorporated as appendices in the Final Study Report. The Final Report will provide highlights and conclusions of the six component reports in an executive summary format.

1.4 Report Objectives

The objective of this report is to identify up to ten pilot/demonstration projects for potential further evaluation in Phase II of this Project. These projects were identified during the evaluation and analysis of the survey data, during a series of regional meetings, and from information provided by local agencies. The regional meetings were held to review the survey results, review deficiencies in brine-concentrate management, and identify local agency potential projects. This report consists of a description of each of the 34 projects followed by a comparison of the projects using a multicriteria analysis (MCA) approach.

2 Calleguas Salinity Management Pipeline System

2.1 Project Description

2.1.1 Full Size Project

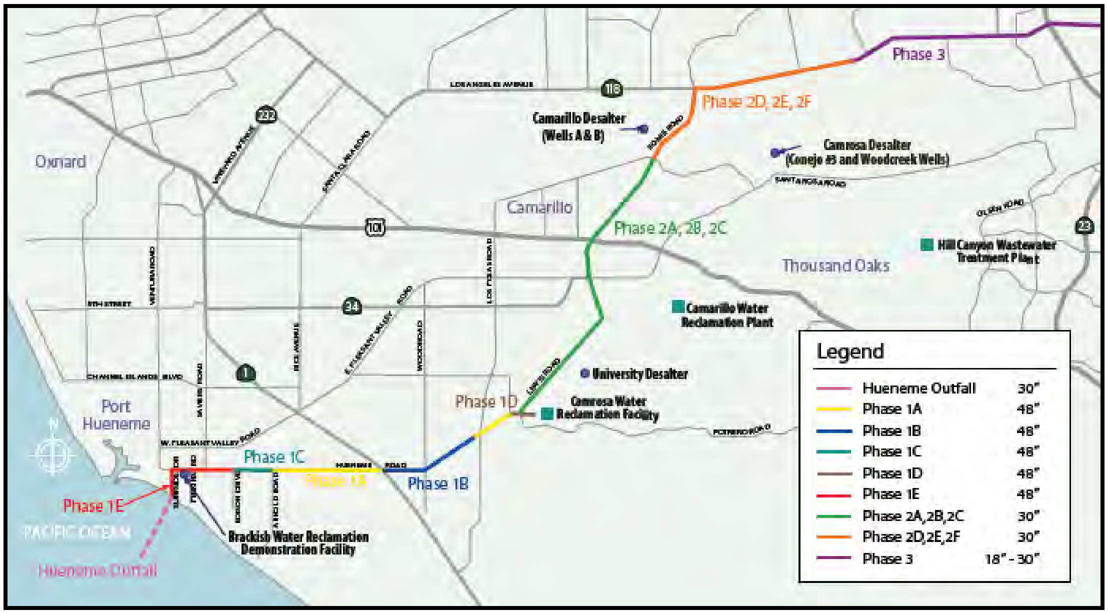
The Calleguas Creek Watershed has increasing salinity levels in both its surface water and groundwater supplies. These water sources have high concentrations of salts, including total dissolved solids (TDS), boron, sulfate, and chloride. Increasing salinity causes many problems for the watershed. Groundwater must be mixed with imported water to meet water quality requirements for drinking water. Water high in salinity concentration is harmful to agriculture. Additionally, habitat can be adversely affected by high salinity levels in soils and surface water.

The high levels of salt in the soil and water supplies are mainly caused by point and non-point source pollution from agriculture and urbanization. The salts originate from imported water supplies, discharges from wastewater treatment plants, and fertilizer use in agricultural. These factors have resulted in Calleguas Creek and many of its tributaries being listed as "impaired" by the Los Angeles Regional Water Quality Control Board (RWQCB), and total maximum daily loads (TMDLs) have been developed for Calleguas Creek and its tributaries.

In addition to water quality problems, there are also water supply issues, as Ventura County is largely dependent on imported water sources. A primary source of imported water passes through the San Francisco Bay-Delta, as water is transported from the Bay-Delta through the State Water Project (SWP). The SWP is under high demand due to an increasing population. Additionally, there are environmental concerns that removing water from the Bay-Delta could have adverse affects on the habitat. The other primary source of imported water is the Colorado River Aqueduct, which supplies water to other states, including Nevada and Arizona. As population increases in these states, water demand from the Colorado River Aqueduct increases, further stressing the region's water supplies.

Due to the water quality issues of local supplies, water must be treated before being used. Reverse osmosis (RO) can be used to remove salts and other constituents from these supply sources. However, RO produces a brine-concentrate that must be properly disposed. The Calleguas Regional Salinity Management Pipeline (SMP) will provide a discharge mechanism for brine concentrate produced from RO. The SMP will collect concentrate produced from numerous sources. These sources include brackish groundwater for municipal, industrial, and agricultural purposes, demineralization of potable water for high-tech industrial purposes, recycled water from municipal wastewater treatment plants. The SMP will convey the flows to areas for reuse, or discharge to the ocean when there are insufficient demands for reuse. Figure 2.1 provides a schematic of the SMP system.

FIGURE 2.1 CALLEGUAS REGIONAL SALINITY MANAGEMENT PIPELINE



Source: Calleguas Regional Salinity Management Project, Channel Counties Water Utilities Association, 2008.

The Calleguas SMP will be constructed in nine phases and will ultimately connect the West Simi Valley Desalter with the Hueneme Outfall. The SMP will eventually connect at least six desalters, five wastewater treatment plants (WWTPs)/water reclamation plants (WRPs), and a number of industrial dischargers. The initial phase of construction of the project began in 2004 and is scheduled to be completed in 2019. The capacity of the SMP is 20 million gallons per day (mgd), which should be sufficient to convey brine-concentrate flow to the ocean. However, if all upstream WWTPs/WRPs discharge all of their flows, then the SMP will not have adequate capacity. The pipeline will ultimately extend from the eastern end of the city of Simi Valley, through the cities of Moorpark, Camarillo, Oxnard, and areas of unincorporated Ventura County.

The SMP will provide numerous benefits to water supply, water quality, and the environment. Water supply benefits include enabling local water agencies to develop new local water from existing groundwater, while reducing dependence on imported water. Water quality benefits include removing up to 42,300 tons of salt per year from the watershed, and achieving TMDLs for Calleguas Creek and its tributaries. Environmental benefits include wetland restoration from recycled water and reduced greenhouse gas emissions through the use of local water supplies.

2.1.2 Pilot Description and Need

The first phase of the project is currently under construction.

2.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. However, some agencies may consider brine-concentrate reduction technologies to maximize water recovery or to reduce the brine-concentrate disposal flows.

2.3 Institutional Arrangements

Implementation of the SMP is being coordinated through the Calleguas Creek Watershed Management Plan (CCWMP). The CCWMP has been developed through a collaborative process, including representatives from cities, water purveyors, agricultural interests, natural resource agencies, and environmental organizations. The Calleguas Municipal Water District is the lead agency representing this group.

2.4 Implementability

The SMP will convey brine-concentrate flow to the ocean via a new ocean outfall. The discharge from the ocean outfall must comply with a National Pollutant Discharge Elimination System (NPDES) permit from the RWQCB. The permit requires that the discharge complies with California Ocean Plan water quality standards. The Ocean Plan establishes water quality standards and policies for discharges into the Pacific Ocean. As part of the permit, requirements will be established for monitoring the water quality and volume discharged to the ocean. Additionally, the permit requires periodic ocean sampling to confirm that the discharge is not adversely impacting the ocean environment.

3 Oxnard AWPF Brine-Concentrate Treatment Wetlands

3.1 Project Description

3.1.1 Full Size Project

The Advance Water Purification Facility (AWPF) is a part of the City of Oxnard's Groundwater Recovery Enhancement and Treatment (GREAT) program. The focus of the GREAT program is to use existing water resources more efficiently. To this end, the AWPF will provide the City with reclaimed water that can be used for landscape and agricultural irrigation, industrial process water, groundwater recharge, and seawater injection barrier. The AWPF will be constructed in two phases—the initial phase will treat approximately 8 to 9 mgd of secondary effluent and produce 6.25 mgd of product water; the buildout phase will treat approximately 33 to 37 mgd of secondary effluent and produce 25 mgd of product water. The AWPF will use microfiltration (MF), RO, and advanced oxidation to treat the secondary effluent. The use of RO will result in generation of brine-concentrate.

A portion of the brackish concentrate that the RO system will generate will be treated by an innovative wetlands system intended to reduce nutrients, heavy metals, and other toxic compounds while demonstrating the ability to use the concentrate as a beneficial resource. This treatment will begin in 2012 by treating flow ranging from 0.01 - 0.1 cfs of brine-concentrate in a demonstration wetland. Depending on the wetland performance, the demonstration wetland has hydraulic capability for up to 1.0 cfs. Discharge from the demonstration wetland will be returned to the Oxnard Wastewater Treatment Plant. This unique application of wetlands treatment is the first of its kind being used to reduce the volume of concentrate flows that use the ocean for an ultimate disposal locale. The City of Oxnard would like to use brine-concentrate to assist in rehabilitating an existing degraded wetland that feeds into the ocean. A long-term study of the efficacy of the brackish wetlands needs to be undertaken to determine if this water could be used to feed these existing degraded wetlands. The wetlands demonstration project proposed as part of the Phase 1 will help to assess the viability towards discharging the brine-concentrate into the existing wetlands.

3.1.2 Pilot Description and Need

The MF-RO and wetlands treatment processes were previously piloted prior to the final design, which was completed in 2009. The current Phase I project is scheduled to begin construction by 2010 and will include the brine-concentrate wetlands demonstration component. As part of this demonstration, varies wetland types will be utilized to determine the optimal treatment performance. These types include horizontal subsurface flow, vertical flow, and surface flow or low marsh type wetlands.

3.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or zero liquid discharge (ZLD) process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates.

3.3 Institutional Arrangements

There are no known institutional arrangements for this project.

3.4 Implementability

The City of Oxnard has received some funding from the Reclamation for the construction of the Advance Water Purification Facility. Final design is complete, and the City will soon begin construction on the first phase of the project.

4 Hyperion WWTP Water Quality Concerns

4.1 Project Description

4.1.1 Full Size Project

Water quality at the Hyperion WWTP might be affected by advanced treatment at the Donald C Tillman WRP. This advanced treatment would be driven by the need to provide high-quality recharge water for the East Valley Recharge Project. The planned recharge project would result in the implementation of RO at the Donald C. Tillman WRP, which would generate between 5 and 10 mgd of brine-concentrate depending on the size of the advanced water treatment plant. This concentrate would result in increased levels of TDS and Chloride at the Hyperion WWTP (Figure 4.1). The projected TDS level at the Hyperion WWTP with a 40 mgd advance treatment plant at the Donald C. Tillman WRP is 1,176 mg/l during low flow periods. This would impact Title 22 reuse customers supplied by the West Basin WRP, which receives secondary treated effluent from the Hyperion WWTP. In addition, increased water conservation, could further impact the influent water quality to the Hyperion WWTP and the influent water quality to the West Basin Municipal Water District's (MWD) recycled water system.

Any reduction in the quality of the Hyperion WWTP secondary influent could impact West Basin MWD's Title 22 recycled water users and impact their RO operations at their WRPs. West Basin MWD's WRPs serves polished water to a number of industrial users for cooling water and boiler make-up water. These uses require consistently high-quality water as specified in the user contracts. If the water quality changes significantly, then West Basin MWD's ability to satisfy these user requirements will be jeopardized.

FIGURE 4.1 HYPERION WWTP

4.1.2 Pilot Description and Need

The City of Los Angeles has studied this potential impact and currently does not consider it to be significant. There are no current plans to further study or pilot any technologies related to this issue.

4.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered.

4.3 Institutional Arrangements

If a potential impact was identified, it is certain that the City of Los Angeles and the West Basin MWD would need to collaborate to resolve any potential impacts and implement the solutions. This project and the potential impacts could also be compounded by changes in source water to the potable water systems to the City of Los Angeles and the West Basin MWD. This is described in the next project summary. The impacts due to the combination of these issues need be worked out between the City of Los Angeles and the West Basin MWD.

5 West Basin MWD Water Quality Requirements

5.1 Project Description

5.1.1 Full Size Project

West Basin MWD's WRPs serve recycled water to a number of industrial users in its recycled water system. See Figure 5.1 for an overview of the West Basin's MWD recycled water system. These uses require a consistent quality water as specified in the user contracts. If the water quality changes significantly, then the ability of West Basin MWD to meet its user requirements are jeopardized.

Due to recent changes in water quality from the Weymouth Water Treatment Plant (WTP), West Basin MWD has had difficulty supplying consistent water quality to its users. Water quality fluctuations at the Weymouth WTP are the result of different mixes of SWP water and Colorado River water, both of which serve as water supply sources for the Weymouth WTP. Due to recent court decisions that limit the amount of State Project Water that can be pumped out of the California Bay-Delta system, more Colorado River water has been used as a supply for the Weymouth WTP. This has resulted in increased TDS at the Weymouth WTP, which has caused an increase in TDS in sewage influent to the Hyperion WWTP. This has affected the ability of West Basin MWD to meet user water quality requirements.

West Basin MWD has not considered a project to address these concerns. However, if their users continue to be impacted by water quality changes, then the West Basin MWD may have to address these concerns.

5.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this issue.

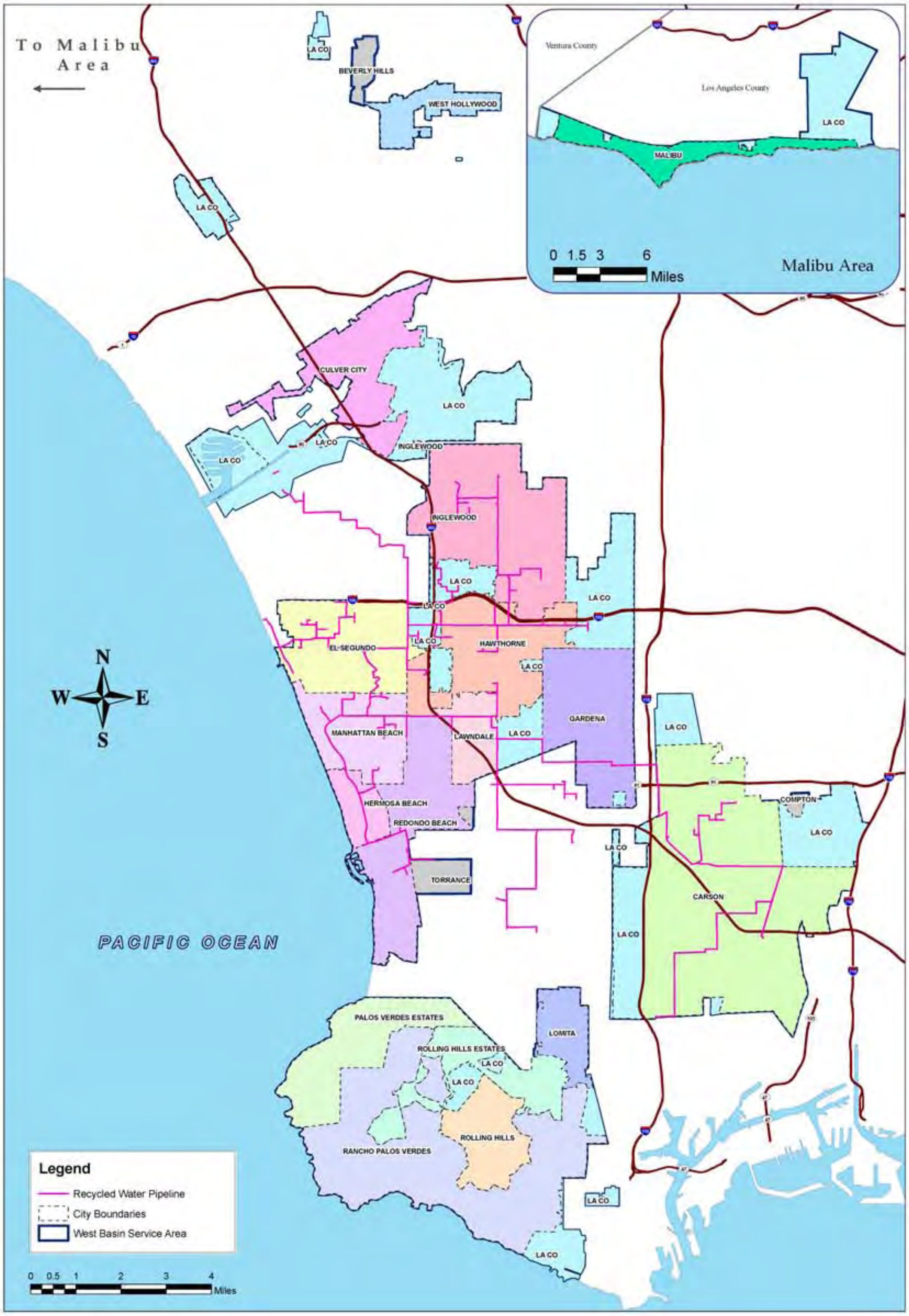
5.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered.

5.3 Institutional Arrangements

If a project or other solution was required, West Basin MWD may want to collaborate with Metropolitan Water District of Southern California (MWDSC), the City of Los Angeles, and/or its users in developing potential solutions.

FIGURE 5.1 WBMWD RECYCLED WATER SYSTEM



Source: WBMWD, www.westbasin.org/water-reliability-2020/recycled-water/district-recycled-water-map

6 The Groundwater Reliability Improvement Program

6.1 Project Description

6.1.1 Full Size Project

The Water Replenishment District of Southern California (WRD) and the Upper San Gabriel Valley MWD (USGVMWD) are investigating the feasibility of implementing an indirect potable reuse project that would treat up to 54.5 mgd of effluent from the County Sanitation Districts of Los Angeles County's (Sanitation Districts) San Jose Creek WRP. The product water (up to 46,000 acre-feet per year [afy]) would be used to recharge the Central and Main San Gabriel Groundwater Basins. Because of recent drought conditions, groundwater basin levels have dropped to their lowest levels in recorded history. The primary goals of the Groundwater Reliability Improvement Program (GRIP) are to 1) protect groundwater quality and quality of life, 2) provide a sustainable and reliable supply for replenishing the basins, 3) minimize the environmental/energy footprint of any options selected, 4) minimize costs to agencies using groundwater, and 5) engage stakeholders in a decision making process.

The involved agencies are preparing to form a Joint Powers Authority (JPA) to manage this project. The initial stage of this project is planned to be online by 2015 and the final stage is planned to be in place by 2020. The projected brine-concentrate flows resulting from this project are 2.84 mgd by 2015 and 7.25 mgd by 2020. This project would most likely use existing industrial brinelines or interties between the San Jose Creek WRP and the Joint Water Pollution Control Plant (WPCP). The project costs are estimated to be $400 million for overall completion of the project.

Currently, a pilot treatment plant is being operated to optimize the treatment processes. The likely treatment train includes MF-RO followed by UV and hydrogen peroxide for disinfection. A 6-mile pipeline to the north and a 2-mile pipeline extended south would be constructed along the San Gabriel River with several discharge points allowing for recharge into the basins. Upon completion of the pilot project, environmental documentation and design would be initiated.

6.1.2 Pilot Description and Need

The WRD, the USGVMWD, and the Sanitation Districts are jointly conducting a membrane pilot study to compare nanofiltration (NF) to RO membranes for advanced treatment of recycled water. The primary objectives of the pilot study are:

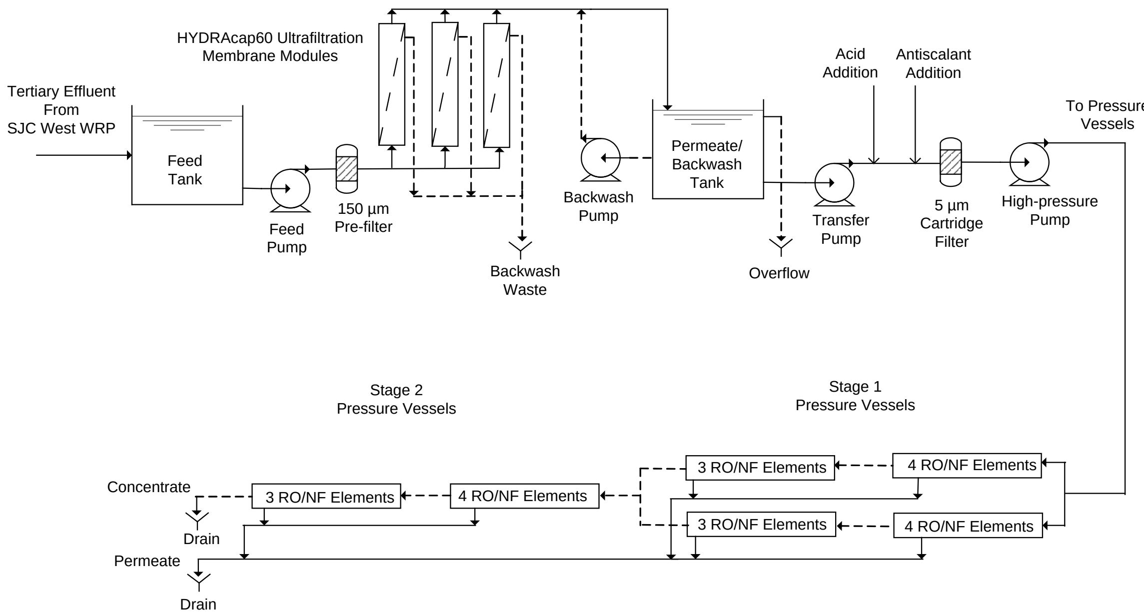
1. Validation of the concept of operating NF membranes at higher permeate fluxes and recoveries at lower pressure (i.e., less energy) than RO

2. Evaluation of the performance of a primary NF/secondary RO treatment system to increase the overall recovery to 93 percent

3. Information that may be used to support the design of the advanced treatment facility for the proposed GRIP

Figure 6.1 provides a schematic of the pilot scale research system for the GRIP project. The estimated cost to conduct this pilot study is approximately $250,000.

FIGURE 6.1 GRIP PILOT-SCALE RESEARCH SYSTEM



6.2 Technologies or Other Options Being Considered

A concept was developed with NF as primary treatment to remove contaminants followed by RO as a secondary treatment to further enhance the overall water recovery to over 93 percent. The NF provides the benefits of a high flux, low pressure (energy savings), reduced chemical usage, and provides a favorable water quality for additional recovery by the secondary RO system. If the treatment concept proves to be successful, the GRIP facility would have lower capital and operating costs than a conventional RO facility. In addition, the higher recovery would result in substantially reduced waste discharge as well as the associated brine disposal costs.

6.3 Institutional Arrangements

The WRD, USGVMWD, and the Sanitation Districts are currently forming a JPA for this project. Under this JPA, the Sanitation Districts would be the operator of this plant.

6.4 Implementability

This project is using proven technologies (i.e., NF and RO). Also, the project is similar in form to the Orange County Water District's (OCWD) Groundwater Replenishment System project as a result there are no major technical implementation concerns. The only implementation concerns are the ability of the project proponents to meet existing and future regulatory requirements and fund or finance this project.

7 C. Marvin Brewer Desalter Outfall

7.1 Project Description

7.1.1 Full Size Project

The C. Marvin Brewer Desalter, as shown in Figure 7.1, uses RO to treat a saline groundwater plume prior to supplying the water to users. TDS in the groundwater plume is approximately 3,600 milligram per liter (mg/L). The desalter began pumping in May, 1993, and provides 1.5 million gallons of fresh water each day from two wells in Torrance. In 2005, the two original wells were replaced with a new more productive well; however, due to water quality concerns this well has not been fully operational. The West Basin MWD has the ability to extract up to 2,000 afy of brackish water. West Basin MWD is considering expanding the desalter so that the full 2,000 afy can be produced.

FIGURE 7.1 C. MARVIN BREWER GROUNDWATER DESALTER

Source: West Basin MWD, www.westbasin.org/files/images/brewer-desalters.jpg

The groundwater extracted for this project is from the Silverado aquifer. The wells at the desalter tap the leading edge of mixture of injected water from the West Basin Barrier Project and saltwater intrusion from the sea. Approximately 95 percent of this water is sold to MWDSC, and the rest is used to serve local users in the Torrance area.

Currently, brine from the desalter is conveyed to the Joint Water Pollution Control Plant (JWPCP) via a local sewer, where it is treated and discharged via the Joint Plant's ocean outfall. West Basin MWD is investigating the potential option of discharging the brine via another outfall at the AES Redondo Generating Station.

7.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this issue.

7.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or ZLD process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates.

7.3 Institutional Arrangements

The C. Marvin Brewer desalter is owned by WBMWD and is operated on land leased from the California Water Service Company. The majority of the water produced by this desalter is sold to MWDSC. The facility is at the same location as WRD's Goldsworthy Desalter. Currently, the concentrate from the facility is discharged into a local sewer and conveyed to the JWPCP for ocean disposal. If the discharge location is changed an agreement will have to be developed with AES to use their outfall.

7.4 Implementability

Implementation concerns for this project are the cost of a new brine conveyance pipeline and the necessary agreements with AES for ocean disposal of the brine. In addition, the facility would need to meet AES's ocean discharge permit requirements.

8 Leo J. Vander Lans Plant Expansion

8.1 Project Description

8.1.1 Full Size Project

The Leo J. Vander Lans Advanced Water Treatment Facility (LVL) is a state-of-the-art water treatment facility that will ensure that southern California's groundwater supply is sufficient, clean, and safe. The LVL is located in the City of Long Beach, and was constructed by WRD. The LVL began operations in 2005 and currently supplies recycled water to the Alamitos Seawater Barrier, which protects the local groundwater basin from seawater contamination. Figure 8.1 shows an aerial view of the plant.

FIGURE 8.1 AERIAL OF LEO VANDER LANS ADVANCED WATER TREATMENT FACILITY

The facility treats effluent water from the Sanitation Districts' Long Beach WRP using technologies including microfiltration, reverse osmosis and ultraviolet light. After treatment, about 3 mgd of near distilled quality water are produced and blended with imported water for conveyance to the Alamitos Seawater Barrier. The Alamitos Seawater Barrier is one of three seawater barrier systems within the WRD service area that provides protection against seawater intrusion. By the end of 2008, over 1 billion gallons of recycled water had been delivered to the barrier.

By utilizing recycled water at this seawater barrier, the reliability of supply to the barrier is improved and there is greater assurance that water to the barrier will continue to be delivered, even during droughts. By utilizing this local resource, less energy is used to import water, which helps to reduce overall energy consumption.

The goal of the project is to expand the LVL to replace additional imported water with highly treated recycled water for injection to the Alamitos Seawater Intrusion

Barrier. In addition, WRD is committed to reduce the sewer discharge volume by one half through additional membrane treatment. The existing LVL replaces 3,000 afy of imported water. With the expansion, LVL would replace an additional 3,000 to 5,000 afy of imported water when the project becomes operational (planned for 2013). The expansion of the LVL is an important project under WRD's Water Independence Now (WIN) Program, which will help eliminate dependence on imported water for replenishment purposes. The potential cost of the project is between $20 and $25 million.

8.1.2 Pilot Description and Need

The existing RO process is limited to an 85-percent recovery, which results in a production of 15-percent concentrate or approximately 0.53 mgd, which is discharged to the sewer. The expansion project would more than double the volume of the concentrate and exceed the capacity of the sewer; therefore, reduction of RO concentrate volume is essential.

A 5-week pilot study is scheduled for November 2009 to examine the feasibility of concentrate reduction. This brief study is designed to explore the viability of primary RO concentrate treatment using a secondary RO treatment unit to increase the overall water recovery of the water recycling facility. A pilot-scale membrane unit with a capacity of 20 gallons per minute (gpm) will be fed with RO concentrate generated by the LVL. This study will investigate operational conditions that are suitable to sustain flux and characterize the ability to remove bulk parameters (i.e., TOC and nitrogen) and trace organic chemicals in the product water. A sample pilot set-up is shown in Figure 8.2. The budgeted cost to conduct this initial pilot study is approximately $23,000.

FIGURE 8.2 SAMPLE PILOT PLANT

Based on the results of the initial pilot study, WRD anticipates that additional pilot tests will be required to explore various operational conditions to minimize potential membrane scaling or fouling, to improve flux rates, and develop an optimized run time versus chemical cleaning frequency. The potential cost for the additional pilot tests is approximately $100,000.

8.2 Technologies or Other Options Being Considered

Concentrate (brine) reduction has been a subject of research for many inland applications where ocean discharge is not available. The research has focused, primarily on surface and ground waters. Less information is available on brine reduction for recycled water. Furthermore, the research often emphasizes very high recovery or even zero discharge that require multiple pretreatment processes that are expensive and operational intensive.

The goal of WRD's study is to enhance the recovery of RO from 85 percent to approximately 91 percent using an additional RO membrane stage with an optimized operational condition/run time/cleaning approach while avoiding expensive pretreatment processes. This approach, if successful, could be more cost effective than other brine reduction options involving multiple treatment processes.

8.3 Institutional Arrangements

The WRD is the lead agency responsible for implementing the expansion of LVL. The Long Beach Water Department has contracted with WRD to operate the LVL. The Sanitation Districts produce the tertiary effluent as the influent water into LVL where it receives additional treatment. The Los Angeles County Department of Public Works receives the recycled water from the LVL facility and injects the water into the Alamito Seawater Barrier. The Orange County Water District owns a portion of the Barrier and is also a recipient of the recycled water from LVL. All partner agencies are supportive of maximizing the usage of recycled water for groundwater replenishment and protection from seawater intrusion.

8.4 Implementability

The WRD's expansion project for LVL is already in progress. The WRD is currently progressing with preliminary design and permitting for the expansion. In addition, the initial pilot study using RO for brine reduction is in progress and preliminary results scheduled to be completed in December 2009.

9 Sanitation Districts' Clearwater Program

9.1 Project Description

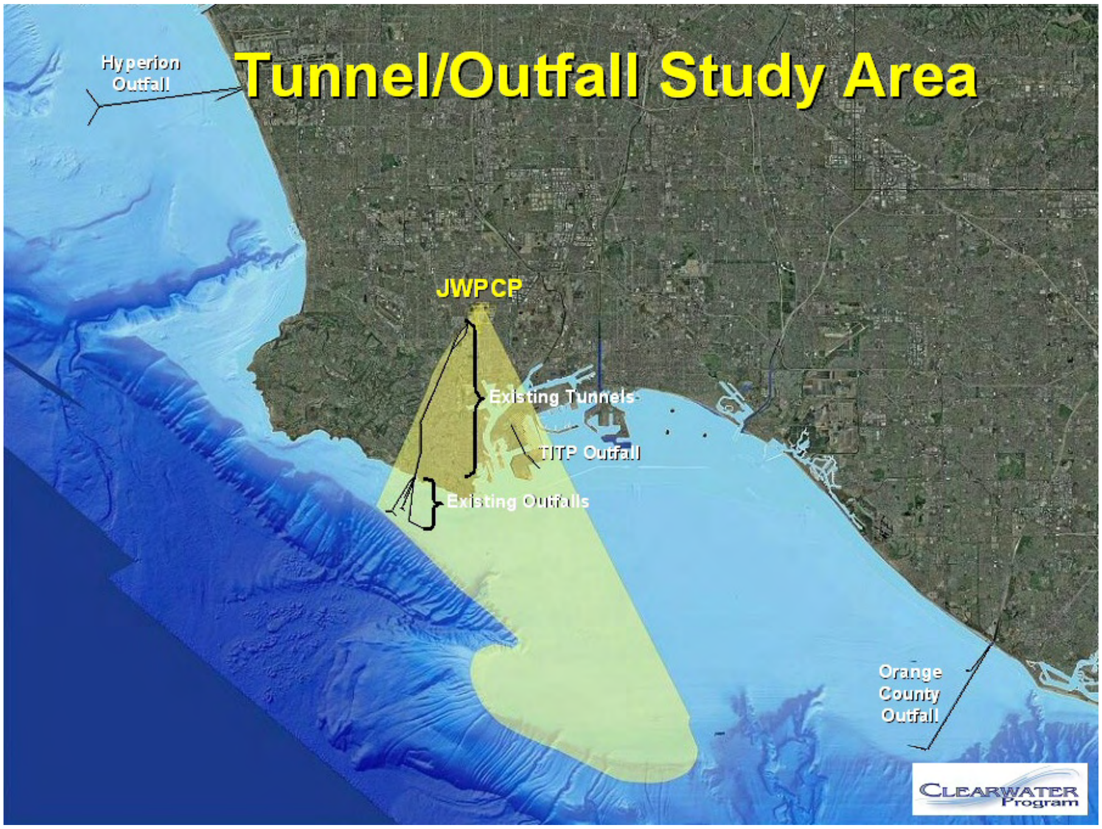
9.1.1 Full Size Project

The Sanitation Districts are in the planning stage of the Clearwater Program. The Clearwater Program is a strategic planning initiative to identify wastewater conveyance, wastewater treatment, effluent management, solids processing, and biosolids management needs for the Sanitation Districts' Joint Outfall System (JOS). As part of the Clearwater Program, the Sanitation Districts will be preparing a new master facilities plan (MFP) for the JOS. The MFP will serve to guide the management and development of the JOS through the year 2050 and may result in the implementation of one or more recommended projects. The proposed plan in the MFP would meet the following needs and objectives:

- Provide adequate system capacity to meet the needs of the growing JOS population
- Provide a long-term solution for meeting water quality requirements set forth by regulatory agencies
- Provide a means of inspecting, maintaining, repairing, rehabilitating, and replacing the aging infrastructure of the JOS to ensure overall reliability
- Provide a wastewater treatment and effluent management program that accommodates and promotes emerging recycled water reuse and biosolids beneficial use opportunities (Sanitation Districts, 2008; U.S. Army Corps of Engineers, 2008)

One component of the JOS that is of particular concern is the existing ocean discharge system, shown on Figure 9.1. The Sanitation Districts currently utilize two tunnels and four ocean outfall structures to convey effluent from their 400-mgd Joint Water Pollution Control Plant (JWPCP) in the city of Carson to the Pacific Ocean. The two tunnels were constructed in 1937 and 1958 and have not been inspected in nearly 50 years. Inspection of the tunnels is not possible due to their overall length, limited access, lack of separation between the tunnels, and the overall flow through the tunnels. These tunnels need to be inspected and, if necessary, repaired to address aging infrastructure and reliability concerns. Under the Clearwater Program, the Sanitation Districts are proposing to either modify the existing JWPCP ocean discharge system or construct a new ocean discharge system.

FIGURE 9.1 JOS TUNNEL OUTFALL SYSTEM



In keeping with the objective of supporting emerging recycled water reuse opportunities, a scenario being evaluated in the MFP is the possible diversion of 100 to 200 mgd of JWPCP effluent from the existing ocean discharge system for groundwater recharge. Under this scenario, the JWPCP effluent would require additional advanced treatment, which would likely include MF/UF, RO, and ultraviolet (UV) disinfection with hydrogen peroxide. Use of such advanced treatment would result in the need to implement brine-concentrate management.

9.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this issue.

9.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. The planned study by the Sanitation Districts would need to address brine-concentrate disposal options, including use of the existing or a new JWPCP ocean discharge system, as well as the feasibility of brine-concentrate volume reduction or ZLD process.

9.3 Institutional Arrangements

This potential project would involve the Sanitation Districts and other local regional agencies working together to study the project. In addition, any such groundwater recharge would require agreements with the groundwater basin managers. If the project were implemented, a long-term agreement would need to be reached between the participating parties on financial, regulatory, and water supply/rights.

9.4 Implementability

Disposal of the brine-concentrate will need to be addressed as it could potentially affect the effluent water quality. This could result in the Sanitation Districts having difficulty meeting their discharge permit requirements.

Implementation of such a large-scale project would require significant coordination amongst the participating agencies as well as any impacted stakeholders. Public acceptance of such a project would also require significant outreach efforts. The cost sharing and financing of this project would also be a potential implementation barrier.

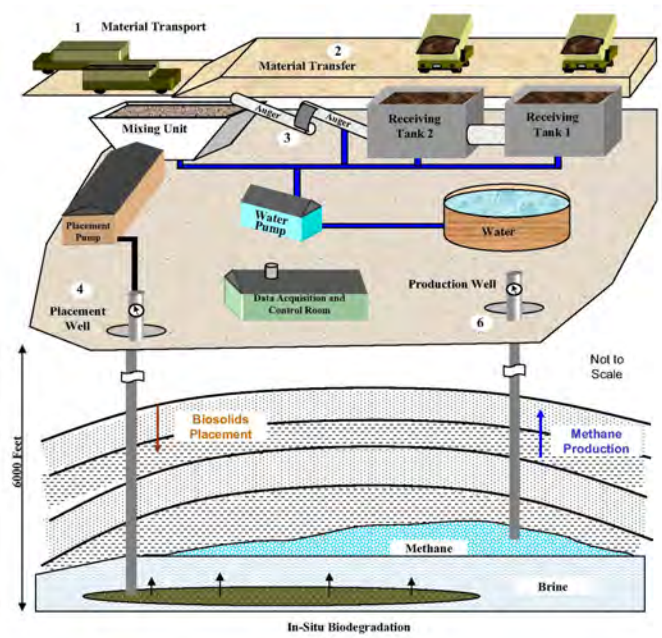
10 Terminal Island Renewable Energy Project

10.1 Project Description

10.1.1 Full Size Project

Over one million tons of treated municipal biosolids are generated each year in southern California. One-third of that waste is generated by the City of Los Angeles. The City of Los Angeles Bureau of Sanitation's Terminal Island Renewable Energy (TIRE) Project is the nation's first and only full-scale application of deep well injection (DWI) technology to convert biosolids into green power and simultaneously sequester greenhouse gases. The project injects biosolids in depleted oil and gas wells more than a mile underground near the City of Los Angeles' Terminal Island Plant. There, the earth's high temperatures and pressures will turn the biosolids into methane gas, which can be captured to power fuel cells and produce green power. Figure 10.1 provides a schematic of the process used for the TIRE Project. Also, the process will dissolve carbon dioxide that biosolids would normally release. The TIRE project will result in keeping 82,000 tons of carbon dioxide out of the atmosphere over a five year period, which is equivalent to taking approximately 16,000 cars of the streets.

FIGURE 10.1 TERMINAL ISLAND RENEWAL ENERGY PROJECT SCHEMATIC



Source: City of Los Angeles Bureau of Sanitation Website, 2009

When completed, the TIRE is expected to produce 3.5 megawatts (mW) of electricity annually, which is worth approximately $2.4 million a year. This renewable energy could power more than 3,000 homes a day. Also, the amount of waste the city hauls to Kern County for fertilizer will be reduced over 2,000 truck trips annually, which results in an annual savings of approximately $1.6 million. The system is expected to cost $3 million to $4 million to build, and will come on line in phases.

The TIRE project has been injecting brine-concentrate along with Terminal Island WWTP biosolids for the past 13 months via a 6,000-foot-deep well. Figure 10.2 shows the TIRE facility. However, the amount of brine-concentrate that can be injected is limited due to the capacity of the well used for the TIRE project. The addition of brine-concentrate to biosolids creates a bioslurry that is easier to inject than the biosolids alone. The bioslurry is approximately 6 to 8 percent solids. Biosolids without brine-concentrate might not be injectable because it is not liquid enough for DWI. For gas recovery or energy production in the future, the existing monitoring wells would have to be converted to extraction wells; however, this cannot be done until enough pressure is created from the methane gas generated by the injected bioslurry.

FIGURE 10.2 TERMINAL ISLAND RENEWAL ENERGY FACILITY

Currently, all of the biosolids from the Terminal Island WWTP are being injected. To expand injection of brine-concentrate, another well(s) would need to be developed. This well could be at a shallower depth (depth of 2,000 feet) than the existing biosolids well as long as any underground sources of drinking water (USDW) are not impacted. In addition, the well would have to be permitted as an U.S. Environmental Protection Agency (USEPA) Class V well, which includes water quality requirements for TDS.

10.1.2 Pilot Description and Need

Pilot project for the biosolids injection already exists and the city is considering moving to full-scale implementation. As the City of Los Angeles is not currently planning to inject the remaining brine-concentrate stream, no additional pilot project is under consideration.

10.2 Technologies or Other Options Being Considered

The proposed project will have more advanced monitoring, sampling, and analysis, and more comprehensive scientific and environmental review than any similar projects ever conducted in the United States. The project is using many innovative technological features, such as carbon sequestration, the use of fuel cells powered by methane, and a state-of-the-art monitoring system. The sophisticated delivery system and advanced monitoring equipment ensure safe and proper handling.

10.3 Institutional Arrangements

There are no known institutional arrangements for this project.

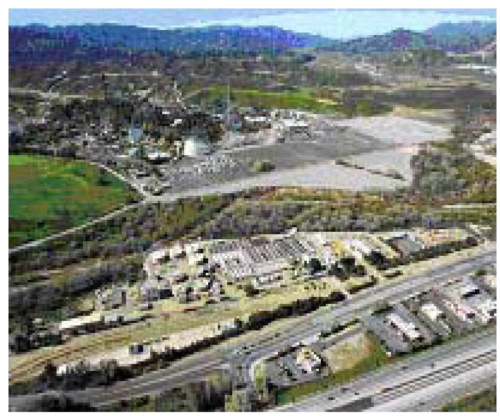
10.4 Implementability

This project will require significant monitoring, sampling, and analysis as required by the City of Los Angeles's permit with the USEPA. If an additional brine-concentrate injection well was considered, then additional permit requirements would need to be implemented specific to that project.

11 Santa Clarita River: Chloride TMDL

The Santa Clarita area is served by two treatment plants, the Valencia and Saugus WRPs (Figure 11.1). These two WRPs are owned and operated by the Santa Clarita Valley Sanitation District of Los Angeles County (SCVSD), which is part of the County Sanitation Districts of Los Angeles County (Sanitation Districts). In 2008, these plants produced approximately 21 mgd of tertiary treated recycled water. The Valencia WRP (VWRP) has a design capacity of 21.6 mgd, and produced an average of 16.1 mgd of recycled water in 2008. The Saugus WRP (SWRP) has a design capacity of 6.5 mgd, and produced an average of 4.9 mgd of recycled water in 2008. Currently, no flow from the SWRP is municipally reused and only a partial amount of flow is municipally reused from the VWRP. Due to space limitations, no future conventional expansions are possible at the SWRP.

FIGURE 11.1 SAUGUS AND VALENCIA WRPS



Source: Sanitation Districts of Los Angeles County, 2009

Recycled water is mainly delivered for use through a hard-plumbing delivery system. Occasionally, reuse via water truck hauling has occurred. The Castaic Lake Water Agency (CLWA), the regional importer and wholesaler of State Project water in the Santa Clarita Valley, has begun implementing an expansion of the recycled water distribution system with plans to eventually use recycled water produced at both treatment plants.

Chloride levels in the upper Santa Clara River and in downstream groundwater basins have increased over the past three decades, due in part to the discharges of recycled water from the WRPs to the river with elevated levels of chloride, resulting in the Santa Clara River being listed on the State's 303(d) list of impaired water bodies.

As a result, the Los Angeles RWQCB adopted the Upper Santa Clara River Chloride TMDL in 2002, establishing chloride waste-load allocations for the SCVSD's VWRP and SWRP at 100 mg/L. Amendments to the TMDL in 2004 and 2006 established a phased TMDL approach, which allowed for the development of several scientific studies to support potential site-specific objectives (SSOs) for chloride that the Los Angeles RWQCB may consider in revising the existing 100-mg/L water quality objectives (WQOs). The TMDL implementation schedule specified scientific studies be conducted to evaluate the appropriate chloride threshold levels for protection of both sensitive agriculture and endangered species. In addition, a groundwater/surface water interaction model (GSWIM) was developed to evaluate chloride loadings and water quality impacts from a total watershed perspective.

As required by the revised TMDL, the Regional Board and the SCVSD established a collaborative process involving a number of stakeholders in Los Angeles and Ventura Counties to review and direct these scientific studies. Through this collaborative process, an Alternative Compliance Program (ACP) was developed by stakeholders that protects beneficial uses of the Santa Clara River while reducing the cost of compliance with the TMDL. As a result of these efforts, supported by results from the scientific studies, the Regional Board adopted a Basin Plan Amendment incorporating conditional SSOs and a revision to the Santa Clara River Chloride TMDL in December 2008.

The ACP represents a regional watershed approach to the management of chlorides that includes small-scale advanced treatment for a portion of the recycled water and salt management facilities to mitigate excessive chloride loading to impacted downstream groundwater basins. The ACP is designed to meet the conditional SSOs adopted by the LARWQCB.

The ACP consists of multiple elements that: provide for the protection of all beneficial uses of the Santa Clara River while improving water quality in the river and impacted downstream groundwater basins; improve the overall export of salts from the basin; maintain a salt balance in the watershed; and enhance water supply benefits to Ventura County stakeholders. The elements of the ACP that are most relevant to this report are described below.

A key element of the ACP is a small-scale Advanced Wastewater Treatment (AWT) system located at one of the treatment plants, or at an offsite location. The AWT would treat a portion of the influent to the VWRP using MF and reverse osmosis (RO). The planned AWT would have an influent capacity of up to 3.5 mgd and would produce up to 3.0 mgd of RO permeate and up to 0.5 mgd of brine-concentrate. By limiting the size of the AWT, it is believed that the brine-concentrate generated by the AWT system can be disposed of locally through deep well injection. Additional alternatives for brine disposal include ocean discharge and zero liquid discharge (evaporation) technology. As part of a facilities planning effort, a study is underway to assess the feasibility of implementing deep well injection.

The overall cost of this project is approximately $250 million (Sanitation Districts of Los Angeles County, 2009b) and includes costs for implementation of the ACP facilities to be constructed by SCVSD.

11.1 Pilot Project Description and Need

The pilot project would physically assess the ability to inject brine-concentrate through development of a deep well injection site and testing the rate of injection and clogging potential. The Sanitation Districts is currently investigating the specific requirements and costs for such a pilot project.

11.2 Technologies or Other Options Being Considered

In addition to deep well injection, the Sanitation District is evaluating ocean disposal and zero liquid discharge alternatives. For ocean disposal, there are several options consisting of different alignments, potential partnerships, and use of new or existing ocean outfalls.

11.3 Institutional Arrangements

The Sanitation Districts will be the only project partner. A test well would require a Class I non-hazardous waste injection permit from the USEPA.

11.4 Implementability

Deep well injection to dispose of liquid wastes is an environmentally and technically sound waste disposal method. Deep well injection of liquids began in the petroleum industry to dispose of oilfield wastes and enhance oil production. Disposal of salt water by injection has been in practice since the 1930s. Today, injection wells are known to exist in almost every state, and a wide range of industries utilize deep well disposal. These include food processing, pharmaceutical, paper, mining, automotive, chemical, and petrochemical industries. In some areas, municipalities use deep well injection for wastewater effluent disposal. In California, a significant number of Class II injection wells are used by the oil and gas industry.

The suitability of this technology for a specific application depends on the presence of geologic formations which have the natural capability to store and confine the wastes. The capability of geologic formations to confine liquid is demonstrated in some areas by the presence of oil and gas, often at high pressures. Accumulation of these reserves requires sufficient confinement to prevent them from moving to the surface for millions of years.

12 Newhall Ranch WRP Deep Well Injection

12.1 Project Description

12.1.1 Full Size Project

Newhall Ranch is a new master planned community northwest of Valencia and accessed from Interstate 5 and State Highway 126. As part of this new community, water and wastewater infrastructure is being developed to meet the needs of the community. One element of this infrastructure is the development of the Newhall Ranch Wastewater Reclamation Plant (NRWRP), which is planned to be constructed by 2015. The plant would produce Title 22 recycled water. In addition, a portion of the municipal wastewater from the NRWRP will receive further treatment to remove chlorides so that the facility can meet TMDLs set for the receiving surface water, the Santa Clara River. To comply with these requirements, RO treatment will be provided, and DWI will be used to dispose of the brine-concentrate waste stream.

An initial reconnaissance evaluation of deep well injection technology to dispose concentrate from RO at the NRWRP has been completed. Different system capacities were considered based on the planned capacity of the NRWRP as part of the study:

- An initial plant capacity of 2.0 mgd, which would generate 102 gallons per minute (gpm) or 0.36 mgd of RO concentrate
- A plant capacity of 6.8 mgd, which would generate 342.7 gpm (5 mgd) of RO concentrate

The final cost of the system will depend on the system capacity. A nearby suitable geologic formation has been identified which has the capability to accept, store, and confine the brine-concentrate. Capital costs are expected to range from approximately $9.4 million for the 2.0 mgd plant capacity to $22 million for the 6.8 mgd plant capacity project

Deep well injection to dispose of liquid wastes is an environmentally and technically sound waste disposal method. Deep well injection of liquids began in the petroleum industry to dispose of oilfield wastes and to enhance oil production. Disposal of salt water by injection has been in practice since the 1930s. Today, injection wells are known to exist in almost every state, and a wide range of industries utilize deep well disposal. These include food processing, pharmaceutical, paper, mining, automotive, chemical, and petrochemical industries, and in some areas municipalities use deep well injection for wastewater effluent disposal. In California, a significant number of Class II injection wells are used by the oil and gas industry, including several identified on Newhall Ranch property.

The suitability of this technology for a specific application depends on the presence of geologic formations which have the natural capability to store and confine the wastes. The capability of geologic formations to confine liquid is demonstrated in some areas by the presence of oil and gas often at high pressures. Accumulation of these reserves requires sufficient confinement to prevent them from moving to the surface for millions of years.

A deep well injection system comprised of one or more wells located on-site, used for disposal of wastes generated by Newhall Ranch, would be a Class I non-hazardous waste disposal well. Class I non-hazardous waste injection wells require injection zones below the lowest USDW.

12.1.2 Pilot Description and Need

An application for deep well injection is currently under review by the USEPA. The next step is to construct a test well and perform an injection formation test to confirm injection capacities. This test well would cost approximately $1.5 million to drill. The test well could be used by the full-scale project as an injection well.

An injection well feasibility study was completed in July 2008. It identified potential injection zones and injection zone properties such as thickness, areal extent, porosity, vertical and lateral extent, confining layer, and injection life. The study was prepared by reviewing published geologic and oil field reports and reviewing data from wells drilled in the injection area. In general, the potential injection zones, the Pliocene Pico and the Miocene Modelo formations, have produced oil and gas and have proven injection potential associated with the historical oil field operations. Based on the detailed feasibility study, deep well injection is a viable method for disposal of brine from the Newhall Ranch WRP.

12.2 Technologies or Other Options Being Considered

No other options are currently being considered as part of this project.

12.3 Institutional Arrangements

The Newhall Ranch WRP will be owned and operated by the Newhall Ranch Sanitation District. The district was formed by the Local Agency Formation Commission (LACFO) in June of 2006.

12.4 Implementability

The USEPA requires that Class I non-hazardous waste injection wells be located in geologically stable areas that are free of transmissive fractures or faults through which injected fluids could travel to drinking water sources. As part of the permitting process, the well operator must show that there are no wells or other artificial pathways between the injection zone and USDWs through which fluids can travel.

13 Antelope Valley Power Generation

13.1 Project Description

13.1.1 Full Size Project

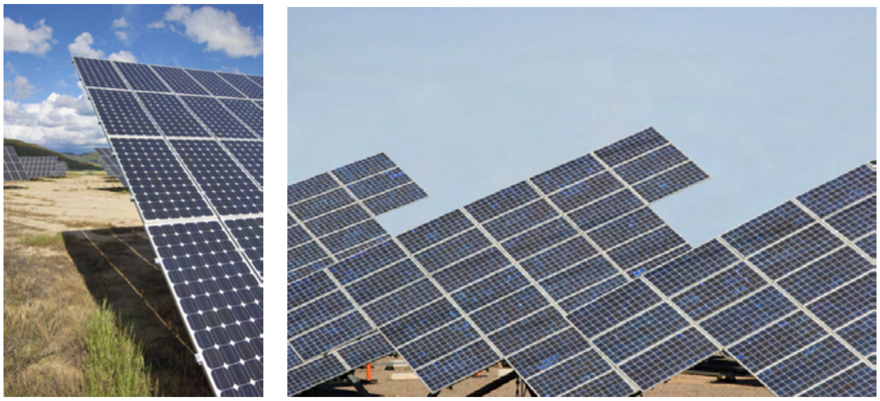
Two companies, Esolar and Nextlight Renewable Power, are in the process of developing solar power projects in the Antelope Valley. These companies will generate power from the sun and sell it to power companies. There are two technologies planned for use in the Antelope Valley, either photovoltaic technology or heliostats (specialized mirrors).

Esolar has developed the Sierra Suntower Power Plant, a demonstration project in the Lancaster area on a 20-acre site in northern Lancaster. This site is capable of producing 5 mW of power. Esolar uses heliostats, which focus the sun's power to heat water and generate steam and produce electricity. These heliostats replace the big arrays of solar panels that gather energy through photovoltaic cells that has been used in the past. Esolar has plans to build two more power plant sites in the Antelope Valley using the heliostat technology. Figure 13.1 is a picture of the Sierra Suntower Power Plant.

FIGURE 13.1 SIERRA SUNTOWER POWER PLANT

Nextlight Renewable Power is developing the AV Solar Ranch One project on a 2,100-acre site located along State Highway 138 West of State Highway 14. This project is being developed on former farmlands and will generate up to 6 million kW-hour (kW-hr). AV Solar Ranch One will utilize proven photovoltaic (PV) technology to convert sunlight into energy. The project will use solar modules that convert sunlight directly into electricity and produce the greatest amounts of power during the afternoon, when electricity demand is high. It is expected to begin deliveries in 2011 and be fully operational by late 2013. Figure 13.2 shows the PV technology to be used on the site.

FIGURE 13.2 SIERRA SUNTOWER PV TECHNOLOGY



These solar power generators will create brine-concentrate as a waste product from the power facilities. This brine-concentrate is generated from the advanced treatment of water for process water. Currently, the brine-concentrate generated from the Esolar pilot solar project is conveyed to the Sanitation District's WRP in Lancaster for disposal via the sewer system. However, the Sanitation Districts does not want to take brine from either of the full scale power facilities due to water quality concerns. The solar power generators will have to implement brine-concentrate management technologies for full-scale facility development. Brine-concentrate reduction or disposal technologies would most likely include evaporation ponds or a ZLD. The method used will depend upon whether the RWQCB will permit evaporation ponds, which can have the potential for adverse environmental impacts. The RWQCB is in the process of permitting evaporations ponds for the Esolar pilot project (California RWQCB, 2009).

13.1.2 Pilot Description and Need

It is not known whether Esolar and Nextlight Renewable Power are planning any pilot projects as part of their brine-concentrate disposal needs.

13.2 Technologies or Other Options Being Considered

It is not known whether Esolar and Nextlight Renewable Power are planning any other brine-concentrate disposal technology options beyond evaporation ponds or ZLD processes for the full-scale projects.

14 San Joaquin Valley Agricultural Water Recovery Demonstration Project

14.1 Project Description

14.1.1 Full Size Project

The MWDSC has entered into an agreement with the Semitropic Water Storage District (Semitropic) to perform environmental and other technical studies for an agricultural water recovery project. This project would recover excess agricultural flows in the San Joaquin Valley from perched groundwater basins and tile drain systems located south of the Delta. This water will be treated using pressure filters and chemical treatment for pretreatment, followed by RO to remove salts. The RO system is proposed to produce 9.4 mgd of permeate, which will be blended with a split stream to produce a total of 10 mgd of product water, or 11,000 afy. The brine-concentrate from the RO system will be handled using an enhanced evaporation system that consists of spray evaporators used in conjunction with evaporation ponds (MWDSC, 2009).

The overall cost of the project is estimated to be $44.5 million. The water produced from this project will support MWDSC's program to increase water supply reliability over the next few years. The supply will be delivered through exchange to the California Aqueduct. Therefore, it could help alleviate possible supply restrictions to MWDSC's SWP exclusive delivery areas.

For this project, the source water will be collected in 100-foot-deep wells, or sumps, with perforations ranging from 10 to 90 feet below the ground surface. These wells will be designed to collect excess water from agriculture irrigation, while not removing water from the shallow groundwater zone. The water will be pumped to the RO facility for treatment.

Because the source water for the proposed RO system will be obtained from shallow wells with minimal passage through the ground, it could contain a high concentration of total suspended solids and a high turbidity. Additionally, there is no soil data on iron and manganese concentrations, which cause problems with RO. Therefore, pretreatment of the source water will be required through pressure filters and chemical treatment.

A three-stage RO process is proposed to achieve a 90 percent recovery rate of the influent feed water. The RO system is proposed to produce 9.4 mgd of permeate, which will be blended with a split stream 0.6 mgd or pretreated water. This proposed system will produce a total of 10 mgd of product water with a TDS of 300 mg/L, which is consistent with the water quality in the California Aqueduct.

The product water will not require pH adjustment or stabilization, because the water will be delivered to Semitropic's irrigation water supply conveyance system, and not supplied directly for potable use.

The brine-concentrate from the RO system will be handled using an enhanced evaporation system that consists of spray evaporators used in conjunction with evaporation ponds. For this project, over 25 acres of earthen-lined ponds are proposed to be used. Due to shallow groundwater in the area, an impermeable layer may have to be installed in the ponds. This will depend on the requirements from the waste discharge permit. Sludge accumulation from the evaporation ponds will be hauled to landfills for disposal.

14.1.2 Pilot Description and Need

No pilot project for brine-concentrate management is currently planned. However, it is possible that a pilot evaporation pond would be necessary to confirm sizing and performance abilities prior to final design. In addition, if MWDSC deemed it feasible, additional brine-concentrate reduction technologies could be employed to increase the water recovery and to reduce the size of the evaporation ponds.

14.2 Technologies or Other Options Being Considered

No other technologies beyond the brine-concentration disposal evaporation ponds are planned for use on this project.

14.3 Institutional Arrangements

In the agreement between the Semitropic and MWDSC, Semitropic would be the lead agency for purposes related to the California Environmental Quality Act (CEQA). Therefore, Semitropic would be responsible for determining the feasibility and effectiveness of the proposed project, and obtaining the necessary amendments to their WDRs which permit the diffuse discharge of agriculture drainage to land or groundwater.

The agreement is intended to identify any water quality, hydrogeologic, environmental, and permitting issues related to the proposed demonstration project. In March 2009, the MWDSC board identified the following four areas of concern: salt loading, impacts of selenium on wildlife, brine disposal, and energy and costs of treatment. These areas will be addressed in the environmental documentation process, and must be resolved before the larger demonstration project can be implemented.

MWDSC and Semitropic wish to enter into an agreement to perform technical and environmental evaluations of alternatives for the proposed project and Waste Discharge Requirements (WDR) revisions. In the agreement, Semitropic will be the lead agency, and will be responsible for selecting consultants to perform the evaluation. MWDSC must approve all work performed by consultants prior to commencement.

14.4 Implementability

The proposed project will require several permits and environmental documentation. In addition, the brine-concentrate evaporation ponds will likely require extensive permits and monitoring requirements. The scale of this project could also present a challenge to project implementation.

15 Santa Ana Regional Interceptor Capacity and Scaling Issues

15.1 Project Description

15.1.1 Full Size Project

As shown in Figure 15.1, the Santa Ana Regional Interceptor (SARI) system conveys brine-concentrate flows from industrial and groundwater desalter sources. Current projections by the Santa Ana Watershed Project Authority (SAWPA) indicate that future groundwater desalter and MF-RO reuse projects will produce brine-concentrate flows that will exceed the SARI system capacities in several reaches. As such, SAWPA has initiated studies to address these capacity limitations as well as potential scaling concerns.

The SARI system conveys flows from the Inland Empire into Orange County where additional domestic sewage is added to the brine-concentrate flows. This trunk sewer then flows to the Orange County Sanitation District's (OCSD) Plant Number (No.) 2 where the influent is treated and discharged to the ocean via the OCSD's ocean outfall. The SARI system has two main existing feeders, the Temescal Valley Regional Interceptor (TVRI) and the SARI Reach IV system that extends to the San Bernardino WRP. In addition to the existing system, three additional extensions are planned for the SARI system. They are the Eastern Municipal Water District (EMWD) brineline, Temecula Valley brineline, and the Yucaipa-SARI pipeline. The EMWD brineline extension and the Temecula Valley brineline will connect to the TVRI at the Railroad Canyon Wastewater Reclamation Facility (WWRF). The Yucaipa-SARI extension will connect industrial users and the Henry N. Wolcholz WWTP to the SARI system at the San Bernardino WRP.

OCWD projections indicate that there is approximately 10 mgd of available capacity during maximum daily flows in the downstream (Reach 1) portion of the SARI line in Orange County. However, the SARI system capacity is limited to 30 mgd of flow near the Riverside/Orange County border area.

Some concern arises due to potential projects and existing discharges that this capacity could be exceeded. Only 13 mgd of maximum day flows was observed in 2008. SAWPA recently projected a flow of 28 mgd by 2035. This projection was actually higher based on the planned groundwater and MF-RO reuse projects. However, SAWPA and its member agencies concurred that they would need to reduce these brine-concentrate flows to no more than 28 mgd to keep below the 30-mgd capacity limit and to account for potential sewer infiltrations. SAWPA and its member agencies are looking for opportunities to reduce or remove flow to the SARI system to accommodate the future projects.

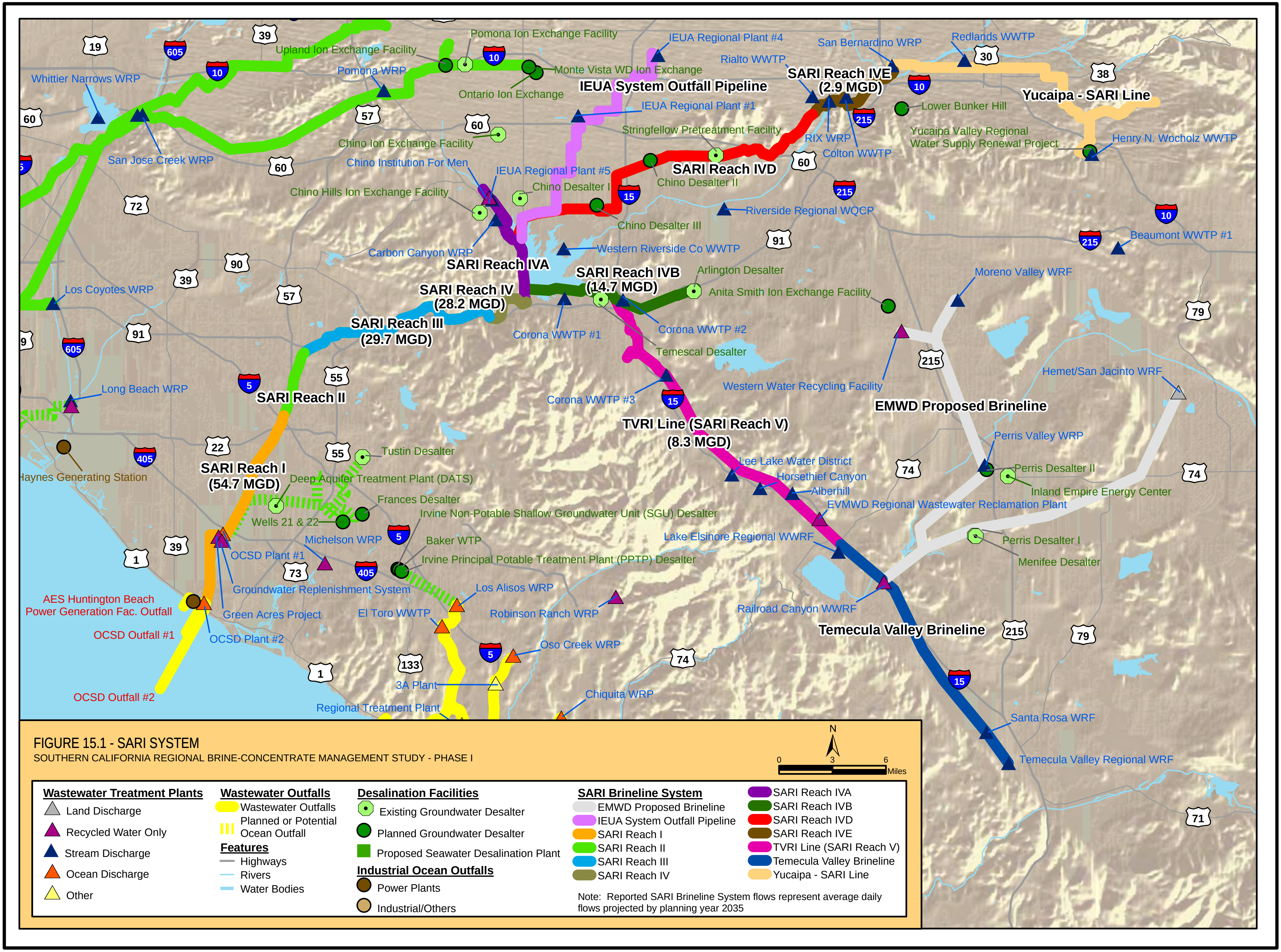


FIGURE 15.1 - SARI SYSTEM
SOUTHERN CALIFORNIA REGIONAL BRINE-CONCENTRATE MANAGEMENT STUDY - PHASE I

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Currently, SAWPA is investigating the long-term viability of the SARI system for salt export. Two ways exist to reduce flow in the SARI system; (1) remove the downstream domestic wastewater flows in Orange County by building a separate parallel sewer trunkline or (2) implement brine-concentrate volume-reduction or -elimination technologies. Such brine-concentrate management technologies could be implemented at local agency facilities or at a centralized location. SAWPA is currently studying these options.

In addition to capacity issues, the SARI system also has solids settlement problems and scaling in its system. Suspended solids (SS) concentrations of 100 mg/L have been measured in the SARI system in portions of the pipeline receiving primarily groundwater brine with SS of less than 1 mg/L (SDCWA, 2008.). Also, the SARI has occurrences of SS concentrations of over 200 mg/L in composite flow from all dischargers.

Suspended solids could be driven by the existence of a supersaturated condition for calcium, magnesium, and silica. These constituents precipitate in the pipeline causing the formation of suspended solids and sedimentation, which occur primarily when the brine is not sufficiently diluted by other flows. Under normal operating conditions, brine constitutes approximately 25 percent of the flow.

Creation of a funding mechanism to fund SARI upgrades, such as a sinking fund, is being investigated. Implementation of technologies to reduce or eliminate brine-concentrate could be a solution to this issue and are being investigated as part of SAWPA's Salinity Watershed Management Program. In addition, this study will investigate the pros and cons of centralized versus satellite facilities.

15.1.2 Pilot Description and Need

SAWPA recently initiated the Santa Ana Watershed Salinity Management Program, which consists of two phase. Under Phase 1, the key objectives are:

- Validate watershed salt budget assumptions and calculations
- Establish salt export need for various planning horizons
- Identify potentially feasible projects and BMPs to achieve salt balance in the watershed
- Develop and quantify scenarios that maximize the use of the SARI as a salt management too.

One of the key elements under Phase 1 will be to evaluate maximizing water recovery through concentrate management technologies. This could include source protection Best Management Practices (BMPs), desalter facilities, and either centralized or satellite brine-concentrate facilities. Under Phase 2, the key objectives will be to:

- Optimize SARI system configuration
- Meet salt export goals and maximize water recovery
- Evaluate SARI operations to achieve economic viability

As part of the Phase 2 work, specific issues will be reviewed and addresses. These include examination of the industrial and Stringfellow discharges and an evaluation of potential system configuration changes. As part of Phase 3, the key objectives will be to:

- Identify solutions for specific issues
- Schleisman siphon
- Supervisory Control And Data Acquisition (SCADA) system
- Cleaning Reach IV-E
- Record drawing/locating methods for Reach IV
- Prepare an updated Capital Improvement Plan (CIP)
- Conduct an assessment of the operation and maintenance (O&M) program
- Prepare a Final Report

While Eastern and Western MWD's have tested specific brine-concentration technologies, SAWPA does not have any current plans to pilot any such technology as part of this study. Any specific pilot project will likely be identified during the course of the study. One specific question that is somewhat unique to the SARI system is the consideration of a centralized brine-concentrate treatment option vs. multiple satellite facilities. As discussed, such facilities will be needed to reduce the volume of flow in the SARI line to provide for further expansion of groundwater desalter and advanced treated reuse supplies. Satellite pilot testing has been conducted by the Eastern and Western MWDs and additional pilots at these locations have been included as separate potential pilot projects. A potential centralized treatment plant could be considered by SAWPA to assess the feasibility of such a project and to compare the benefits and costs and to a satellite facility approach.

15.2 Technologies or Other Options Being Considered

Other than the technologies being considered by the individual agencies (see EMWD and WMWD project summaries), no other current technologies are being proposed at this time. However, as discussed above, the recently initiated Salinity Management Program may develop recommendations for pilot testing of brine-concentrate technologies.

15.3 Institutional Arrangements

Currently, SAWPA consists of five member agencies:

- OCWD
- EMWD
- City of San Bernardino
- Western MWD
- Inland Empire Utilities Agency (IEUA)

These agencies are working collaboratively on the Salinity Management Program and will need to continue this partnership in developing future brine-concentrate management plans or projects.

15.4 Implementability

Implementation of the recommended solutions or projects from the Salinity Management Program will likely require cooperation and potentially collaboration by the SAWPA member agencies. As the SARI capacity constraints affects all the agencies currently utilizing or planning to use this pipeline, it will be a challenge to ensure that all affected parties are able to reach equitable agreements related to cost and benefit sharing. In addition, potential impacts to the OCSD and its ocean discharge permit requirements will need to be addressed and potentially mitigated as additional brine-concentrate flows are added to or further concentrated in the SARI line.

16 Arlington and Chino Desalters Pellet Softening

16.1 Project Description

16.1.1 Full Size Project

The Arlington and Chino Desalters produce drinking water from saline groundwater basins. In 2005, Western MWD took over operations of the Arlington Desalter. The Arlington Desalter was constructed in the late 1980s to manage basin salt and discharge treated water to the flood channel. The desalter was upgraded in 2002, and began producing drinking water 2005. With a production of 6.3 mgd of drinking water, the desalter produces 1.6 mgd of brine-concentrate. The Chino Desalters were developed in the 1980s to manage salt, produce drinking water, and hydraulically control the basin. The Chino Desalters currently produce 14 mgd of drinking water as well as 2 mgd of brine, which is disposed in the SARI. The brine-concentrate is disposed via the SARI, which conveys brine and wastewater to OCSD's WWTP by gravity.

The SARI is owned and operated by the SAWPA. SARI disposal costs have been increasing at a rate that is higher than inflation. Operating costs are anticipated to increase approximately 4 to 6 percent annually between 2009 and 2020. The SARI has experienced maintenance problems due to brine-concentrate water quality. Desalter brine is supersaturated with minerals that precipitate to form scale. These mineral deposits are composed of calcium and silica. Scale inhibitors are effective for RO, but not for the SARI. The future rate structure may include a charge for scale forming minerals.

Western MWD is investigating brine minimization/recovery at the Arlington Desalter as well as considering it for the Chino Desalters. The Chino Basin Desalter Authority (CBDA) has worked with Western MWD to pilot test pellet softening at the Arlington Desalter (Figure 16.1). The purpose of the pilot test was to evaluate if pellet softening reduces a scale-forming mineral and thereby reduces scale formation in the SARI line. The CBDA is considering implementing this technology at the Arlington and Chino desalting facilities. The pellet softening also results in reduction in the amount of brine-concentrate discharge to the SARI system. Additionally, the desalter can be expanded from 6.3 mgd to 8.5 mgd without the need for new wells.

According to Western MWD's investigations, pellet softening has a number of advantages including:

- Smaller footprint (30 gallon per day per square foot; gpm/ft^2) than a conventional softener (1.75 gpm/ft^2)

- Requires less energy because there is no need to break head on the primary RO Brine
- Pellets dewater rapidly by gravity, while sludge requires lots of land or mechanical dewatering equipment
- Reduced treatment/disposal costs by as much as $1.24 million (net present value).
- Solids pellets formed from the process have value as recycled material for concrete mix and agriculture

FIGURE 16.1 ARLINGTON PELLET SOFTENING DEMONSTRATION PROJECT

Source: "Financial Aspects of Brineline Construction and Operation," Western Municipal Water District, 2009. Presentation given by Jack Safely to the BEMT on August 12, 2009.

In summary, the SARI brine line has experienced mineral scaling resulting from desalter operation. This brine minimization/reduction project will reduce the mass of scale forming minerals from the desalters, reduce the cost of operations, and develop a new local water supply. However, energy consumption will increase. In the Arlington Desalter pilot energy consumption was estimated to increase by 275 kW-hr/acre-foot (AF; 0.88 kW-hr/kilogallon; kgal).

16.1.2 Pilot Description and Need

The pilot testing for this project has already occurred and WMWD is preparing to initiate the full size project at the Arlington Desalter. Pilot or full-scale operations also could be implemented at the Chino Desalters.

16.2 Technologies or Other Options Being Considered

Pellet softening has already been pilot tested at the Arlington Desalter and is likely to reduce the mass of scale forming minerals to SARI. Silica concentrations were reduced from 200 mg/L to 50 mg/L, and calcium carbonate was removed. No other technologies are being considered at this time.

16.3 Institutional Arrangements

For a full-scale project to be built, the CBDA and its member agencies would have to fund the project. This is likely to occur due to potential capacity issues in the SARI.

17 Santa Rosa WRF Brine-Concentrate Management

17.1 Project Description

17.1.1 Full Size Project

The Rancho California Water District (RCWD) currently provides 76,000 afy of water for domestic, commercial, agricultural, and landscape needs. Agricultural uses account for 47 percent of the total demand, while domestic, commercial, and landscape uses account for the other 53 percent. To meet this water demand, RCWD obtains water from four sources.

- 29,000 afy, or 38 percent of the total supply is obtained from locally occurring groundwater and storage at Vail Lake. The cost of this water is $150/AF.
- 25,000 afy, or 33 percent of the total supply is fully treated water purchased from the Colorado River and the California Bay Delta at a cost of $430-$530/AF.
- 18,000 afy, or 24 percent of the total supply is raw untreated water purchased from the Colorado River and the California Bay Delta at a cost of $230-$330/AF,
- 4,000 afy, or 5 percent of the total supply is recycled water produced from RCWD's Santa Rosa Wastewater Reclamation Facility or purchased from EMWD Temecula Valley Regional WRF. This water has a TDS of 750 mg/L. Because the Regional Water Board has a limit of 500 mg/L TDS, this water can only be used in a small area of the water district.

RCWD is planning to implement an advanced wastewater treatment project to reduce TDS levels so that recycled water can be served to its agricultural customers by 2015. In addition, RCWD is considering implementing a brine-concentrate volume-reduction technology to reduce brine-concentrate disposal flows to the TVRI/SARI system. Because of recent water supply cutbacks by the MWDSC, agriculture users in the RCWD service area have struggled to find viable replacement water supplies. This project will help to reduce water demands from the State Water Project and ensure a more reliable water supply source that meets their water quality needs.

One project proposed as part of this effort is to build a demineralization/desalination plant to reduce TDS levels to less than 500 mg/L in recycled water from EMWD's Temecula Valley WRP. This will enable up to 16,000 afy of recycled water to be reused in the basin for agricultural use. However, current plans include approximately 5 mgd of advanced treatment, which will include MF followed by RO. This treatment will result in the need to implement a volume-reduction technology by 2015 to reduce flow to the TVRI/SARI system. Brine-concentrate generation from the RO system will be approximately 0.3 mgd by 2015 and will expand to 0.7 mgd by ultimate buildout. If a brine-concentrate volume reduction technology system is employed, then the reject stream would be reduced to 0.002 mgd by 2015 and 0.003 mgd by ultimate buildout. This project will require the construction of the Temecula Valley brineline extension of the TVRI/SARI system.

17.1.2 Pilot Description and Need

RCWD has not determined the specific brine-concentrate technology that would be employed as part of this project. However, it is likely the RCWD would utilize one of the technologies recently tested by the EMWD.

17.2 Technologies or Other Options Being Considered

RCWD has not indicated if they are looking at other technologies or options to this project.

17.3 Institutional Arrangements

As part of this project, RCWD will need agreements with EMWD to utilize their brinelines and recycled water from the Temecula Valley WRP. This would likely require meeting SAWPA and any EMWD specific water quality requirements.

17.4 Implementability

This project would likely require some level of pilot scale testing and pre-engineering to ensure the feasibility of the project. In addition, the full size project would require permitting and environmental documentation. Funding and cost/benefit equity issues may need to be addressed prior to implementation of the project. In addition, potential capacity limitations in the SARI system would have to be addressed.

18 EMWD Brine-Concentrate Volume Reduction

18.1 Project Description

18.1.1 Full Size Project

The EMWD provides drinking water, wastewater, and recycled water services to approximately 675,000 people in over 500 square miles of area in Riverside County. EMWD currently relies heavily on imported water from the MWDSC and is trying to reduce its dependence via several strategies. This will assure the long-term availability of drinking water to an increasing population.

EMWD is currently facing brine disposal problems from their ground water desalination facilities. Currently, the brine is being disposed via the SARI which conveys the brine to the ocean. However, it is becoming increasingly more expensive to dispose of brine through the SARI. Additionally, the SARI is under heavy demand, and is facing capacity issues. EMWD anticipates future brine flows of 6.6 mgd. This includes 4.2 mgd from groundwater desalters, 0.2 mgd from industrial via truck hauling, and 2.2 mgd from two future power plants. EMWD currently owns 5.964 mgd of capacity in the SARI system, and 3.548 mgd of capacity in OCSD's facilities.

To dispose of this projected brine flow, EMWD is considering different options. EMWD investigated expanding the EMWD brine management system that connects to the TVRI/SARI system by constructing up to four new pipelines that would convey high salinity effluent. Currently, this system connects EMWD's groundwater desalters to the TVRI/SARI system. EMWD is considering allowing industrial dischargers to dispose of brine in the EMWD brine management system through the new brine disposal pipelines. Conceptual level capital costs for the construction of the four new brine disposal pipelines ranges from $22 to 53 million per pipeline. Annual O&M costs range from $0.2 to 0.6 million per pipeline.

In addition to expanding the brine management system, EMWD has been investigating a number of different brine-concentrate volume reduction and ZLD technologies. The total annual cost for implementing these ZLD technologies ranges from approximately $5 to 6 million, with only a 5 to 7 percent difference in the total annual cost between the different treatment trains. This total cost is the sum of amortized capital annual costs plus O&M costs. Possible revenue generated from reused water was not included in the costs nor was potential revenue from the sale of excess SARI capacity.

18.1.2 Pilot Description and Need

To date, EWMD has tested the following brine-concentrate treatment technologies; Slurry Precipitation and Recycle Reverse Osmosis (SPARRO), membrane distillation (MD), forward osmosis (FO), and Salt Solidification and Sequestration (SAL-PROC). EMWD has determined that so far, the most cost-effective treatment sequence is primary RO followed by softening, secondary RO, SPARRO, brine-concentration, crystallizer, and finally landfill for final disposal. EMWD concluded that additional research of MD and FO is necessary.

EMWD has not formalized their next phase of pilot testing, however, they have the necessary facility to conduct additional pilot testing efforts.

18.2 Technologies or Other Options Being Considered

Currently, the technologies that are being considered for ZLD are expensive and energy intensive. Other technologies under consideration include electrodialysis reversal (EDR), brine concentrators, evaporation ponds, crystallizers, and precipitative softening (PS)/RO. EMWD has made no decision on what technology to implement.

18.3 Institutional Arrangements

There are no known institutional arrangements for this project.

18.4 Implementability

EMWD has been testing brine-concentrate technologies over the past few years. While EMWD is not currently planning to do additional tests at this time, they could easily implement additional testing on other technologies.

Implementation of the project would require some coordination with SAWPA and potentially other agencies utilizing the SARI line to ensure that such a project did not have any adverse impacts downstream in the SARI system or at OCSD’s Plant No. 2. Little to no environmental or other barriers are foreseen for this project.

19 City of Corona Temescal Desalter

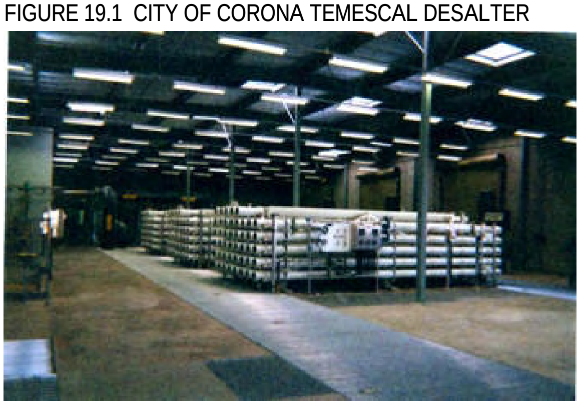
19.1 Project Description

19.1.1 Full Size Project

The City of Corona may need to reduce the amount of brine-concentrate discharged to the SARI from the Temescal Desalter (Figure 19.1). Without a reduction in current brine-concentrate flows, new groundwater desalter and wastewater RO projects needing to discharge brine-concentrate to the SARI will be limited. In addition, SARI disposal costs have been increasing at a rate that is higher than inflation. Operating costs are anticipated to increase approximately 4 to 6 percent annually between now and 2020. The SARI has experienced maintenance problems due to brine water quality. Desalter brine is supersaturated with minerals that precipitate to form scale. These mineral deposits are composed of calcium and silica. Scale inhibitors are effective for RO, but not for the SARI. The future rate structure may include a charge for scale forming minerals.

To reduce the volume of brine-concentrate discharge to SARI, a likely volume-reduction technology to be used is and PS as a pretreatment for RO, which would be similar in nature to the pellet softening being tested at the Arlington Desalter. This would need to be pilot tested prior to implementation.

FIGURE 19.1 CITY OF CORONA TEMESCAL DESALTER



19.1.2 Pilot Description and Need

The City of Corona is not currently planning a pilot test; however, a pilot testing of the pellet softening process at the Temescal Desalter would be a potential pilot project, similar to the Arlington Desalter pilot testing.

19.2 Technologies or Other Options Being Considered

Pellet softening has already been pilot tested at the Arlington Desalter. Pellet softening at Arlington could reduce the mass of scale forming minerals to the SARI pipeline. In the Arlington pilot testing, silica concentrations were reduced from 200 mg/L to 50 mg/L, and calcium carbonate was removed. Other technologies have not been tested on the groundwater desalter in this area.

19.3 Institutional Arrangements

There are no known institutional arrangements for this project.

19.4 Implementability

Implementation of the project would require some coordinate with SAWPA and potentially other agencies utilizing the SARI line to ensure that such a project did not have any adverse impacts downstream in the SARI system or at OCSD's Plant No. 2. Little to no environmental or other barriers are foreseen for this project. It is not known if the City of Corona is setup to pilot test brine-concentrate reduction technologies at its desalter plant.

20 San Bernardino Clean Water Factory

20.1 Project Description

20.1.1 Full Size Project

The City of San Bernardino is considering implementing an advanced treatment reuse system at the San Bernardino WRP (Figure 20.1) to recharge recycled water into the Bunker Hill Groundwater Basin. Preliminary analysis is being conducted on the project by the City of San Bernardino. This is a seven phased project that could range in size from approximately 6 to 23 mgd (treated capacity). The advanced treatment technologies that are under consideration for pilot testing include membrane bioreactors, microfiltration, nanofiltration, reverse osmosis, and ultraviolet light with hydrogen peroxide disinfection.

FIGURE 20.1 SAN BERNARDINO WRP

Source: City of San Bernardino, www.ci.san-bernardino.ca.us/sbmwd_divisions/water_reclamation/water_reclamation_homepage.asp

If this advanced treatment reuse project is implemented, a brine-concentrate management technology could also be employed to reduce the amount of brine-concentrate disposed of via the SARI system and to increase the overall water supply yield of the project. The City of San Bernardino currently owns 2.5 mgd of capacity in the SARI system, so brine-concentrate reduction may be needed depending on the project size, recovery efficiency of the MF/RO processes, or amount of recovered water needed. The size of the project is likely to be limited to how much water can be safely extracted from the Bunker Hill Basin without damaging the environmental habitat in the Santa Ana River. An analysis of this will be conducted as part of the projects environmental documentation.

20.1.2 Pilot Description and Need

No current brine-concentrate pilot project is being considered. However, pilot testing is planned for the advanced treatment. This would likely occurring 2011 or later. A potential brine-concentrate reduction or ZLD pilot could be conducted simultaneously to assess the cost and recovery level as well as reductions and benefits of disposal of the brine-concentrate to the SARI system. Such a brine-concentrate reduction or ZLD pilot process would be needed if the size of the project created a brine-concentrate flow that exceeded the City of San Bernardino's current 2.5-mgd SARI capacity limit.

20.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered for piloting of the RO reject stream. If the City of San Bernardino decided to pilot test brine-concentrate management technologies, then several options could be utilized. These include EDR, mechanical and thermal evaporation, conventional ZLD processes, evaporation ponds, and deep well injection disposal options.

20.3 Institutional Arrangements

There are no known institutional arrangements for this project.

20.4 Implementability

Implementation of the project would require some coordinate with SAWPA and potentially other agencies utilizing the SARI line to ensure that such a project did not have any adverse impacts downstream in the SARI system or at OCSD's Plant No. 2. Little to no environmental or other barriers is foreseen for this project. It is not know if the City of San Bernardino is setup to pilot test brine-concentrate reduction technologies at its desalter plant.

21 Big Bear Groundwater Recharge Project

21.1 Project Description

21.1.1 Full Size Project

The Big Bear Area Regional Wastewater Agency (BBARWA) Recycled Water Program was proposed to ensure that an adequate supply of safe water is available to supplement existing potable water supplies for the residents and visitors of the Big Bear Valley (Valley) in a timely and environmentally responsible manner. The BBARWA recycled water program is important because local water resources in the Valley are limited and the demand for water periodically could exceed supply, particularly in dry years or during prolonged drought periods. With no imported water available, the area is in need of other sources that will augment and provide a drought-proof, reliable, and locally controlled water supply.

Recycled water from the BBARWA WWTP has been identified as the most viable potential supplemental supply for water resources in the Valley. Artificial groundwater recharge in the Valley was identified as the optimal use for recycled water. The BBARWA Board of Directors determined that implementation of a groundwater recharge project would require the most advanced treatment available to ensure that no detrimental impacts occurred to the precious groundwater supply in the Valley. The advanced treatment proposed at the BBARWA Facility consists of MF, RO, followed by ultraviolet disinfection (UV) with advanced oxidation (e.g., the addition of hydrogen peroxide). A natural by-product of the RO component of this treatment train is the production of a concentrate (reject) stream. The BBARWA Advanced Treatment Facility (ATF) will be a 1.17-mgd plant that will produce approximately 160,000 gallons per day (gpd) of concentrate (reject) stream.

In a 2006 study, seven brine-concentrate technological solutions were identified as feasible for use at the proposed BBARWA ATF, they are:

- Constructed Wetlands
- EDR
- Enhanced Membrane Systems
- Mechanical Evaporation
- Solar Evaporation (evaporation ponds)
- Vibratory Shear Enhanced Process (VSEP)
- Wastewater Effluent Mixing

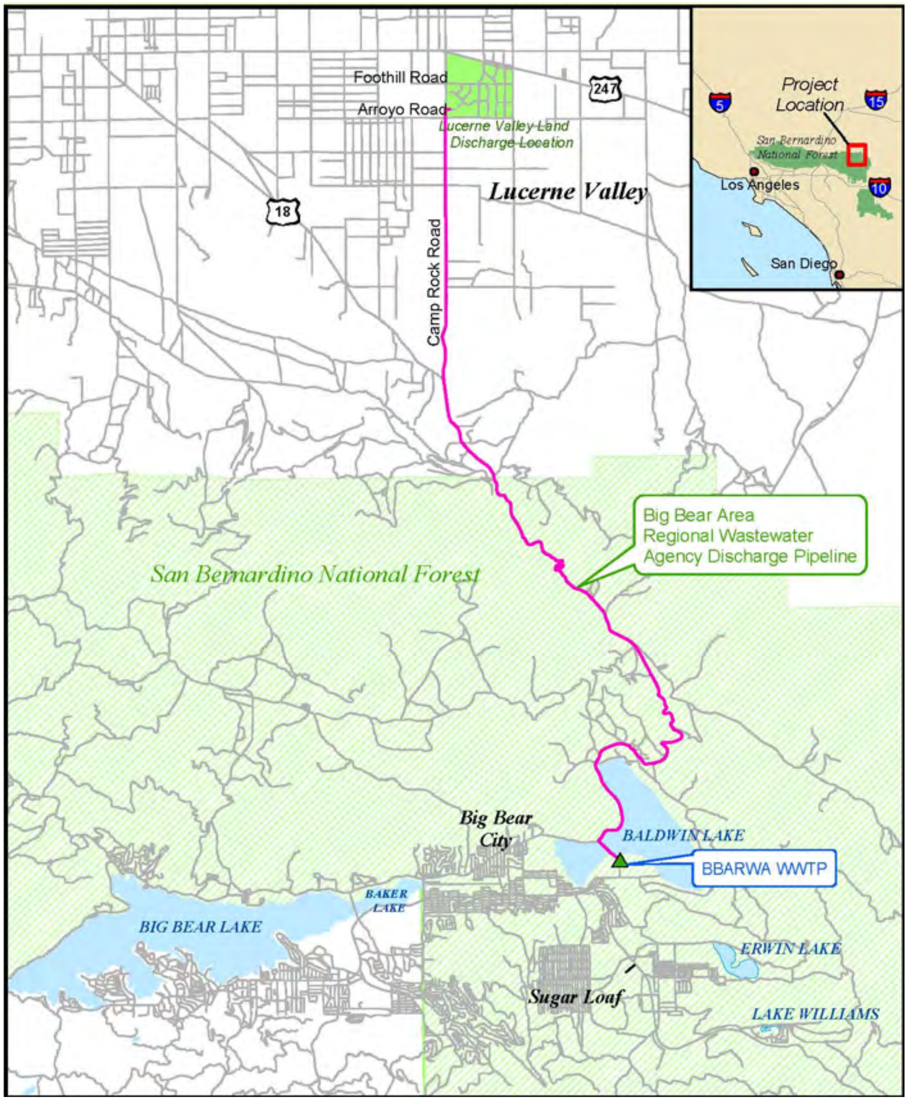
Out of these technologies, four potential solutions were deemed to provide the most promise for implementation at the BBARWA ATF. These solutions include:

- Combination of wastewater effluent mixing, VSEP, and constructed wetlands

- Combination of VSEP and constructed wetlands
- Combination of wastewater effluent mixing, VSEP, and evaporation ponds
- Mechanical evaporation

These technologies could be implemented in either the Big Bear Valley or the Lucerne Valley. Currently, BBARWA's outfall supplies Lucerne Valley farmers with water for fodder crop irrigation. Figure 21.1 shows a map of BBARWA's facilities. Table 21.1 shows the potential costs for each of these alternatives.

FIGURE 21.1 BBARWA FACILITIES IN THE BIG BEAR AND LUCERNE VALLEYS



Source: BBARWA, 2006

TABLE 21.1
COMPARISON OF THE BEST TECHNOLOGIES FOR THE BIG BEAR AND LUCERNE VALLEY CONCEPTUAL DESIGN SCENARIOS

Conceptual Design Scenarios Process Description	Capital Cost	O&M Cost ($/year)	Life Cycle Cost
VSEP + Wetlands at BBARWA	$5,716,000	$464,000	**$13,187,000**
Effluent Mixing + VSEP + Wetlands at BBARWA	$5,028,000	$401,000	**$11,485,000**
VSEP + Evaporation Pond at BBARWA	$6,852,000	$438,000	**$13,904,000**
Effluent Mixing + VSEP + Evaporation Pond at BBARWA	$6,149,000	$372,000	**$12,142,000**
VSEP+ Flow Conveyance + Wetlands in Lucerne Valley	$6,067,000	$483,000	**$13,844,000**
Effluent Mixing + VSEP + Flow Conveyance + Wetlands in Lucerne Valley	$5,820,000	$433,000	**$12,792,000**
VSEP + Flow Conveyance + Evaporation Ponds in Lucerne Valley	$6,169,000	$491,000	**$14,075,000**
Effluent Mixing + VSEP +Flow Conveyance +Evaporation Ponds in Lucerne Valley	$6,199,000	$450,000	**$13,444,000**

21.1.2 Pilot Description and Need

VSEP was pilot tested at BBARWA in 2006. There are no current plans to further study or pilot any technologies related to this project.

21.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or ZLD process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates.

21.3 Institutional Arrangements

There are three agencies that providing water and/or wastewater services in the Big Bear area; they are the BBARWA, City of Big Bear, and Big Bear Lake Community Services District (CSD). These agencies will need to work together to fund, develop user agreements, and develop water rights agreements for the project.

21.4 Implementability

Although a number of studies have been completed on this project, the project is not currently being considered for implementation. Implementation concerns related to this project include costs and identification of a brine disposal method. Another issue facing this project is the regulatory permitting that will be required to dispose of brine-concentrate. Big Bear is surrounded by the San Bernardino National Forrest, and as a result, any disposal or reduction method selected will require coordination with U.S. Forrest Service and U.S. Fish and Game as well as their state government counterparts. In addition, the project will require permits from two RWQCBs. Specifically, the Lahontan RWQCB would address issues related to the discharge of brine-concentrate into the Lucerne Valley, and the Santa Ana RWQCB would permit the groundwater recharge project in Big Bear.

22 Lake Arrowhead Groundwater Recharge Project

22.1 Project Description

22.1.1 Full Size Project

The Lake Arrowhead CSD has included as part of the Integrated Water Resources Program Report, a potential brine concentrate management project. This project would be needed if recycled water treatment is used for lake augmentation. Lake augmentation using recycled water would be an indirect potable reuse project (IPR) and would require a multiple barrier approach with advanced treatment methods. Potential advanced treatment planned for the IPR would include MF, RO, and an advanced oxidation process (AOP) that uses high intensity UV disinfection combined with hydrogen peroxide. This treatment results in a water quality that meets or exceeds all drinking water standards but results in a brine-concentrate waste stream that has to be disposed. This is complicated in the Lake Arrowhead area as the community is surrounded by the San Bernardino Mountains.

The overall IPR project concept is to provide advanced treatment at the Grass Valley WWTP for up to 1.5 mgd. The process would produce approximately 1.1 mgd (approximately 1,200 afy) of product water and approximately 0.4 mgd of concentrate. The quantity of concentrate would be further reduced using a brine concentrator then conveyed via the existing wastewater disposal outfall pipeline to evaporation ponds at the existing wastewater disposal site in Hesperia. The advanced treated recycled water would be conveyed to irrigation users as well as Lake Arrowhead when it is not full. The product water would enter Lake Arrowhead's western edge for mixing with surface water. The water would remain in the upper half of the lake until lake turnover occurs during the winter and when the entire lake volume mixes. Lake water will eventually be extracted by the District's water intakes for treatment at their water treatment plants. The cost for this project is estimated to be approximately $11.4 million (Integrated Water Resources Program Report, 2007).

22.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this project.

22.2 Technologies or Other Options Being Considered

A brine concentrator followed by evaporation ponds is planned for use on this project. The specific technology being considered is unknown at this time. Implementation of brine-concentrate volume reduction or zero liquid discharge

(ZLD) process could increase the water yield of the project. However, the cost to implement this additional water recovery could be unfeasible.

22.3 Institutional Arrangements

There are no known institutional arrangements for this project.

22.4 Implementability

A major concern for this project is collaborating with Federal, State, and local regulators to implement the project. Lake Arrowhead's location in mountains of the San Bernardino National Forrest complicates permitting and project implementation. As part of the environmental compliance for this project, U.S. Fish and Game and the U.S. Forrest Service will likely be involved. In addition, Lake Arrowhead will have to deal with two RWQCBs. Specifically, the Lahontan RWQCB will address issues related to the discharge in Hesperia and the Santa Ana RWQCB will permit the IPR project in Lake Arrowhead.

23 Moulton Niguel Water District: Golf Course Recycled Water Projects

23.1 Project Description

23.1.1 Full Size Project

The Moulton Niguel Water District (MNWD) is currently working with three golf courses to potentially serve recycled water to their greens. Currently, the golf courses utilize tertiary treated recycled water from South Orange County Wastewater Authority's (SOCWA) Regional Treatment Plant to irrigate the fairway and other landscape areas. However, due to the high TDS levels in the recycled water, the greens are not able to utilize the recycled water. Advanced treatment will be needed to reduce the TDS levels to serve water to the greens. This would create a brine-concentrate waste stream, which could not be disposed of into the sewer system as it would return the flow back to the Regional Treatment Plant. The golf courses are currently investigating potential onsite brine-concentrate disposal mechanisms, including using the existing ponds on the course as evaporation ponds.

23.1.2 Pilot Description and Need

While no specific pilot project is being planned, it is likely that an initial pilot study in converting and using an existing pond or construction of new evaporation and would be necessary. This pilot would test the effectiveness of the evaporation pond and could be used to identify potential challenges and barrier to a full size pond system at all three courses.

23.2 Technologies or Other Options Being Considered

It is not known whether other options are being considered. However, enhancement of the evaporation ponds could be accomplished via wind aided technologies or misters. These could be tested for effectiveness and feasibility during a pilot study. A wetlands pre-treatment system could also be testes to potentially reduce the size of the evaporation ponds.

Implementation of brine-concentrate volume reduction or ZLD process could increase the water yield of the project and eliminate the evaporation ponds. However, the costs and benefits of such a system would need to be compared to the costs and benefits of an evaporation pond system.

23.3 Institutional Arrangements

The costs of the advanced treatment and brine-concentrate management system are likely to be significant for the potential water supply savings. Therefore, it is likely that the costs and benefits of such a project would need to be equitably shared amongst the project stakeholders, and/or external funding be sought.

23.4 Implementability

Regulatory barriers for using an evaporation pond in a urban area are likely to be challenging for both the pilot and full size project. There are likely environmental challenges to such a project as wildlife would need to be kept out of such a facility.

As the project is in the early stages of investigation, it is not likely that a pilot study is implementable within the next year. However, if the project drivers are strong enough, it is possible for MNWD and/or the golf courses to initiate the preliminary and design phases of such a project within the next year. Additional information is needed to confirm this.

24 OCSD Outfall Water Quality Limitations

24.1 Project Description

24.1.1 Full Size Project

The OCSD may not be able to continue to meet its WDR if brine-concentrate levels do not have adequate blending with wastewater. OCSD has stringent WDR limits for ammonia and hardness, which restricts the amount of brine-concentrate that can be discharged without adequate dilution with treated sewage flows. This could become a significant issue if the use of recycled water for groundwater recharge increases in Orange County and the Inland Empire while the amount of domestic wastewater is decreased in the SARI system and in the OCSD's service area.

OCSD parses wastewater flow and limits the types of brine/concentrate discharges allowed into its collection system. In addition, the OCSD has refused brine/concentrate discharges to the OCSD Plant No. 1 from the Irvine Ranch Water District because of the adverse effects on the ability to reclaim flows as well as the effects to the effluent ammonia levels in the WWTP effluent discharges. The OCSD also has refused to allow other agencies permission to discharge into the SARI line due to the negative regulatory consequences as well as the costs associated with treatment required to meet discharge regulations resulting from these flows (U.S. Bureau of Reclamation, 2003).

If a brine-concentrate management technology is required to meet WDR, the efficacy of the technology can be tested at the OCWD membrane test laboratory. However, the specific technology and potential disposal mechanism would need to be further identified. Without the adequate level of dilution, future RO membrane treatment supply projects in the area could be jeopardized by the lack of a cost effective disposal option. Currently, the OCSD is not planning to implement such a pilot study.

24.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this issue.

24.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or zero liquid discharge (ZLD) processes could increase the water yield and improve the water quality to OCSD's outfall.

24.3 Institutional Arrangements

As this potential issue would impact the water quality at OCSD's outfall as well as inhibiting future potential membrane projects, this project could have significant institutional challenges. Agencies ability to implement advanced treated water supply projects could necessitate an agreement with the OCSD in regard to technology, disposal mechanism, size, location, and cost/benefit tradeoffs. A balance in the costs and benefits between the water supply and brine-concentrate projects would be needed to make the project feasible for all entities.

24.4 Implementability

As the OCSD has current pilot testing abilities, if a technology was identified for piloting, this could be easily implemented. Reject streams from such a pilot could be easily disposed of into OCSD's sewer, treatment, or even its outfall system.

Implementation of a project would likely require site specific mitigation of any potential environmental or other impacts. Cost and benefits of a full size project would also have to be worked out between all involved parties.

25 Newport Back Bay Nitrogen-Selenium Program

25.1 Project Description

25.1.1 Full Size Project

Selenium and nitrogen are both naturally occurring elements that are essential for life, but can cause problems in the environment at high levels. Selenium is a bioaccumulative pollutant that can be toxic at high levels. Excessive levels of nitrogen can be harmful to the environment by causing algal blooms that decrease dissolved oxygen in water bodies, leading to fish kills. In the Newport Back Bay watershed, selenium levels exceed the California Toxics Rule (CRT) criterion. However, the impacts to the environment and wildlife are currently unknown. High levels of nitrogen in the Upper and Lower Newport Bay from agricultural land uses caused large algae blooms and fish kills in the 1980s and 1990s. Currently, there are no feasible treatment options to eliminate selenium and nitrogen levels from discharges to the Newport Back Bay watershed.

To address these nutrient problems, the Santa Ana Regional Water Quality Control Board issued a NPDES permit in 2004 specific to the Newport Back Bay watershed – Order Number R8-2004-0021. This Order specifies waste discharge requirements for short-term (one year or less) discharges from activities involving groundwater extraction and discharge and for discharges that pose an insignificant threat to water quality. The Order acknowledges that while existing levels exceed the CTR limit of 5 µg/L selenium, there are currently no feasible treatment technologies to lower the selenium levels to meet the CTR criterion. Therefore, the Order incorporates an alternative compliance approach by authorizing the formation of a Working Group and the implementation of a Work Plan to develop a comprehensive understanding of and management plan for selenium and nitrogen groundwater-related inflows in the watershed. Specifically, the Work Plan will investigate the extent of ecosystem impacts, examine BMPs and treatment technologies that can reasonably be applied throughout the watershed to reduce the inputs of selenium and nitrates, develop a management program (i.e. a trading, offset, or mitigation program) for selenium and nutrients in the watershed, evaluate the Nutrient TMDL, and, if necessary, develop a site specific objective for selenium for the Newport Bay watershed (Nitrogen and Selenium Management Program, 2009).

Various stakeholders have formed a Working Group to comply with the terms and conditions of the Order, including the development and implementation of the comprehensive Work Plan. This group has created the Nitrogen and Selenium Management Program. This is a 5-year program to address nitrogen and selenium in the Newport Bay Watershed to be in compliance with the requirements of the Order issued by the Santa Ana Regional Water Quality Control Board.

In November 2008, the Santa Ana Regional Water Quality Control Board proposed a revision to the nutrient TMDLs for the Newport Back Bay/San Diego Creek Watershed. This was necessary to achieve and maintain compliance with nutrient-related water quality issues, and protect beneficial uses of the Newport Back Bay. The proposed Basin Plan amendment would revise the numeric water quality objectives for nitrogen in San Diego Creek and establish new numeric water quality objectives for nitrogen in additional tributaries to the Newport Bay. Additionally, the proposed amendment would revise the nutrient TMDLs for the Newport Bay/San Diego Creek Watershed. To comply with the amendments, actions will need to be taken to reduce or eliminate nitrogen discharges. These actions may include: diversion of nitrogen-containing waste discharges to sanitary sewers, implementation of one or more types of nitrogen treatment facilities, stream restoration, enforcement of existing water quality regulations that prohibit non-storm runoff in discharges from storm sewers to waters of the state, and landscape retrofit projects to reduce nitrogen fertilizer use.

Studies have found that ambient groundwater concentrations in the watershed frequently exceed numeric limits for selenium established in the Order. A pilot/demonstration project was completed in 2006 that identified RO as a potential BMP for the treatment and removal of nitrogen and selenium. The brine-concentrate from the pilot test was disposed of via OCSD sewers. If RO is implemented across the watershed to reduce nitrogen and selenium levels, a second process, such as a brine concentrator, might be added to achieve higher water recovery rates. The addition of brine-concentrate management technologies would enable Orange County to maximize water supply from the treatment process.

25.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this project.

25.2 Technologies or Other Options Being Considered

There are no current brine-concentrate technologies or other options being considered.

25.3 Institutional Arrangements

If the project was implemented and a brine-concentrating process was utilized, then the disposal of the concentrated reject stream would need to be arranged between the Working Group and the entity receiving the concentrated waste stream, which would most likely be the OCSD. Potential impacts to the OCSD's treatment processes at its WWTP and to the effluent water quality would need to investigated and potentially mitigated depending on the impacts.

25.4 Implementability

A brine-concentration technology option is no foreseen for this project at this time. Implementation of such a technology as part of this project would likely require a pilot study. Either the current Working Group or another agency would be needed to take the lead on such a project. Potential regulatory barriers would also need to be addressed.

26 South Coast Water District (SCWD) Groundwater Recovery Project

26.1 Project Description

26.1.1 Full Size Project

The South County Water District (SCWD) uses greensand filtration and RO to recover groundwater with high concentrations of TDS, iron, and manganese. Currently, the project is having difficulty complying with discharge limitations due to the high concentrations of iron and manganese in the backwash water. The discharge is considered an industrial discharge and must comply with stringent water quality requirements prior to discharge into the South Orange County Wastewater Authority's (SOCWA) San Juan Ocean Outfall. As a temporary measure, the SCWD is sending the groundwater treatment reject stream to its adjacent wastewater treatment plant. However, this has increased the TDS of the wastewater plant's recycled water, and hence may not be a long-term solution. The SCWD is considering implementing new technologies to the treat brine-concentrate prior to discharge to the ocean outfall that would comply with permit limits.

26.1.2 Pilot Description and Need

There are no current plans for a pilot project on any brine-concentrate technologies related to this project.

26.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or zero liquid discharge (ZLD) process could increase the water yield of the project and eliminate the discharge permit violation issue. However, the cost to implement such a technology is likely unfeasible compared to current water rates or other treatment options.

26.3 Institutional Arrangements

They only institutional arrangements for this project are those between the SCWD and the SOCWA. Both are subject to the current San Diego RWQCB's discharge permit requirements.

26.4 Implementability

The major hurdle to implementation are funding for the project. Due to constituents of concern that are driving the project, any disposal of concentrate with these constituents would not be in compliance with the RWQCB. For this reason high cost technologies including ZLD may be the only option to remove these constituents.

27 South Orange Coastal Ocean Desalination Project

27.1 Project Description

27.1.1 Full Size Project

The proposed 30-mgd capacity (15-mgd production) seawater desalination facility will obtain seawater from slant wells drilled under the ocean floor. As part of an initial pilot program, an extended pumping and pilot plant test using the test slant well is under construction and is scheduled to begin test operations in April 2010, and continue through October 2011. After the project participant agencies decide to proceed with the full scale project, a baseline monitoring and Environmental Impact Report (EIR) and permitting are tentatively scheduled to be completed in 2012/13. The full-scale facility will be constructed using a Design/Build/Operate model and is scheduled to start-up in 2015/16. Brine concentrate from the proposed desalination facility will be co-disposed through SOCWA's San Juan Creek Ocean Outfall.

This project will generate up to 15 mgd of ocean concentrate flow which would nearly double the current average daily flow in the San Juan Outfall (18 mgd projected by 2010). Therefore, constituents of concern in the desalination brine-concentrate (such as iron and manganese under initial start up conditions) will affect the quality of the water that is discharged from the outfall. In addition, this project could face the same regulations that are driving SCWD to implement brine-concentrate management due to high concentrations of iron and manganese. Based on the San Diego RWQCB's current permitting practice on the SOCWA outfall system, an individual permit would be require of the ocean desalter for discharge into the outfall system. The outfall itself is also regulated to comply with ocean discharge standards.

27.1.2 Pilot Description and Need

The project's Phase 3 Extended Pumping and Pilot Plant Test will be utilized to evaluate water quality, RO membranes, pretreatment options, concentrate management, and use of concentrate for specialized brine disposal studies.

27.2 Technologies or Other Options Being Considered

There are no planned brine-concentrate technologies or other options being considered for this project.

27.3 Institutional Arrangements

The South Orange Coastal Ocean Desalination Project Participating Agencies planning to form a Joint Power Authority for this facility will need to work with SOCWA in obtaining a discharge permit for full scale project.

Institutional arrangements include allocation of capacity and costs to each project participant in proportion to their capacity ownership in the desalination project. Acquisition of unused capacity from existing outfall owners will be required.

27.4 Implementability

The pilot plant is fully funded, permitted, and is currently under construction. The pilot plant testing work will commence approximately one year after start up of the extended pumping test (i.e., once the yield from the well is about one-half ocean water). This is estimated based on groundwater modeling studies to occur at the 12^{th} month of pumping, about April 2011. The pilot plant is currently scheduled to be operated for 6 months. The barriers to project implementation are cost and water supply demand. However, current cost estimates are considered reasonable and there is a strong sense of need for the project by the participants to meet water demands.

28 North San Diego Farming Brine/Concentrate Project(s)

28.1 Project Description

28.1.1 Full Size Project

In the northern San Diego region, the majority of growers have parcels of 10 acres or less, which causes difficulties in implementing the requirements of monitoring and reporting for these operations. The RWQCB is developing a conditional waiver (No. 4) for discharges from agricultural and nursery operations. This waiver will require monitoring and installation of management measures (MMs) or BMPs for discharges from agricultural and nursery operations if discharges contain pollutants that can percolate to groundwater or infiltrate to surface waters via runoff. Discharges are defined to include emissions from growing operations, irrigation return flows, and stormwater runoff. Currently, agricultural and nursery operations are required to install MMs and BMPs. Farmers have organized the San Diego Region Irrigated Lands Group Educational Corporation to help them satisfy the requirements of the waiver.

The new conditional waiver requires enrollment in a monitoring group by December 31, 2010. For agricultural operations, the new waiver will specify that discharging pollutants with the ability to adversely affect the beneficial uses of water should be minimized or eliminated, and it will prohibit altering surface water unless a permit to do so has been approved. This new waiver condition, coupled with increasing costs for imported water, forces agricultural and nursery operators to investigate the use of RO. RO could be used to improve water quality from locally controlled degraded groundwater that is not currently usable because of its high TDS. One limitation to the implementation of RO by local users is the disposal of brine-concentrate.

28.1.2 Pilot Description and Need

There are no current plans to further study or pilot any technologies related to this issue.

28.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or ZLD process could increase the water yield of the project. ZLD or disposal solutions for the brine-concentrate waste stream would need to be assessed as part of a solution involving the use of RO membranes. While the cost to implement this additional water recovery is likely unfeasible compared to current water rates, the regulatory circumstances and lack of a feasible brineline may require such solutions.

28.3 Institutional Arrangements

This project will require an entity to work with the farmers to develop a centralized brine disposal method. The monitoring groups that are required under the conditional waiver could act as a forum for the farmer to work together on this issue.

28.4 Implementability

While the technical challenges of implementing a brine-concentrate or disposal or volume reduction process are challenging, the most significant hurdle to developing this project is likely to be the financing and operating the project. Farms in northern San Diego County are spread out, and developing a cost effective project will most likely involve concentrating the brine at a central location. An agreement would have to be made on who would be responsible for operating the plant or an existing agency take responsibility for operating this facility. If the farmers can develop a mechanism to fund and operate the project, then some level of pilot scale testing and pre-engineering would be needed to ensure the project's feasibility. In addition, the full size project would require permitting and environmental documentation. Funding and cost/benefit equity issues may need to be addressed prior to implementation of such a project.

29 Camp Pendleton Wastewater and Groundwater Treatment

29.1 Project Description

29.1.1 Full Size Project

Currently, the Marine Corps Base Camp Pendleton has five WWTPs located in the southern portion of the base. There is a plan to consolidate WWTPs No. 1, No. 2, No. 3, and No. 13, construct a new regional WWTP, and maximize the use of tertiary-treated effluent on the base. This new treatment plant would treat 2.71 mgd of average day influent and have a maximum capacity of 5 mgd. Excess flow from the new WWTP would be discharged using the existing Oceanside Ocean Outfall.

In the northern portion of the base, construction of an Advanced Water Treatment Facility and a new ocean outfall are planned. The AWTF would include granulated activated carbon and RO processes to reduce the concentrations of TDS, Total organic carbon (TOC), and corrosivity in the groundwater. This plant would require construction a new ocean outfall near to or connecting to the existing outfall at the San Onofre Nuclear Generating Station (SONGS).

29.1.2 Pilot Description and Need

There are no current plans to further study or pilot any brine-concentrate technologies as part of this project. However, the ocean outfall may require extensive modeling as part of the permit review and approval process.

29.2 Technologies or Other Options Being Considered

There are no current brine-concentrate technologies or other options being considered. Implementation of brine-concentrate volume reduction or zero liquid discharge (ZLD) process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates. Additionally, the ability to discharge a more concentrated waste stream via an ocean outfall would likely require more detailed dispersion modeling part of the permit review and approval process. Additional monitoring requirements could also be imposed on such a concentrated waste stream.

29.3 Institutional Arrangements

The only known institutional arrangements for this project would be the discharge of concentrate to the Oceanside Ocean Outfall. Specific water quality requirements on the ocean outfall would need to be reviewed before such an arrangement could be finalized.

29.4 Implementability

These projects are subject to the annual Federal budget process, so it is not known how soon these projects will move forward. It is likely that they could begin in late 2010 or 2011. As no pilot work on brine-concentrate technology has been discussed, it is not likely that such a need will arise unless project conditions change.

30 Ramona MWD San Vicente Evaporation Pond

30.1 Project Description

30.1.1 Full Size Project

The San Vicente WWTP has a current tertiary capacity of 0.8 mgd. The secondary water produced at the plant is sent to Spangler Peak Ranch, and the tertiary water is sent to the San Vicente Golf Course for irrigation. In 2008, the San Vicente WWTP received a notice of 33 violations for discharges from the offices of the San Diego RWQCB. 30 of the 33 violations were for high TDS levels from the San Vicente Plant. The RWQCB established a TDS limit of 550 mg/L on the WDR for the San Vicente WWTP. This required the installation of RO to use recycled water in the area. In May 2000, the Ramona MWD requested an amendment to the requirements of the waste discharge permit for the San Vicente Plant. This would have increased the TDS limit and eliminated the need for RO. However, the RWQCB denied the request. In 2003, the Ramona MWD proposed the “Salt Reduction Plan” intended to reduce the salt loading to the groundwater basin by increasing the Ramona MWD’s use of local water supplies; however, the RWQCB never responded to this proposal, so in 2008 construction of the RO was initiated.

The Ramona MWD is implementing RO to address TDS and nutrient loading concerns for recycled water customers in the basin. In order to obtain incentive funding for the San Vicente Water Recycling Program, the Ramona MWD board has entered into a joint participation agreement under the MWDSC’s Southern California’s Local Resources Program. Additionally, the Ramona MWD is receiving incentive funding for using recycled water for irrigation on the San Vicente Golf Course.

Construction of the RO unit was completed in 2009, and is now in operation. To reduce the volume of brine produced, the system was constructed with a second-stage RO unit to further process the brine from the primary unit. The brine-concentrate from the RO unit is currently being hauled to a treatment plant for ocean disposal, but the Ramona MWD is designing an evaporation pond as a long-term disposal mechanism. Currently, the evaporation pond is still in the design phase.

Original plans considered the design of two evaporation ponds. However, one pond, with an overall area of approximately 5 acres is now being designed. The pond is being designed with a double-liner and monitoring wells to ensure no ground water quality degradation occurs. An existing 3 inch diameter irrigation line will be extended to carry the brine to the new evaporation pond from the San Vicente WWTP.

30.1.2 .Pilot Description and Need

There are no current plans to further study or pilot the evaporation pond.

30.2 Technologies or Other Options Being Considered

This project is currently designing evaporation ponds. No other options are currently being considered.

30.3 Institutional Arrangements

The San Diego County Water Authority (SDCWA)/MWDSC/Ramona MWD are the agencies involved in the local water supply development program incentive agreement.

30.4 Implementability

The major hurdles to implementation are funding and permitting. This project is moving forward as a method to reduce hauling costs over the long term. In spite of design efforts to protect groundwater by the installation of a double liner, permitting of the pond may be difficult due to groundwater quality degradation concerns. In addition, eventually the evaporation ponds will need to be dried out and material removed and disposed in a landfill.

31 City of Escondido Advanced Tertiary Treatment Project

31.1 Project Description

31.1.1 Full Size Project

The City of Escondido is investigating potential projects using advanced treated water from the Hale Avenue Resource Recovery Facility (HARRF). For these projects, 6 mgd to 18 mgd of tertiary treated effluent would be treated via MF and RO. The City is currently pursuing multiple uses for the treated water. Possibilities include indirect potable reuse, direct potable reuse, wetlands, live stream discharge, groundwater replenishment, saltwater barrier and industrial use. Brine-concentrate reject flows from the RO process would be disposed of via the existing San Elijo outfall.

There are two main drivers for this project: renewable potable water source to lessen demand for imported water and alternative disposal option in lieu of outfall expansion. The City of Escondido is the main user of the additional supply; however, the water potentially can be used regionwide.

31.1.2 Pilot Description and Need

A 3-month pilot project is planned for testing of the advanced treatment during the winter of 2010. Processes to be tested include cloth filtration, MF, and RO. The cloth filters are scheduled to be tested during the first month. During this first test period the treatment by the cloth filters will be followed by an MF/ RO treatment train. In the second month, effluent from existing continuous backwash sand filters will be treated using only the MF/RO treatment train. During the third month, the MF/RO treatment train will treat secondary effluent. Testing will determine the performance, quality, and maintenance required for operation of advanced treatment to treat each of the feed waters. The pilot project is expected to cost between $350,000 to $400,000.

No pilot has been identified for brine-concentrate management of this project. However, a capacity study may be needed to confirm available capacity for disposal of the brine-concentrate reject stream in the outfall.

31.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered.

31.3 Institutional Arrangements

Capacity in the San Elijo outfall will need to be confirmed. In addition, the City of San Diego is also considering a project to recover brackish groundwater from the San Pasqual basin. This project would also produce a brine-concentrate flow that would need to be disposed. The San Elijo outfall is an option and would need to be worked out in conjunction with the City of Escondido's project.

31.4 Implementability

A pilot test would likely be necessary to identify the most feasible technology. This could be completed in conjunction with the City of San Diego's San Pasqual Groundwater Desalter project. In addition, the full size project would require permitting and environmental documentation. Funding and cost/benefit equity issues may need to be address prior to implementation of the project.

32 San Pasqual Groundwater Desalter Brineline

32.1 Project Description

32.1.1 Full Size Project

The City of San Diego is investigating the recovery of degraded groundwater from the San Pasqual basin. The proposed 5-mgd San Pasqual desalter would be located at the site of the decommissioned (since 2001) San Pasqual Water Reclamation Plant. The desalter may be built in conjunction with an imported raw water storage and recovery project, located in the eastern (less brackish) portion of the San Pasqual basin. The desalter would produce about 1 mgd of brine-concentrate.

Brine disposal options evaluated include: sewer disposal through Escondido's HARRF and subsequent San Elijo Outfall; a 7-mile brine line directly to the San Elijo Outfall; and ZLD. Each of the options has drawbacks including: limited capacity of the San Elijo Outfall, salt loading at HARRF, and costs associated with a brineline or ZLD processes.

A process that reduces brine volume and total salt content would reduce cost impacts associated with each option, described above. In addition, the reduced flow could be pumped to a closer and smaller sewer pipeline that flows to the City of San Diego's North City WRP. This additional brine treatment and disposal opportunity could significantly reduce the need for infrastructure development and improves the City of San Diego's ability to permit and construct a groundwater recovery plant.

The City of San Diego is currently conducting a 150-gpm demonstration study of the desalter using nanofiltration (NF) and RO membranes. Use of this demonstration plant and the decommissioned reclamation plant facilities, will reduce the cost of building a pilot site for testing a brine minimization process and allow the brine minimization treatment train to be evaluated.

32.1.2 Pilot Description and Need

The City of San Diego is currently investigating a brine minimization process that would:

- Reduce the projects downstream salt impacts to HARRF or North City WRP by 30 to 35 percent
- Reduce San Elijo Ocean Outfall capacity needs for this project by 80 percent.

All brine disposal options identified would have reduced costs and/or impacts. These potential savings must be compared to the costs and practicality of minimizing brine.

The brine minimization method recommended for study uses a precipitative softening processes (the addition of lime, lime and soda ash, or caustic in a conventional reactor or a pellet reactor) followed by a secondary RO system. The secondary RO membranes will require pretreatment with membrane (polymeric and ceramic) or granular media filtration.

Bench-scale testing was performed in September 2009 on the brine-concentrate produced by the San Pasqual Demonstration plant. A future brine minimization pilot will help determine the cost, design, and operating parameters for the full-scale desalting plant. The pilot will detail all aspects of the technology, so it can be easily transferred to a full-scale project. The San Pasqual Demonstration Plant which includes groundwater wells and the primary (NF/RO) process is available to produce brine for the pilot.

32.2 Technologies or Other Options Being Considered

The City of San Diego conducted a literature review of 13 concentrate minimization technologies. Based on results of the paper study the City performed the following technology testing:

- Proof of concept bench-scale testing was performed on bipolar membrane electrodialysis (BMED). Performance data obtained suggests a large fraction of the O&M costs would be offset by the commercial value of the recovered product if a superior quality acid and base can be extracted. However, a number of uncertainties exist in the scaling up of BMED to full scale.
- A 2008 pilot study tested Vibratory Shear Enhanced Process (VSEP) at San Pasqual. Costs estimates assumed evaporation ponds would follow. The cost of the 1-mgd pump station and brineline to the San Elijo Outfall was estimated to cost $425/AF of product water less than this ZLD option.
- Minimization of brine using salt tolerant plants (halophytes).

ZLD methods considered were determined to be too expensive. The most promising technology is the precipitative softening with secondary RO process which is recommended for pilot testing. This technology is proven at full scale. Also, each brine discharge option under consideration would benefit from the volume and salt mass reductions.

32.3 Institutional Arrangements

For full-scale operation of the San Pasqual Groundwater Desalter, the City of San Diego may need to work with the City of Escondido if the HARRF disposal option is preferred. If the City can meet the capacity limits of the San Elijo Ocean Outfall, then the City will need to work with the San Elijo JPA to ensure its capacity needs and to gain access to the San Elijo Ocean Outfall. If these options are not feasible, then the City could discharge the brine-concentrate to the North City WRP sewer system. Increased TDS levels impacting the North City WRP's reuse operations would need to be considered under this option. The pilot test is not expected to have any institutional barriers.

32.4 Implementability

The City of San Diego is the lead agency on this project and will be ready to proceed with pilot testing the brine minimization process in 2010. This project's treatment train is currently at demonstration level (150-gpm) testing. Pilot testing the brine minimization system and developing full-scale plant 10 percent design drawings are the next steps in the project. In addition, City Council action would be needed to fund a full-scale project. The full-scale project would likely require a Site Development Permit and CEQA review. It is anticipated that a Mitigated Negative Declaration could address the environmental impacts.

Potential capacity limitations in the San Elijo outfall and salt loading issues at HARRF also might have to be addressed. Capacity outfall limits on the San Elijo Ocean Outfall will need to be addressed by both the City of San Diego and the City of Escondido, which is considering its own RO system at the HARRF and would utilize the same outfall for it brine-concentrate waste disposal. The City of San Diego plans to develop existing San Pasqual resources for groundwater supply, storage and recovery as part of this effort new sources of water that augment basin volume and improve water quality may be considered.

33 Mission Valley Groundwater Desalination Project

33.1 Project Description

33.1.1 Full Size Project

The City of San Diego is considering desalination of brackish groundwater in the Mission Valley area. This project would be located along the San Diego River near the intersection of Interstates 8 and 15. The project would result in the generation of approximately 2.0 mgd of potable water. The desalination process would generate approximately 0.4 mgd of brine-concentrate by 2015. The brine-concentrate would be disposed of in the East Mission Gorge Interceptor System or in the proposed San Diego Regional Concentrate Conveyance System and the South Bay Ocean Outfall (SBOO). The feasibility of this project will be determined in part by the cost to dispose of the brine-concentrate.

In the San Diego Regional Concentrate Conveyance System Feasibility Study, it was concluded that there is a low probability that the Mission Valley Desalination Plant would connect to San Diego Regional Concentrate Conveyance System. This conclusion was based on the fact that the Mission Valley Desalination Plant is not located near any of the other potential users of the conveyance system. Therefore, over 7 miles of pipeline would need to be constructed to connect the Mission Valley Desalination Plant to the regional concentrate brineline system. Because of this, the San Diego Regional Concentrate Conveyance System Feasibility Study did not complete a detailed feasibility level assessment for connecting the Mission Valley Desalination Plant to the conveyance system.

33.1.2 Pilot Description and Need

The City has no immediate plans to pilot test a brine-concentrate reduction or disposal technology related to this project.

33.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or zero liquid discharge (ZLD) process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates and the ability to discharge the brine-concentrate into the East Mission Gorge Interceptor System.

33.3 Institutional Arrangements

If the brine-concentrate is disposed of via the proposed San Diego Regional Concentrate Conveyance System and the South Bay Ocean Outfall (SBOO), then the project would be subject to whatever agreements are set forth by the project partners. This could be a Joint Powers Authority, to which the City would belong. However, the institutional arrangements for this project are still under consideration.

33.4 Implementability

This project would likely have some level of pilot scale testing and pre-engineering for the RO process. If brine-concentrate reduction or a ZLD process was use, then additional pilot studies would be needed to identify and optimize the best technology and process configuration. In addition, the full size project would require permitting and environmental documentation. Permitting could include specific discharge permits that would be issued by the RWQCB to the sewer or brineline system. In addition, the downstream WWTP and/or outfall may have specific permitting requirements that the project would have to meet. Funding and cost/benefit equity issues may need to be addressed prior to implementation of the San Diego Regional Concentrate Conveyance System and the South Bay Ocean Outfall (SBOO).

34 San Diego County Regional Brineline System

34.1 Project Description

34.1.1 Full Size Project

The San Diego County Water Authority (SDCWA), in association with the City of San Diego, City of Chula Vista, Otay Water District, and the Sweetwater Authority, evaluated the feasibility of establishing an environmentally sound and cost effective method to manage the disposal of brine/concentrate flows generated within south San Diego County. The study focused on southern San Diego County, which includes the cities of San Diego, National City, Chula Vista, and Imperial Beach for the following reasons:

- There are considerable number of proposed brackish groundwater desalination and recycling projects in southern San Diego County, which may not happen without a regional brineline system.
- There is an available and efficient disposal system through the SBOO with sufficient capacity.

The study also investigated the viability of using this regional brineline to serve the eastern San Diego County area cities of El Cajon, La Mesa, and Santee.

The San Diego County Regional Brineline System would generally follow a north/south alignment along the coast of San Diego Bay between Sweetwater River and the SBOO. Three potential system extensions were identified, which could be implemented as needs arise. These are: the Mission Valley Alignment, City of San Diego Alignment, and the Otay Mesa Alignment. The Regional Brineline would collect brine-concentrate flows from wastewater treatment plants, groundwater desalters, and industrial dischargers in southern San Diego County. Potential users include facilities that, either currently or in the future, will produce highly saline flows that do not require municipal wastewater treatment, or previously treated flows that do not require additional treatment, prior to ocean discharge. Potential municipal users include groundwater desalination facilities, water treatment plants, and wastewater treatment and recycling facilities. Potential industrial/institutional users include the United States Navy, energy plants, and correctional facilities.

The concentrate flow identified from the potential users in the region is between 11 and 13 mgd. The construction of a regional brineline system could facilitate the development of between 20 and 40 mgd of new water supplies as well as potentially reduce or eliminate the impacts from current concentrate management practices. The new water supplies projects being evaluated include the proposed expansion of the Reynolds Desalination Plant, the Otay River Desalination Plant, the San Diego

Formation Desalination Plant, the Mission Valley Desalination Plant and the Chula Vista MBR Treatment Plant. Among the projects listed above, the Otay River Desalination Plant, a project being evaluated by the Sweetwater Authority and Otay Water District, would likely be developed first. Results from recent hydrogeological investigations in the Otay River basin indicate there is a great potential to develop a significant water supply project.

The utilization of the SBOO for discharge of brine is critical to the success of the proposed regional brineline system. The owners of the SBOO, the City of San Diego and the International Boundary and Water Commission (IBWC), understand the purpose and need for the proposed brineline system and support the concept of utilizing the SBOO for brine management. The SBOO has sufficient capacity to accommodate the projected brine/concentrate flows from the regional brineline system. The capacity of the SBOO is 258 mgd (gravity) and 333 mgd (pumped). Currently, the SBOO serves the City of San Diego's South Bay Water Reclamation Plant and the IBWC's International Wastewater Treatment Plant. The current combined flow through the SBOO is less than 30 mgd (Figure 34.1).

The City of San Diego is also conducting a study to identify opportunities to increase recycling and beneficial reuse within the service area of the San Diego and Metro Participating Agencies. The outcome of these studies, which will be completed over the next several years, may lead to changes in the brine volumes through the Point Loma Outfall and /or the SBOO from what is represented in this report.

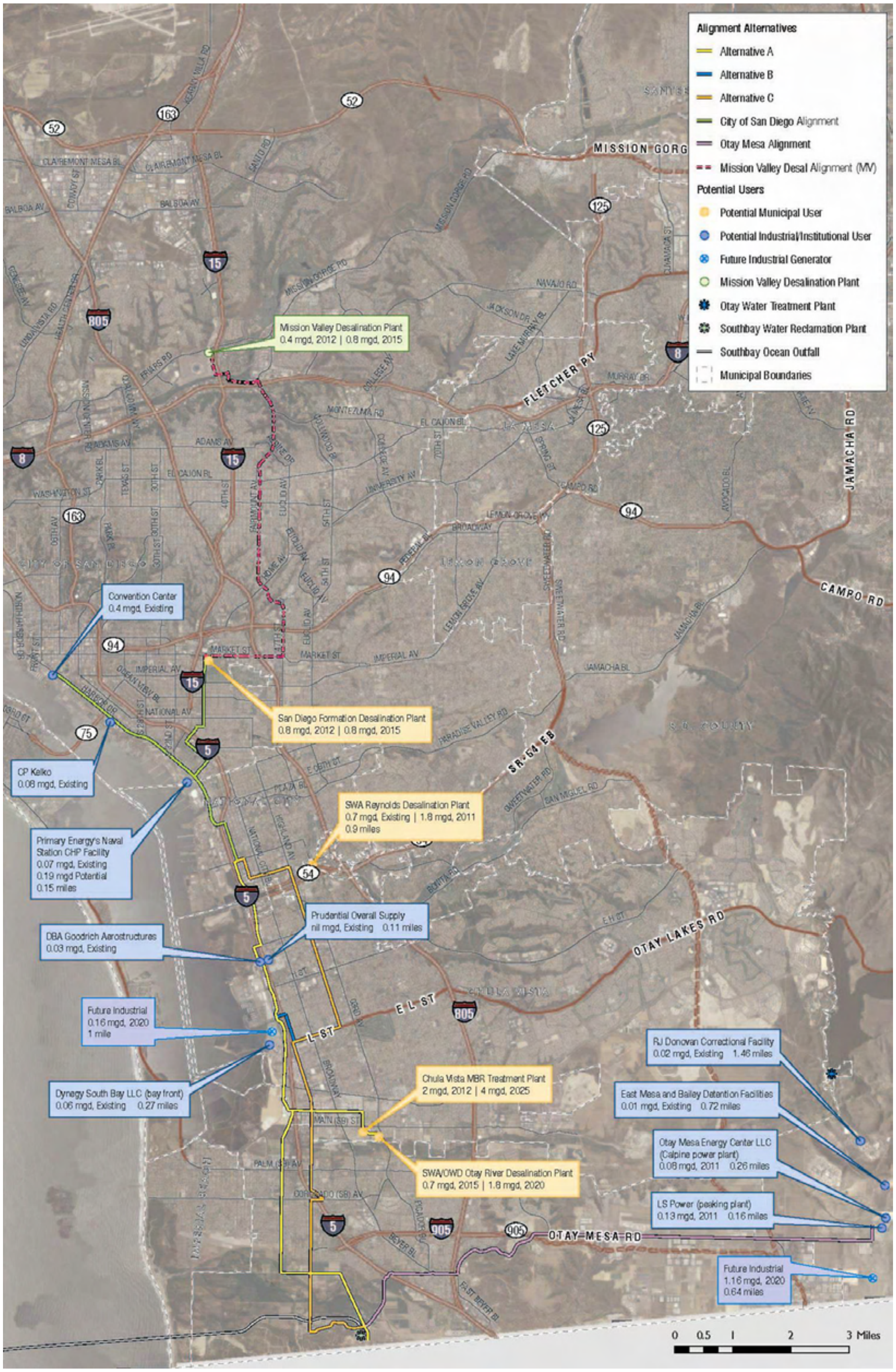
34.1.2 Pilot Description and Need

There are no current plans to pilot any brine-concentrate technologies related to this project.

34.2 Technologies or Other Options Being Considered

There are no current technologies or other options being considered. Implementation of brine-concentrate volume reduction or zero liquid discharge (ZLD) process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates.

FIGURE 34.1 SOUTH BAY OCEAN OUTFALL



Source: San Diego Regional Concentrate Conveyance System Feasibility Study, San Diego County Water Authority, 2008.

34.3 Institutional Arrangements

The institutional arrangement for operating the San Diego Regional Concentrate Conveyance System is complex, and responsibility and implementation issues vary depending on who owns, constructs, operates, and maintains the system. The potential participants are currently working on these issues as part of their on-going project assessment.

Possible organizational structures include Multiple Owners, Joint Powers Authority, Single Owner with Contracts, and Single Owner Special District. Each organizational structure will have unique implementation issues. Potential issues include permit compliance, permit violation management and enforcement, and clear accountability. Responsibility issues include asset management and protection of investments, user commitments, and who is involved with the decision to add users. Finally, possible financial issues include availability of outside funding, involvement in rate setting, and capital reserves and bonding.

34.4 Implementability

As part of the institutional arrangements, the project economics and project details still need to be worked out by the potential participating agencies. These complex issues are currently being discussed. A specific pilot/demonstration project has yet to be identified as part of this project. It is possible that volume reduction technology or even a zero liquid discharge application could be implemented as a cheaper solution than one of the tributary brinelines. This is particularly possible for the Mission Valley Groundwater project, which is located north of the main section of this brineline system.

At this time, there appears to be no immediate or pending driver to implement this brine-concentrate conveyance system. As such, this concept project is not foreseen to be implemented in the near future.

35 City of San Diego Indirect Potable Reuse Project

35.1 Project Description

35.1.1 Full Size Project

The City of San Diego was granted a waiver from secondary treatment standards and has been permitted by the USEPA and RWQCB to use chemically enhanced primary treatment at its Point Loma WWTP. The waiver status is tentative, and is subject to a 5-year review and renewal process. The City of San Diego is actively investigating alternative methods that can increase local water supplies and also off load wastewater flow to the Point Loma WWTP. San Diego is currently planning demonstration testing for an Indirect Potable Reuse with Reservoir Augmentation (IPR/RA) project. The City of San Diego is also conducting a study to identify opportunities to increase recycling and beneficial reuse within the service area of the San Diego and Metro Participating Agencies. The outcome of these studies, which will be completed over the next several years, may lead to changes in the brine volumes through the Point Loma Outfall and /or the SBOO from what is represented in this report. Total recycled water beneficial use volumes may also change.

The IPR/RA Demonstration Project will provide technical, environmental, regulatory, funding and public outreach requirements necessary to implement a full scale project. A proposed one mgd AWT plant located at the North City WRP will be operated and tested for a year. Testing will be used to verify that water quality and reliability aspects comply with the California Department of Public Health (CDPH) and RWQCB requirements.

If the IPR/RA Demonstration Project meets regulatory requirements and provides evidence of viability of the IPR/RA process, the City of San Diego could choose to proceed with the full-scale facilities. The full scale IPR/RA plant would send AWT water to San Vicente Reservoir via a 23 mile pipeline where, after months of blending and additional treatment, it would be distributed as potable water. A separate City Council action would be required to initiate a full scale IPR/RA Project.

35.1.2 Pilot Description and Need

There are no current plans to further study or pilot any brine-concentrate technologies related to this project. Brine-concentrate reject flows would be discharge back into the sewer which flows to the City's Point Loma WWTP where domestic sewage is treated and discharge to the ocean.

35.2 Technologies or Other Options Being Considered

There are no current brine-concentrate technologies or other options being considered. Implementation of brine-concentrate volume reduction or ZLD process could increase the water yield of the project. However, the cost to implement this additional water recovery is likely unfeasible compared to current water rates. A ZLD process is not likely to be feasible because of the proximity and ability to discharge reject flows back into the Point Loma sewer system.

35.3 Institutional Arrangements

The City of San Diego is lead agency on this project. The full-scale project will require approval by the City Council as well as development of agreements with and approval by other local agencies sharing water from the San Vicente reservoir. Reclamation and the California Department of Water Resources (DWR) are providing funding support for the IPR/RA Demonstration Project.

35.4 Implementability

The full-scale project costs and other details are currently being studied by the City and as part of the Demonstration Project. No brine-concentrate treatment process is currently being considered as part of this study. It is possible that volume reduction technology could be implemented or included in the future. The biggest environmental or regulatory challenge related to this project will be the public acceptance and approval by CDPH and RWQCB.

36 Pilot / Demonstration Project Evaluations

The pilot/demonstration projects discussed in this report were evaluated using a multicriteria analysis (MCA) process. This MCA process rates each potential project by assigning values directly using predefined scales for the criteria. The criteria used in the analysis must be measurable or assessable (qualitatively or quantitatively). The MCA was used specifically in this evaluation to select potential pilot projects based on a defined numeric score for each criterion and a weighting or importance factor. The importance factors ranged from 0 to 100 with each criterion being assigned a score based on how important the criterion was in the overall decision-making process. The following subsections will outline how the criteria were selected, ranked, and defined, as well as how the pilot projects were scored (i.e., the results of the MCA).

The MCA process consisted of the following elements, as seen in Figure 36.1 and described below:

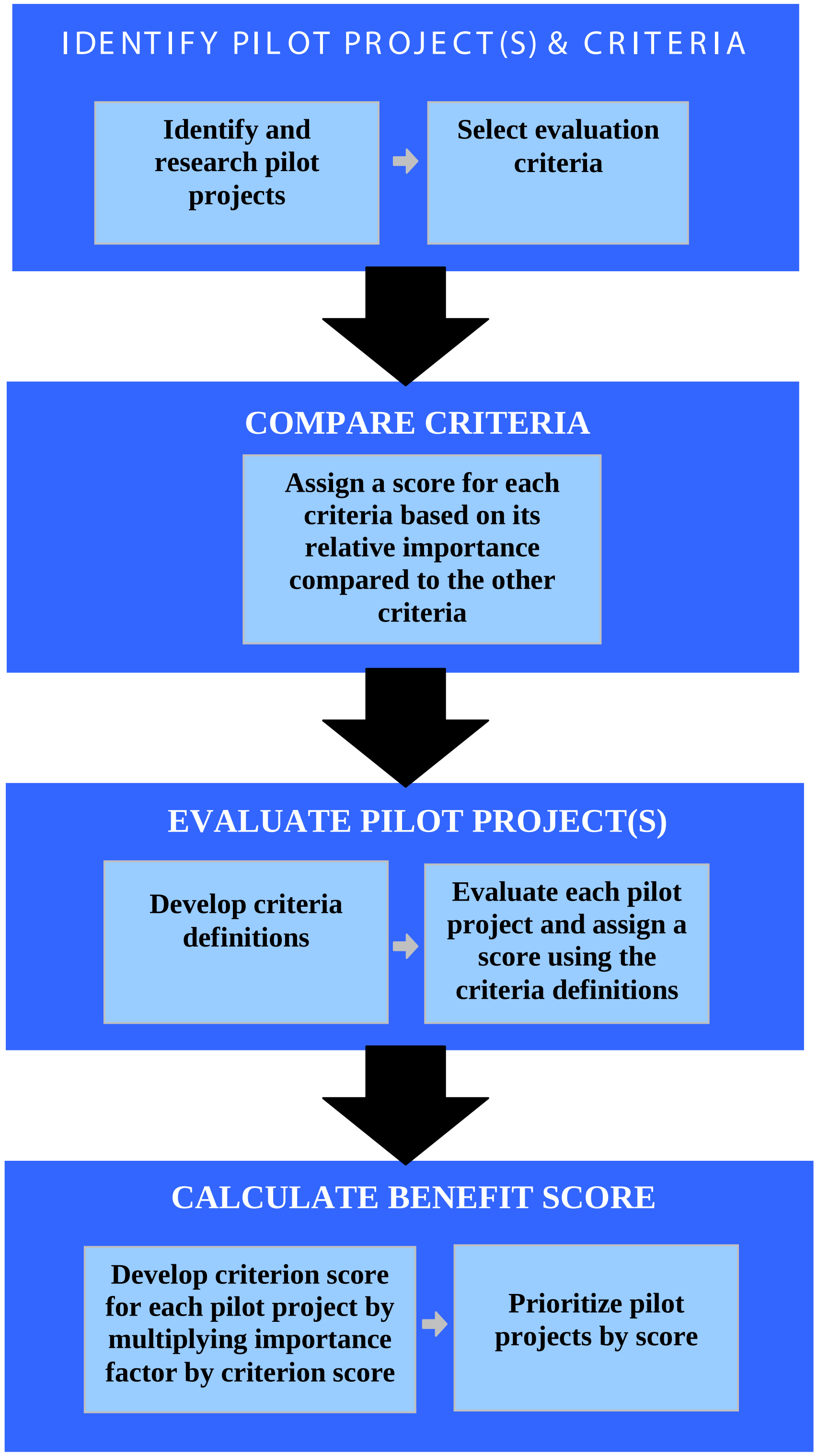
- Identify and research pilot projects.
- Select criteria for evaluation of pilot projects.
- Develop importance factors for ranking criteria.
- Define criteria for evaluation of pilot projects.
- Evaluate pilot projects using MCA.
- Select the optimal pilot project(s) based on the MCA score(s).

36.1 Selection of Criteria for Evaluation of Pilot Project(s)

The first step in the MCA process was to identify and research pilot project(s), which were described in previous sections of this report. The second step of the process was to develop criteria to evaluate the pilot project(s) using the MCA process. The criteria were:

- Does the technology/pilot have regional applicability?
- Is the pilot implementable from an institutional, funding, and schedule, perspective?
- Is the pilot implementable from a regulatory/environmental perspective?
- Is the technology ready to be pilot tested?
- Is there a BEMT local agency partner or other local agency ready to champion the project?

FIGURE 36.1 MCA PROCESS FLOW DIAGRAM



- Does the project have regional benefits?
- How much water supply is saved/generated by the project?
- Does the project improve water quality or provide environmental benefits?
- Can the technology be implemented for a full-scale project?
- Are there barriers (i.e., regulatory, environmental, or funding) to full-scale project implementation?

36.2 Compare Criteria

The next step in the MCA process was to set relative importance factors or weighting factors for each of the criteria. This was done by determining which of the criteria was most important compared to the other criteria. Table 36.1 provides a summary of the importance factors for each of the criteria.

TABLE 36.1
IMPORTANCE FACTORS FOR EACH CRITERIA

CRITERIA	WEIGHTING (%)
1. Does the technology/pilot have regional applicability?	30%
2. Is the pilot implementable from an institutional, cost, funding, and schedule perspective?	20%
3. Is the pilot implementable from a regulatory/environmental and permitting perspective?	10%
4. Is the technology ready to be pilot tested?	10%
5. Is there a BEMT local agency partner or other local agency ready to champion the project?	5%
6. Does the ultimate project have regional benefits?	5%
7. How much water supply is saved/generated by the project?	5%
8. Does the project improve water quality or provide environmental benefits?	5%
9. Can the technology be implemented for a full-scale project?	5%
10. Are there barriers (i.e., regulatory, environmental, or funding) to full-scale project implementation?	5%
Total Possible	**100%**

36.3 Define Criteria for Evaluation

Defining the criteria was the next step in the MCA process. Definition is important because MCA rates the discharge options by assigning values directly using defined scales for the criteria. Table 36.2 provides the scoring definitions used for each of the nine criteria. The definitions were developed so that each pilot project had a qualitative and quantitative basis for a given score.

TABLE 36.2
CRITERIA DEFINITIONS

1. Does the technology/pilot have regional applicability?

Criteria Score	Description
1	Only locally applicable
5	Somewhat regionally applicable
10	Technology is transferrable to other facilities/projects in the region

2. Is the pilot implementable from an institutional, cost, funding, and schedule perspective?

Criteria Score	Description
1	Low level of certainty that pilot is implementable
5	Medium level of certainty that pilot is implementable
10	High level of certainty that pilot is implementable

3. Is the pilot implementable from a regulatory/environmental and permitting perspective?

Criteria Score	Description
1	Low level of certainty that pilot is implementable
5	Medium level of certainty that pilot is implementable
10	High level of certainty that pilot is implementable

4. Is the technology ready to be pilot tested?

Criteria Score	Description
1	Pilot-scale application needs to be developed or is unavailable
5	Pilot-scale application is in development and will be ready in near future
10	Pilot-scale application exists and is ready for use

TABLE 36.2
CRITERIA DEFINITIONS

5. Is there a BEMT local agency partner or other local agency ready to champion the project?

Criteria Score	Description
1	No project champion exists
5	Local agency project champion exists
10	BEMT local agency partner champion exists

6. Does the ultimate project have regional benefits?

Criteria Score	Description
1	Project is beneficial to local agency only
5	Project is beneficial to part of region or several agencies
10	Project is beneficial to southern California region

7. How much water supply is saved/generated by the project?

Criteria Score	Description
1	Little savings/generation of water supply
5	Moderate savings/generation of water supply
10	Substantial savings/generation of water supply

8. Does the project improve water quality or provide environmental benefits?

Criteria Score	Description
1	No benefits to water quality or the environment
5	Some benefits to water quality or the environment
10	Substantial benefits to water quality or the environment

9. Can the technology be implemented for a full-scale project?

Criteria Score	Description
1	Full-scale application is not likely
5	Some barriers need to be overcome
10	Is easily transferrable to full-scale

10. Are there barriers (i.e., regulatory, environmental, or funding) to full-scale project implementation?

Criteria Score	Description
1	Major barriers (permitting, financing, regulations) that may not be overcome
5	Some barriers that will delay project implementation
10	Minor barriers that can easily be overcome

36.4 Evaluate Pilot Project(s) Using MCA

The next step in the evaluation process was to score the pilot project using the criteria definitions. Once this was completed, the technology scoring was input along with the criteria importance factors. The following steps were followed to score each pilot project for each criterion:

1. Select the criterion to be scored (e.g., Does the technology/pilot have regional applicability?) and read the scoring definitions.
2. Move down the Table vertically, reading the name of the pilot project definition (e.g., Calleguas SMP System) and determine which definition best describes the project.
3. Read the score for the definition and enter it onto the Table under the corresponding criterion.
4. Repeat for each discharge option, moving vertically down the Table.
5. Repeat Steps 1 through 4 for each criterion, moving horizontally across the Table.

Table 36.3 provides the MCA scores for each of the pilot project(s).

36.5 Preliminary Selection of Pilot Project(s)

The final step in the process was to identify the preliminary pilot project(s) using the MCA tool. This tool identified the preliminary pilot project(s) by developing a benefit score from the results of the MCA. The results of this analysis are shown in Figure 36.2 and Table 36.3. The projects that showed the highest MCA benefit score were:

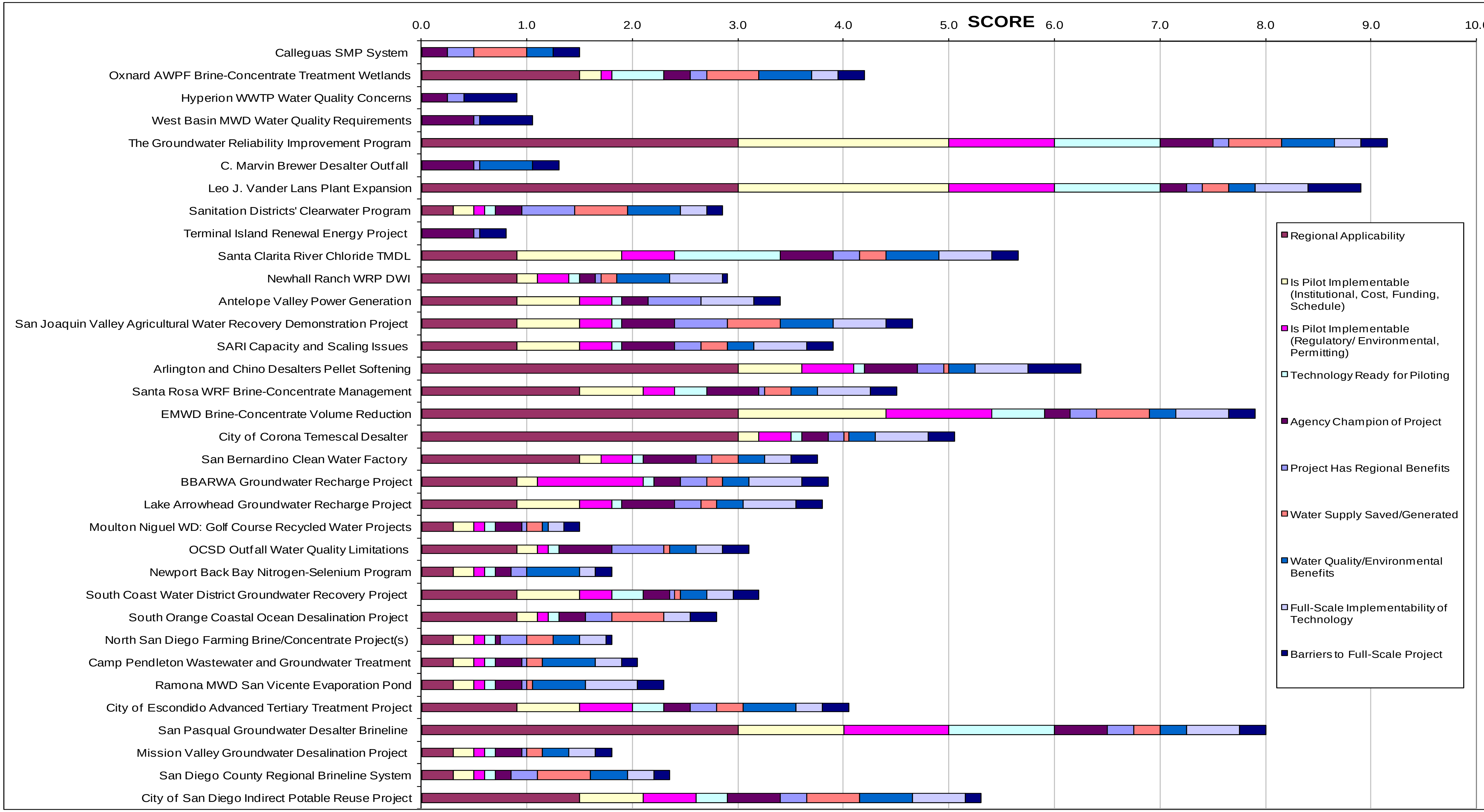
- Groundwater Reliability Improvement Program (Los Angeles County)
- Leo J. Vander Lans Plant Expansion (Los Angeles County)
- San Pasqual Groundwater Desalter Brineline (San Diego County)
- EMWD Brine-Concentrate Volume Reduction (Inland Empire)
- Arlington and Chino Desalters Pellet Softening (Inland Empire)
- Santa Clarita River Chloride TMDL (Los Angeles County)
- City of San Diego Indirect Potable Reuse Project (San Diego County)
- City of Corona Temescal Desalter (Inland Empire)
- San Joaquin Valley Agricultural Water Recovery Demonstration Project (Other)
- Santa Rosa WRF Brine-Concentrate Management (Inland Empire)

These Projects ranked highest in the preliminary analysis, but the project pilot tested, as part of Phase II, will be selected by the Phase II BEMT. The projects cover the entire study area and have a mix of inland and coastal projects.

TABLE 36.3
MCA CRITERIA AND PILOT PROJECT EVALUATION

	PROJECT/CRITERIA	DOES THE TECHNOLOGY/PILOT HAVE REGIONAL APPLICABILITY?		IS THE PILOT IMPLEMENTABLE FROM AN INSTITUTIONAL, COST, FUNDING, AND SCHEDULE PERSPECTIVE?		IS THE PILOT IMPLEMENTABLE FROM A REGULATORY/ENVIRONMENTAL AND PERMITTING PERSPECTIVE?		IS THE TECHNOLOGY READY TO BE PILOT TESTED?		IS THERE A BEMT LOCAL AGENCY PARTNER OR OTHER LOCAL AGENCY READY TO CHAMPION THE PROJECT?		DOES THE ULTIMATE PROJECT HAVE REGIONAL BENEFITS?		HOW MUCH WATER SUPPLY IS SAVED/GENERATED BY THE PROJECT?		DOES THE PROJECT IMPROVE WATER QUALITY OR PROVIDE ENVIRONMENTAL BENEFITS?		CAN THE TECHNOLOGY BE IMPLEMENTED FOR A FULL-SCALE PROJECT?		ARE THERE BARRIERS (I.E., INSTITUTIONAL, REGULATORY, ENVIRONMENTAL, OR FUNDING) TO FULL-SCALE PROJECT IMPLEMENTATION?		TOTAL
		30%		20%		10%		10%		5%		5%		5%		5%		5%		5%		100%
		INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	INPUT	RESULT	
Ventura County	Calleguas SMP System	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.25	5.00	0.25	10.00	0.50	5.00	0.25	0.00	0.00	5.00	0.25	1.50
	Oxnard AWPF Brine-Concentrate Treatment Wetlands	5.00	1.50	1.00	0.20	1.00	0.10	5.00	0.50	5.00	0.25	3.00	0.15	10.00	0.50	10.00	0.50	5.00	0.25	5.00	0.25	4.20
Los Angeles County	Hyperion WWTP Water Quality Concerns	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.25	3.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.50	0.90
	West Basin MWD Water Quality Requirements	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.50	1.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.50	1.05
	The Groundwater Reliability Improvement Program	10.00	3.00	10.00	2.00	10.00	1.00	10.00	1.00	10.00	0.50	3.00	0.15	10.00	0.50	10.00	0.50	5.00	0.25	5.00	0.25	9.15
	C. Marvin Brewer Desalter Outfall	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.50	1.00	0.05	0.00	0.00	10.00	0.50	0.00	0.00	5.00	0.25	1.30
	Leo J. Vander Lans Plant Expansion	10.00	3.00	10.00	2.00	10.00	1.00	10.00	1.00	5.00	0.25	3.00	0.15	5.00	0.25	5.00	0.25	10.00	0.50	10.00	0.50	8.90
	Sanitation Districts' Clearwater Program	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	5.00	0.25	10.00	0.50	10.00	0.50	10.00	0.50	5.00	0.25	3.00	0.15	2.85
	Terminal Island Renewal Energy Project	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.00	0.50	1.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.25	0.80
	Santa Clarita River Chloride TMDL	3.00	0.90	5.00	1.00	5.00	0.50	10.00	1.00	10.00	0.50	5.00	0.25	5.00	0.25	10.00	0.50	10.00	0.50	5.00	0.25	5.65
	Newhall Ranch WRP DWI	3.00	0.90	1.00	0.20	3.00	0.30	1.00	0.10	3.00	0.15	1.00	0.05	3.00	0.15	10.00	0.50	10.00	0.50	1.00	0.05	2.90
	Antelope Valley Power Generation	3.00	0.90	3.00	0.60	3.00	0.30	1.00	0.10	5.00	0.25	10.00	0.50	0.00	0.00	0.00	0.00	10.00	0.50	5.00	0.25	3.40
	San Joaquin Valley Agricultural Water Recovery Demonstration Project	3.00	0.90	3.00	0.60	3.00	0.30	1.00	0.10	10.00	0.50	10.00	0.50	10.00	0.50	10.00	0.50	10.00	0.50	5.00	0.25	4.65
Inland Empire	SARI Capacity and Scaling Issues	3.00	0.90	3.00	0.60	3.00	0.30	1.00	0.10	10.00	0.50	5.00	0.25	5.00	0.25	5.00	0.25	10.00	0.50	5.00	0.25	3.90
	Arlington and Chino Desalters Pellet Softening	10.00	3.00	3.00	0.60	5.00	0.50	1.00	0.10	10.00	0.50	5.00	0.25	1.00	0.05	5.00	0.25	10.00	0.50	10.00	0.50	6.25
	Santa Rosa WRF Brine-Concentrate Management	5.00	1.50	3.00	0.60	3.00	0.30	3.00	0.30	10.00	0.50	1.00	0.05	5.00	0.25	5.00	0.25	10.00	0.50	5.00	0.25	4.50
	EMWD Brine-Concentrate Volume Reduction	10.00	3.00	7.00	1.40	10.00	1.00	5.00	0.50	5.00	0.25	5.00	0.25	10.00	0.50	5.00	0.25	10.00	0.50	5.00	0.25	7.90
	City of Corona Temescal Desalter	10.00	3.00	1.00	0.20	3.00	0.30	1.00	0.10	5.00	0.25	3.00	0.15	1.00	0.05	5.00	0.25	10.00	0.50	5.00	0.25	5.05
	San Bernardino Clean Water Factory	5.00	1.50	1.00	0.20	3.00	0.30	1.00	0.10	10.00	0.50	3.00	0.15	5.00	0.25	5.00	0.25	5.00	0.25	5.00	0.25	3.75
	BBARWA Groundwater Recharge Project	3.00	0.90	1.00	0.20	10.00	1.00	1.00	0.10	5.00	0.25	5.00	0.25	3.00	0.15	5.00	0.25	10.00	0.50	5.00	0.25	3.85
	Lake Arrowhead Groundwater Recharge Project	3.00	0.90	3.00	0.60	3.00	0.30	1.00	0.10	10.00	0.50	5.00	0.25	3.00	0.15	5.00	0.25	10.00	0.50	5.00	0.25	3.80
Orange County	Moulton Niguel WD: Golf Course Recycled Water Projects	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	5.00	0.25	1.00	0.05	3.00	0.15	1.00	0.05	3.00	0.15	3.00	0.15	1.50
	OCSD Outfall Water Quality Limitations	3.00	0.90	1.00	0.20	1.00	0.10	1.00	0.10	10.00	0.50	10.00	0.50	1.00	0.05	5.00	0.25	5.00	0.25	5.00	0.25	3.10
	Newport Back Bay Nitrogen-Selenium Program	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	3.00	0.15	3.00	0.15	0.00	0.00	10.00	0.50	3.00	0.15	3.00	0.15	1.80
	South Coast Water District Groundwater Recovery Project	3.00	0.90	3.00	0.60	3.00	0.30	3.00	0.30	5.00	0.25	1.00	0.05	1.00	0.05	5.00	0.25	5.00	0.25	5.00	0.25	3.20
	South Orange Coastal Ocean Desalination Project	3.00	0.90	1.00	0.20	1.00	0.10	1.00	0.10	5.00	0.25	5.00	0.25	10.00	0.50	0.00	0.00	5.00	0.25	5.00	0.25	2.80
San Diego County	North San Diego Farming Brine/Concentrate Project(s)	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	1.00	0.05	5.00	0.25	5.00	0.25	5.00	0.25	5.00	0.25	1.00	0.05	1.80
	Camp Pendleton Wastewater and Groundwater Treatment	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	5.00	0.25	1.00	0.05	3.00	0.15	10.00	0.50	5.00	0.25	3.00	0.15	2.05
	Ramona MWD San Vicente Evaporation Pond	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	5.00	0.25	1.00	0.05	1.00	0.05	10.00	0.50	10.00	0.50	5.00	0.25	2.30
	City of Escondido Advanced Tertiary Treatment Project	3.00	0.90	3.00	0.60	5.00	0.50	3.00	0.30	5.00	0.25	5.00	0.25	5.00	0.25	10.00	0.50	5.00	0.25	5.00	0.25	4.05
	San Pasqual Groundwater Desalter Brineline	10.00	3.00	5.00	1.00	10.00	1.00	10.00	1.00	10.00	0.50	5.00	0.25	5.00	0.25	5.00	0.25	10.00	0.50	5.00	0.25	8.00
	Mission Valley Groundwater Desalination Project	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	5.00	0.25	1.00	0.05	3.00	0.15	5.00	0.25	5.00	0.25	3.00	0.15	1.80
	San Diego County Regional Brineline System	1.00	0.30	1.00	0.20	1.00	0.10	1.00	0.10	3.00	0.15	5.00	0.25	10.00	0.50	7.00	0.35	5.00	0.25	3.00	0.15	2.35
	City of San Diego Indirect Potable Reuse Project	5.00	1.50	3.00	0.60	5.00	0.50	3.00	0.30	10.00	0.50	5.00	0.25	10.00	0.50	10.00	0.50	10.00	0.50	3.00	0.15	5.30

FIGURE 36.2 MCA CRITERIA AND PILOT PROJECT EVALUATION



36.6 Regional Brine-Concentrate Management Study Recommendations

Moving forward to pilot testing will require interagency collaboration to determine how pilot project costs will be shared. This collaboration and the selection of the specific projects to be piloted will be the focus of Phase 2 of this project. In addition to pilot testing, there are other regional concerns that could be addressed via additional studies. These recommendations are based on information and analyses developed as part of this study and relate to brine/concentrate management. Potential regional studies include:

- Prepare an inventory of NPDES permits for wastewater and brine outfalls to identify consistencies/inconsistencies in permitting requirements by locality and RWQCB.
- Develop a framework for capacity credits for agencies that implement brine/concentrate management technologies. The capacity credits would be for an agency that concentrates or reduces its flow contribution to an existing brine line and/or ocean outfall.
- Study the marine impacts of brine/concentrate disposal via ocean outfalls by identifying the constituent(s) that adversely affect the marine environment, specifically in the mixing zone, and include impacts due to changes in temperature, turbidity, toxicity, and dissolved oxygen concentrations. The incorporation of seawater desalting facilities should be considered in this assessment because the addition of five major facilities in southern California could change the impact on marine ecology.
- Evaluate the waste classification of brine/concentrate with the view for potential reclassification as a nonhazardous waste.
- Conduct an appraisal-level study on potential methods to pretreat water for removal of toxic constituents.
- Conduct an appraisal-level study of using existing or abandoned oil and gas pipelines for brine pipelines. This effort could include an inventory of potential pipeline locations in southern California or the western U.S., regulatory constraints, water quality issues, and pipeline-integrity considerations.
- Conduct an appraisal-level study of the issues and impacts associated with decommissioning a brine/concentrate evaporation pond.
- Develop a guidance document for IPR projects based on OCWD’s GWR project experience to assist other agencies with regulatory issues and requirements.
- Work with regulators to develop consistence policies and regulations on requirements or restrictions related to the use of different water sources for recycled water.

These proposed studies could be submitted for funding under Reclamation's Science and Technology grant program. Proposals under this program are typically due in June for funding in the following federal fiscal year.

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