Southern California Comprehensive Water Reclamation and Reuse Study Phase II

Final Report

Cooperative Effort Funded And Managed By:

The United States Bureau of Reclamation

In Partnership With:

California Department of Water Resources,
Central Basin and West Basin Municipal Water Districts, City of Los Angeles,
City of San Diego, Metropolitan Water District of Southern California,
San Diego County Water Authority, Santa Ana Watershed Project Authority,
South Orange County Reclamation Authority

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Acronyms

$/ac-ft	Dollars per acre-foot
ac-ft	Acre-foot
ADM	Allocation and Distribution Model
AFY	Acre-foot per year
AML	Arc macro language
AWMA	Aliso Water Management Agency
AWT	Advanced water treatment
BPO	Basin Plan Objective
Caltrans	California Department of Transportation
CCI	Construction Cost Index
CDC	California Department of Corrections
CDO	Cease and Desist Order
cfs	Cubic feet per second
CIP	Capital Improvements Plan
CSD	County Sanitation District
CWD	County Water District
DHS	California Department of Health Services
DWR	California Department of Water Resources
EDM	Economic Decision Model
EDR	Electrodialysis Reversal
ENR	Engineering News Record
fps	Feet per second
FY	Fiscal year
GAP	Green Acres Project
GIS	Geographic information system
gpd	Gallons per day
gpm	Gallons per minute
GWRS	Groundwater Replenishment System
HL	Head loss
hp	Horsepower
IEUA	Inland Empire Utilities Agency
IRWD	Irvine Ranch Water District

IWTP	International Wastewater Treatment Plant
JPA	Joint Powers Authority
LACSD	Los Angeles County Sanitation District
LACDPW	Los Angeles County Department of Public Works
LADWP	Los Angeles Department of Water and Power
LF	Linear feet
Long-term	Planning year 2040
MAFY	Million acre-feet per year
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
mg/L	Milligrams per liter
mgd	Million gallons per day
MOU	Memorandum of Understanding
MWD	Municipal Water District
MWDOC	Municipal Water District of Orange County
MWDSC	Metropolitan Water District of Southern California
NPDES	National Pollutant Discharge Elimination System
NPV	Net present value
O&M	Operation and maintenance
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
OPRA	Ocean Pollution Reduction Act
PAC	Project Advisory Committee
PCC	Project Coordinating Committee
P.L.	Public Law
ppm	Parts per million
psi	Pounds per square inch
PUD	Public Utilities District
Reclamation	United States Bureau of Reclamation
RIX	Rapid Infiltration/Extraction
RO	Reverse osmosis
RRF	Resource Recovery Facility
RWA	Regional Water Authority
RWQCB	Regional Water Quality Control Board
SARI	Santa Ana Regional Interceptor

SAWPA	Santa Ana Watershed Project Authority
SCCWRRS	Southern California Comprehensive Water Reclamation and Reuse Study
SDCWA	San Diego County Water Authority
SERRA	South East Regional Reclamation Authority
Short-term	Planning year 2010
SOCRA	South Orange County Reclamation Authority
STIP	Short-Term Implementation Plan
TDS	Total dissolved solids
Title 22	Title 22 of the California Administrative Code
TMDL	Total maximum daily load
TVRI	Temescal Valley Regional Interceptor
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
WD	Water District
WPCF	Water Pollution Control Facility
WQCP	Water Quality Control Plant
WRF	Water Reclamation Facility
WRP	Water Reclamation Plant
WWRF	Wastewater Reclamation Facility
WWTP/WTP	Wastewater Treatment Plant

1 Project Overview

1.1 Contents of this Section

Project Background
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1.2 Project Background

Increasing demands and limited supplies of fresh water have led southern California water policymakers to realize that the water supply of the area must be diversified to ensure reliability. One of the most dependable, abundant, and underutilized supplies of water in southern California is recycled water. Recycled water is wastewater, originating from municipal, industrial, or agricultural activities, that has been treated to a quality suitable for beneficial reuse. Recycled water can be used for a number of applications, including irrigation, industrial processes, groundwater recharge, and environmental enhancement.

In 1993, the U.S. Bureau of Reclamation (Reclamation), in conjunction with eight State and local agencies, adopted a Plan of Study to evaluate the feasibility of regional water reclamation in southern California. Regional planning would take advantage of potential surpluses in recycled water that could serve needs in areas throughout the region. The Plan of Study called for a 6-year comprehensive effort to examine recycled water opportunities from a regional perspective, and to develop a long-term planning strategy to increase recycled water use in southern California. This activity was authorized by Public Law (P.L.) 102-575, which directs Reclamation to conduct a study to assess the feasibility of comprehensive water recycling and reuse in southern California. The need for such a study, called the Southern California Comprehensive Water Reclamation and Reuse Study (SCCWRRS), is based on the premise that the increased use of recycled water will reduce pressures on imported water supplies and provide a continuous and dependable local source of supplemental water for southern California.

Prior to the initiation of the SCCWRRS, a preplanning committee was formed to develop the Plan of Study and bring together local and regional entities interested in southern California water reclamation. This committee then evolved into the non-Federal partnership of state and local water agencies that has made the financial commitment to conduct this comprehensive regional planning effort. These eight agencies represent a variety of water reclamation interests in southern California and include the following:

- California Department of Water Resources (DWR)
- Central Basin and West Basin MWD
- City of Los Angeles

- City of San Diego
- Metropolitan Water District of Southern California (MWDSC)
- San Diego County Water Authority (SDCWA)
- Santa Ana Watershed Project Authority (SAWPA)
- South Orange County Reclamation Authority (SOCRA)

The SCCWRRS was organized into Phase IA, Phase IB, and Phase II. In Phase IA, the cost-sharing partners, along with Reclamation, developed an extensive database of existing and potential recycled water demands and supplies, land use, environmental assets, and local water and wastewater agency plans. In Phase IB, a set of sophisticated planning tools was developed with which to analyze the data and evaluate the benefits of regional water recycling strategies. In Phase II, the cost-sharing partners opened the planning process to all southern California water and wastewater agencies, to work together in partnership, using the tools and database from Phase I. The local agencies were asked to identify regional water recycling opportunities that would be attractive to them. Over 70 local agencies joined Reclamation and the eight cost-sharing partners to participate in Phase II of the SCCWRRS, examining the feasibility of regional water recycling over short- and long-term planning horizons. The study area for SCCWRRS is presented in Figure 1-1.

FIGURE 1-1
Study Area

1.3 SCCWRRS Authorization

The SCCWRRS was authorized under Section 1606 of P.L. 102-575, The Reclamation Wastewater and Groundwater Study and Facilities Act of 1992. Section 1606 reads:

(a) General Authority—The Secretary is authorized to conduct a study to assess the feasibility of a comprehensive water reclamation and reuse system for southern California. For the purpose of this title, the term "southern California" means those portions of the Counties of Imperial, Los Angeles, Orange, San Bernardino, Riverside, San Diego, and Ventura within the South Coast and Colorado River hydrologic regions as defined by the California Department of Water Resources.

(b) Cooperation with State; Federal share—The Secretary shall conduct the study authorized by this section in cooperation with the State of California and appropriate local and regional entities. The Federal share of the costs associated with this study shall not exceed 50 per centum of the total.

(c) Report—The Secretary shall submit the report authorized by this section to the Committee on Energy and Natural Resources of the Senate and the Committee on Interior and Insular Affairs of the House of Representatives not later than 6 years after appropriation of funds authorized by this title.

1.4 Study Perspective

SCCWRRS is a cooperative local, state, and Federal effort that is engaged in regional recycled water planning throughout southern California. Southern California is a fast-growing region that relies predominantly on imported water supplies from the Colorado River, Sacramento-San Joaquin Delta, and Owens Valley, as well as local groundwater supplies. All of these sources suffer one or more forms of stress, including water user competition and water quality degradation. Southern California's water supplies are involved in many of the major water controversies in the west.

Using the year 2040 as a long-term planning horizon, regional recycling opportunities were examined in Phase II. From the analysis, a regional recycling strategy was developed that included multiple projects for implementation over the next 10 years. The projects identified for this 10-year period were designated as the first steps toward long-term regional recycling. The yield of these projects represents new, locally developed water supplies offsetting demands on currently used potable supplies. The value to southern California from this new water supply is enhanced by attributes unique to recycled water, including:

- **Locally Controlled**

  Recycled water is generally locally owned and not subject to the same controversial water battles that affect supplies imported from far away.

- **Drought Resistant**

  Recycled water is available even during extreme droughts, since wastewater continues to be generated during shortage periods. Recycled water supplies represent a drought insurance policy that protects local southern California economies by allowing potable water supplies to be stretched that much further when recycled water takes up the drought shortage slack.

- **Environmentally Beneficial**

  Recycled water can relieve pressures on expanding imported water supplies that are stressing the environment. Recycled water is manufactured from treated wastewater discharges. The wastewater discharge to receiving waters is reduced or eliminated, which preserves recognized California assets such as bays and beaches. Once applied to a beneficial use, such as landscape irrigation, plants can beneficially use many of the constituents found in recycled water. These constituents, nitrogen for example, are otherwise detrimental to receiving water quality.

- **Represents Good Water-Industry Public Relations**

  Southern California water agencies are under increasing scrutiny regarding water use. Environmental activists and other motivated citizens have become increasingly involved with water issues and focus much attention on the water use efficiency of southern California water agencies. Water recycling represents a major component of recognized water use efficiency.

- **Represents Good Wastewater-Industry Public Relations**

  Southern California wastewater agencies are under increasing regulatory pressures to limit or eliminate treated effluent discharge to bays, estuaries, and river ecosystems. Public sentiment concerning ocean disposal has also become increasingly negative. Southern California's bays and beaches are recognized assets. Water recycling converts a potentially expensive or controversial discharge to a beneficial, revenue producing resource.

- **Water Use Efficiency**

  Senior water appropriators from the Colorado River recognize that the junior water appropriator also supplies, through wholesale water supply deliveries, the majority of urban residents and industrial water users in southern California. All of these "interested parties" recognize the beneficial value of recycled water from the perspectives of their own issues. There is increasing competition for scarce water resources in the western states, and it is incumbent on water users to demonstrate efficient use of available resources to convince decision makers that the needs are being met in a cost-effective, environmentally-friendly, and equitable fashion.

The value of regional water recycling planning is clearly demonstrated to be the most optimal approach for recycling water in southern California. This is recognized by those agencies who have worked together to identify local and regional opportunities. To develop projects, some agencies had to overcome institutional barriers with each other to craft the regional partnerships. That they have done so in complete cooperation is a testament to the hope that southern California will continue to enjoy the benefits of safe, reliable, and locally and regionally controlled water supplies in the new millennium.

1.5 Plan of Study

The SCCWRRS was organized into Phase IA, Phase IB, and Phase II. During Phase IA, the cost-sharing partners, along with Reclamation, developed an extensive database of existing and potential recycled water demands and supplies, land use, environmental assets, and local water and wastewater agency recycling plans. During Phase IB, a set of sophisticated planning tools was developed with which to analyze the data and evaluate the benefits of regional water recycling strategies. During Phase II, the cost-sharing partners opened the planning process to all southern California water and wastewater agencies, to work together in partnership, using the tools and database from Phase I.

1.5.1 Phase IA

The primary purpose of Phase IA was to compile available information on the supply of and demand for both fresh and recycled water throughout southern California. This effort resulted in a database that evolved further in Phase IB, and demonstrated the great potential for reusing large quantities of recycled water in southern California.

Using water supply and demand information from DWR Bulletin 160-93, California Water Plan Update, the Phase IA analysis concluded that the water supply would remain relatively constant through the year 2040, while demand will increase sharply. Unless measures are taken to increase available supply, a water shortage will result that will increase from 85,000 acre-feet per year (AFY) in 1990 to approximately 3 million AFY (MAFY) by the year 2040.

Phase IA also concluded that the water demand shortfall in the near term could be met with recycled water if the projected recycled water supplies are put to beneficial uses. To accomplish this, however, additional recycled water markets need to be identified to offset total water demands and eliminate the projected shortfall of freshwater supplies expected to occur sometime after the year 2010.

To expand potential recycled water use, Phase IA identified additional groundwater recharge and environmental enhancement projects. Groundwater recharge represents a significant opportunity for offsetting total water demands. Environmental enhancement projects represent “new” water users and, therefore, are unlikely to offset the use of freshwater supplies. However, they represent an opportunity to use potential surplus recycled water production and provide potentially high benefits.

Phase IA also identified several potential constraints to the development of reclamation projects. These included institutional, financial, regulatory, and public acceptance issues.

1.5.2 Phase IB

Phase IB further evaluated the issues identified in Phase IA, while also identifying additional opportunities for reuse. As a reconnaissance-level endeavor, Phase IB examined the study area from the “big-picture” perspective and provided a basis to begin evaluating alternatives that could be analyzed further in Phase II. The Phase IB analysis sought to optimize recycled water use from the regional perspective and, in the process, to identify constraints to maximizing reuse. The SCCWRRS regional planning process was not intended to challenge local agency planning or projects and other ongoing efforts. Instead, it was an opportunity to evaluate local efforts in a regional context. Additionally, various opportunities for recycling were considered. Groundwater recharge with recycled water and surface storage augmentation constitute tremendous opportunities to maximize recycled water use; however, many institutional, regulatory, and public acceptance issues surround these types of projects, potentially affecting implementation. In Phase IB, these implementation issues were not considered so that the analysis could instead focus on maximizing reuse by asking the question "what if" in order to develop an array of alternatives. The alternatives were evaluated to identify candidate projects for the Phase II feasibility analysis.

Phase IB examined three sub-regional and regional solutions for the two planning time horizons. Each of the three analyses consisted of recycled water distribution systems and the associated costs for these projects. All costs generated in Phase IB are the estimated costs to upgrade existing treatment plants to produce 100 percent recycled water, and to distribute the water to a variety and multitude of users. The costs do not include planned expansions or upgrades of existing facilities, nor do they include the costs for constructing, operating, and maintaining the existing facilities.

For each analysis, the assumed conditions under which the water is distributed vary, from a highly constrained climate, to an aggressive climate for recycled water use. The climate reflects regulatory requirements and public acceptability regarding the use of recycled water. Phase IB used the costs generated by each analytical scenario to identify opportunities and constraints for maximizing reuse, and identified a list of candidate projects for further analysis in Phase II.

The primary purpose of Phase IB was to identify potentially feasible southern California projects and develop reconnaissance-level designs and costs for those projects. The result of this effort was a computer model that analyzed project alternatives and the impacts of the economic and regulatory conditions for reuse of recycled water throughout the study area. Another component of Phase IB was to refine and utilize the database developed in Phase IA.

The major conclusion reached during the Phase IB analysis was that a regional water recycling project that spans the entire study area does not appear practical at this time; however, sub-regional systems warranted further evaluation. The sub-regional areas evaluated in the Phase IB analysis were grouped into geographical regions that facilitated the development of reclamation systems to meet the regional recycling goals. There were four geographical regions identified with boundaries that approximate county lines and hydrologic sub-basins within the Study Area. These four regions include the Los Angeles Basin Region, Orange County Region, San Diego Region, and Inland Empire Region.

The Phase IB analysis also demonstrated that as the opportunities for reuse were increased, more recycled water could be used. The reuse opportunities were increased by increasingly adding groundwater recharge sites and surface storage augmentation to the mix of recycled water demands, and as a result, the percentage of beneficial reuse increased.

1.5.3 Phase II

Phase II of the SCCWRRS focused on developing a long-term regional recycling strategy and identifying short-term opportunities for implementing the strategy. Using the data and planning tools developed in Phase I, comprehensive regional water recycling opportunities were examined. Unlike other master planning activities, the SCCWRRS analyses examined two distinct time horizons, which were defined as 2010 (short-term) and 2040 (long-term).

As a result of the SCCWRRS analyses, a regional recycling strategy was identified that consists of the most cost-effective regional and single-agency projects, as well as the development of an implementation process that includes the establishment of regional coalitions of local and regional agencies. The analysis evaluated recycling opportunities that have been overlooked due to real or perceived physical, institutional, or economic planning boundaries, and explored common benefits that might help to remove those barriers. Through the analytical process, regional recycled water project partnerships were formed to address the issues potentially preventing implementation. Through the cooperation of these regional partnerships, the regional projects may be more effectively financed and implemented. The coalition formed for regional projects also benefits single-agency project sponsors, since they worked collectively in the regional partnerships to identify the long-term recycling strategy. Their working relationships can further benefit them if they develop collaborative financing strategies, or seek outside funding through their collaborative efforts.

1.6 The U.S. Bureau of Reclamation Perspective

Reclamation is pleased to have worked with the many water and wastewater agencies that have participated in the SCCWRRS process. The short-term projects that have been identified in this report represent the first step toward implementing a regional water recycling vision. These short-term projects are part of a regional 2040 plan that places recycled water in an important water supply position in southern California, both now and in the future. Reclamation recognizes that much analytical work remains ahead in order for the short-term project sponsors to implement the projects. Reclamation supports their efforts to continue that work, and to identify funding opportunities. Reclamation will continue to facilitate the regional partnership to investigate further recycled water projects, and the continuing dialogue and evaluation of the long-term plans.

Lastly, Reclamation recognizes the commitment to regional water recycling projects that the SCCWRRS participants have forged. These agencies are working together in a cooperative effort that is equally valuable to the long-term water supply picture in southern California and to the projects themselves. The SCCWRRS cooperative model will pay dividends in the future as agencies continue to grapple with the water supply needs of the growing and important southern California economy.

2 Phase II Overview

2.1 Contents of this Section

Introduction
Making Good Decisions
Regional Cooperation Resolves Differences and Makes for Better Projects
Sophisticated Planning Tools Aid in Identifying the Best Projects

2.2 Introduction

Phase II of the SCCWRRS consisted of developing a long-term regional recycling strategy, which included identifying short-term opportunities for implementation over the next 10 years as the first steps towards achieving the long-term vision. In Phase II, the data and tools from Phases IA and IB were used to develop water recycling projects throughout southern California. The processes used in Phase II for establishing objectives and decision criteria, as well as for evaluating and selecting alternatives, were developed to achieve two goals:

- Develop regional water recycling plans and projects in conjunction with the affected local agencies.
- Form cooperative local partnerships as an integral part of an implementation process aimed at overcoming obstacles to the long-term regional recycling strategy.

In Phase I, participation was limited to Reclamation and the eight cost-sharing partners. In Phase II, participation was expanded to include local agencies potentially affected by the implementation of projects arising from the SCCWRRS. In response to the invitation to join the process, more than 70 local agencies located across southern California became active participants in the development and analysis of regional water recycling projects. The local agencies were integral participants in the decision-making process.

2.3 Making Good Decisions

Making good decisions in response to complex problems can be a challenging process, especially when multiple agencies are involved and the issues under consideration include a wide spectrum of complex political, regulatory, engineering, and economic characteristics. In the SCCWRRS, a decision analysis process was established to provide the framework for directing the analyses and to evaluate the results. The SCCWRRS involved more than 70 local agencies in the process of developing, evaluating, and selecting projects for short–term implementation and for the long-term recycling strategy. As a result of the decision-making process, the SCCWRRS developed robust, cost-effective projects within a regional context. In addition, coalitions of local agencies were formed in support of the projects they had been involved in developing. Thus, the SCCWRRS planning process provided an opportunity to incorporate local, as well as regional interests and issues into the solutions.

The decision analysis framework consisted of assembling coalitions of stakeholders to direct the required analyses and to evaluate and select alternatives. Representatives from the local agencies attended facilitated workshops. Workshop attendees developed criteria and analytical objectives that were subsequently used to develop water recycling alternatives using the planning tools from Phase IB. The alternatives were presented at later workshops where the participants reviewed the results and provided direction for revising the analysis. The process was iterative, with the local agencies directing the progress and development of the short-term projects. The decision analysis process is presented in Figure 2-1.

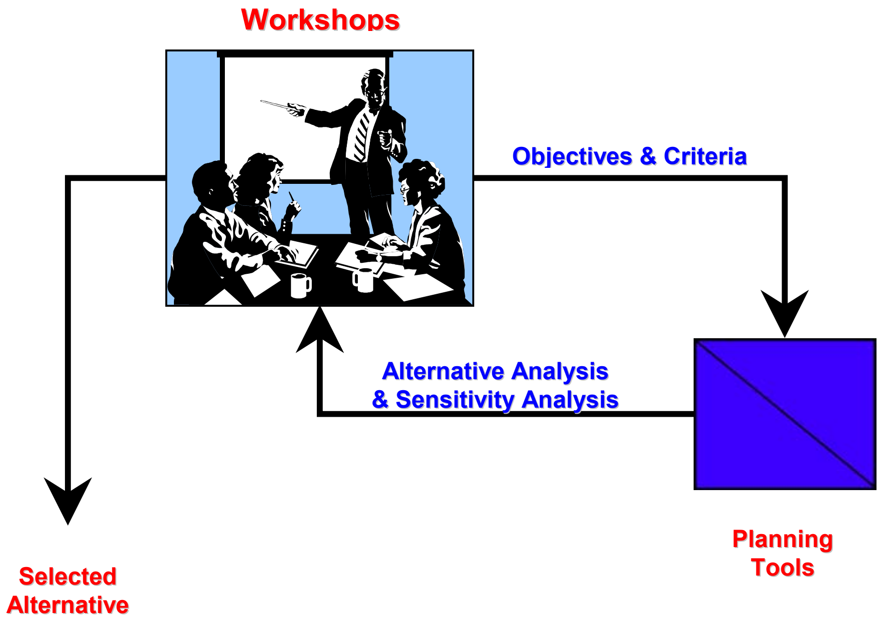


FIGURE 2-1
The Decision-Making Process

The SCCWRRS planning process allowed for the evaluation of recycling opportunities that historically have been overlooked due to issues that include perceived physical, institutional, or economic planning boundaries. The decision analysis framework facilitated the exploration of common benefits that might help remove those barriers and, as a result, identified a regional recycling strategy consisting of the most cost-effective regional and single-agency projects.

2.4 Regional Cooperation Resolves Differences and Makes for Better Projects

For the SCCWRRS Phase II analyses, the study area was divided into four geographic regions, as shown in Figure 2-2.

The regions include the following:

- Los Angeles Basin – Los Angeles County and eastern Ventura County
- Orange County
- San Diego County
- Inland Empire – Western portions of San Bernardino and Riverside Counties

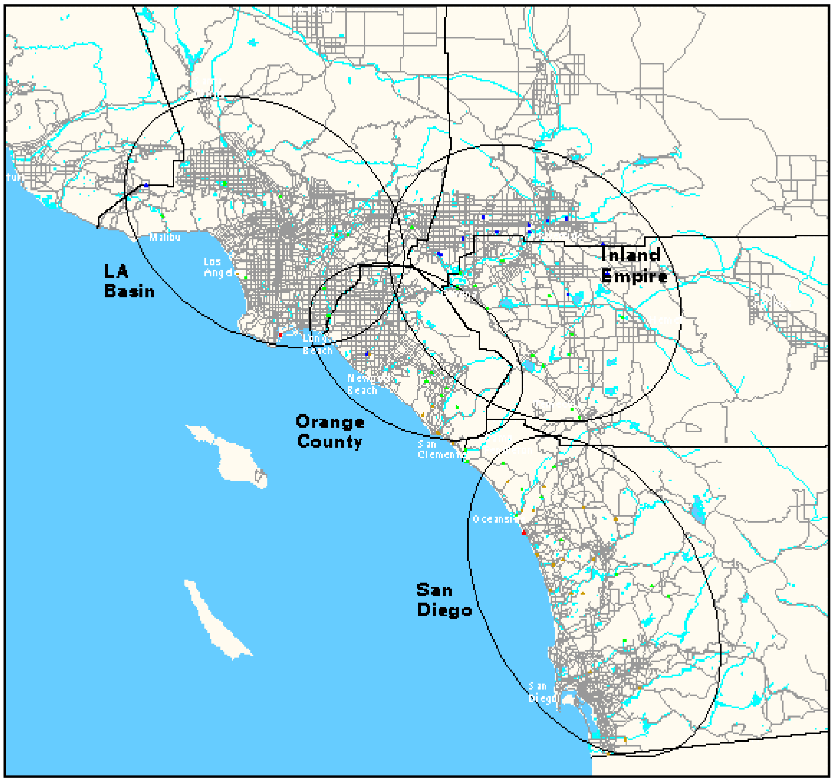


FIGURE 2-2
Project Advisory Committee Regions

For each region, a Project Advisory Committee (PAC) was formed. Each PAC consisted of representatives from the local agencies located within the PAC area. Table 2-1 provides a listing of the various agencies involved in the PAC process. These agencies played an important role in the decision-making process.

2.5 Sophisticated Planning Tools Aid in Identifying the Best Projects

The analysis used two principal planning tools to assist planning team and PAC members in reaching robust decisions. The first is the Allocation and Distribution Model (ADM). The ADM is a geographic information system-based model (GIS) that processes large volumes of data, developing potential corridors for allocating recycled water and the associated costs for constructing the proposed system. The ADM allowed the planning team and PAC members to examine the least-costly systems for meeting recycled water demands in southern California. Detailed information about the ADM, including the cost

TABLE 2-1
Agencies Involved in the PAC Process

Los Angeles	Orange County	Inland Empire	San Diego
California Department of Water Resources	Aliso Water Management Agency	Big Bear Area Regional Wastewater Agency	California Department of Water Resources
Calleguas Municipal Water District	California Department of Water Resources	California Department of Water Resources	Carlsbad Municipal Water District
Camrosa Water District	City of Anaheim	Chino Basin Watermaster	City of Escondido
Central Basin Municipal Water District	City of San Juan Capistrano/Capo Valley Water District	City of Corona	City of Oceanside
City of Burbank	County Sanitation Districts of Los Angeles County	City of Redlands	City of Poway
City of Glendale	El Toro Water District	City of Rialto	City of San Diego Metropolitan Wastewater Department
City of Long Beach	Irvine Ranch Water District	City of Riverside	City of San Diego Water Department
City of Los Angeles Department of Public Works	Los Alisos Water District	City of San Bernardino	Fallbrook Public Utility District
City of Los Angeles Department of Water and Power	Marine Corps Base Camp Pendleton	Eastern Municipal Water District	Leucadia County Water District
City of Santa Monica	Metropolitan Water District of Southern California	Elsinore Valley Municipal Water District	Marine Corps Base Camp Pendleton
County Sanitation Districts of Los Angeles County	Moulton Niguel Water District	Fallbrook Public Utility District	Metropolitan Water District of Southern California
Crescenta Valley Water District	Municipal Water District of Orange County	Inland Empire Utilities Agency	Olivenhain Municipal Water District
Foothill Municipal Water District	Orange County Public Facilities and Resources Department	Marine Corps Base Camp Pendleton	Otay Water District
Las Virgenes Municipal Water District	Orange County Sanitation District	Metropolitan Water District of Southern California	Padre Dam Municipal Water District
Los Angeles County Department of Public Works	Orange County Water District	Pechanga Indian Reservation	San Diego County Water Authority
Metropolitan Water District of Southern California	Santa Ana Watershed Project Authority	Running Springs Water District	San Elijo Joint Power Authority
Southern California Water Company	Santa Margarita Water District	San Bernardino Valley Municipal Water District	Sweetwater Authority
Three Valleys Municipal Water District	South Orange County Reclamation Authority	Santa Ana Watershed Project Authority	Tia Juana Valley County Water District
U.S. Bureau of Reclamation	U.S. Bureau of Reclamation	The Nature Conservancy	U.S. Bureau of Reclamation
U.S. Bureau of Reclamation Native American Affairs Office		Three Valleys Municipal Water District	U.S. Bureau of Reclamation Native American Affairs Office
Water Replenishment District		U.S. Bureau of Indian Affairs	Valley Center Municipal Water District
West Basin Municipal Water District		U.S. Bureau of Reclamation	
		U.S. Bureau of Reclamation Native American Affairs Office	
		Western Municipal Water District	

assumptions and operation of the model, is presented in Appendix A, Engineering Costs and Assumptions. The second tool is the Economic Decision Model (EDM), which is an economic spreadsheet-based calculation engine. The EDM provides for a cost-benefit analysis to permit consistent quantitative comparisons to account for inflation, real growth, and different interest rates faced by agencies, as well as different discount rates for total society, for agencies, and for customers. Most importantly, the EDM identifies the net benefit of the regional projects from the perspectives of the local agency and the broader public beyond the ratepayer service area. Detailed information about the EDM is presented in Appendix B, Economic Methods, Structure, Data, and Assumptions.

While the ADM and EDM are empirical tools, much of the analysis has occurred during discussions with local agency representatives who identified candidate opportunities for reuse. The tools enabled the PAC members to streamline the process of setting priorities and objectives. Also, these tools focused the decision-making process at a regional level. This regional approach to the Phase II process made the crossing of institutional boundaries and linking of systems more obtainable. Moreover, using the planning tools in concert with PAC member discussions allowed local agency representatives to explore regional project economics that were unattainable to their agencies acting alone.

The SCCWRRS process relied on the use of planning tools and facilitated regional PAC dialogue to create a robust decision analysis process. This decision analysis process enabled each PAC to establish objectives and criteria for the Phase II analysis tailored to specific regional needs. The analysis generated proposed corridors along which recycling could occur, the cost and benefits for the proposed recycled water system, as well as identification of project sponsors and recommended arrangements to resolve institutional constraints to make the project happen. This information was also subjected to a sensitivity analysis for each proposed project designed to determine how reasonable the planning assumptions were to the selection of the project. The results were then presented to the PAC members for review and revision in an iterative process that eventually yielded projects for short-term implementation and incorporation into the long-term strategy.

3 Basis of Analysis

3.1 Contents of this Section

3.2 Introduction

Phase II of the SCCWRRS is a regional analysis that assesses the feasibility of a comprehensive recycling program in southern California. Two time horizons were used as part of the assessment: short-term and long-term, and an iterative process was used to develop the recycled water projects that were considered by the PACs. Phase II of the SCCWRRS consisted of reviewing the database of supply and demand information using the planning tools to develop project alternatives, evaluating the alternatives with local agencies, and revising the analyses. The decision analysis framework and workshops were integral components of the analytical process, providing an open forum to discuss the results and provide guidance for additional analyses. The final result of these efforts was the development of a long-term regional recycling strategy and an implementation plan for specific short-term projects.

3.3 Development of Projects is an Iterative Process

The Phase II analyses consisted of the following:

- Review and update the database of information for supplies and demands.
- Develop short-term projects using the planning tools and direction from the PAC.
- Develop the long-term strategy based upon the short-term projects.

Each of these analyses required input, direction, and review from the local agencies. A series of five PAC workshops were scheduled around the analyses such that the local agencies were involved at each of the critical decision points. Figure 3-1 provides a diagram of the Phase II analyses and agency participation process. As illustrated in the diagram, the workshops provided a forum for reviewing the database, assessing the analyses, and providing feedback and direction for revising the analyses. PAC member input was sought with the understanding that selected SCCWRRS projects would likely provide a greater benefit for them than their own individual agency plans. These efforts resulted in projects for short-term and long-term implementation.

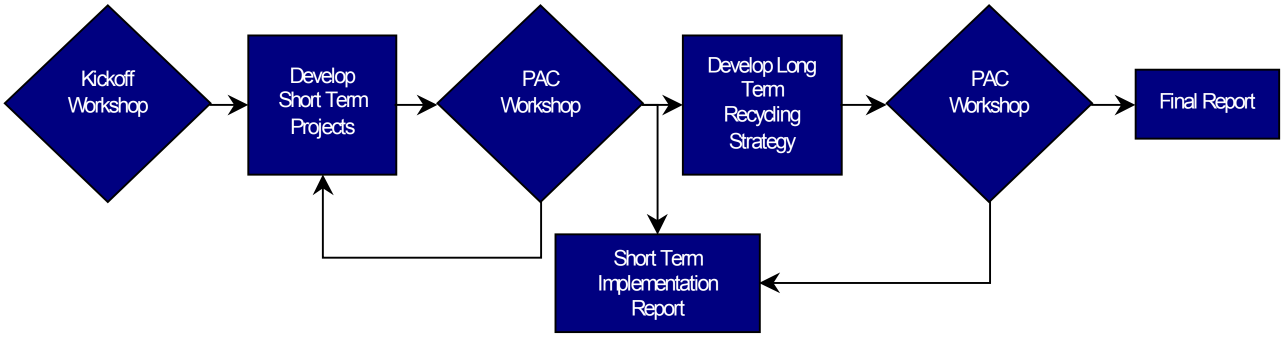


FIGURE 3-1
Phase II Analytical and Agency Participation Process

3.4 Reviewing the Database

The first step in developing the alternatives for consideration in Phase II of the SCCWRRS was to review and update the database of information previously collected in Phase IA and updated during Phase IB. The database consisted of more than 100 wastewater treatment and water reclamation facilities, as well as approximately 7,300 demands. The demands were categorized as follows:

- Groundwater recharge and seawater intrusion barriers.
- Agricultural and landscape irrigation, and industrial uses.
- Environmental enhancement.

Several terms are useful for understanding the projects developed in the analyses:

- **Existing**: Facilities that were undergoing construction during the period of analysis, or that were constructed by the year 2000.
- **Planned**: Facilities that local agencies have demonstrated a strong commitment to building. The demonstration takes the form of ongoing planning, design, engineering, or itemization in their Capital Improvements Plan (CIP).
- **Proposed**: Potential facilities that are the result of the short-term analysis. Some of these facilities may mirror projects that local agencies would like to construct, but that are unlikely to occur without overcoming obstacles, like funding or institutional issues.

The database was organized into subsets of information for each of the local agencies potentially affected by the SCCWRRS analyses and resulting projects. The local agencies reviewed the data for relevancy and accuracy. In addition, the local agencies were asked to submit information on planned projects that they would like incorporated into the SCCWRRS analyses. In particular, it was important that the local agencies identify the existing levels of recycling, including facilities that were under construction by the year 2000. The existing levels of reclamation became an important component in projecting the potential for future recycling. The database was "frozen" in November 1999, at which time changes to the database were no longer incorporated.

3.5 Water Quality Plays a Major Role in the SCCWRRS Projects

Water quality is a significant component of the SCCWRRS analysis. Salinity was selected as the constituent of concern as representative for the reuse types and supplies. The costs associated with water quality are based on meeting the specified targets for each demand. Title 22 of the California Administrative Code (Title 22) specifies a range of treatment options for varying degrees of public contact. For the purposes of the analysis, recycled water supplies are assumed to meet a minimum of full Title 22 requirements for disinfected tertiary recycled water. Note that "Full Title 22 treatment" corresponds to the most stringent degree of public contact, including irrigation of food crops, irrigation of parks and playgrounds, etc. For disinfected tertiary recycled water, Title 22 requires that the level of wastewater treatment include biological oxidation (secondary treatment), filtration, and disinfection. Most of the identified municipal treatment facilities included in the SCCWRRS analysis provide a minimum of secondary treatment and many treatment facilities provide tertiary treatment for some or all of their flow.

To sell recycled water, recycled water quality must also meet the standards set by the regulatory agencies. The California Water Code provides for the California Regional Water Quality Control Boards (RWQCB) to establish water quality standards that protect surface and groundwater quality. These requirements are typically identified in a document commonly referred to as the "Basin Plan." Beneficial uses are designated in the Basin Plan with water quality objectives established to protect the most sensitive beneficial use. The SCCWRRS primarily covers areas under jurisdiction of the Los Angeles, Santa Ana, and San Diego RWQCBs. Some of the facilities are mandated by the RWQCBs to produce recycled water in order to meet these objectives. Project costs generally do not include any wastewater treatment costs based on treatment standards established by the RWQCB.

In addition to the Basin Plan Objectives (BPO), state and Federal recycling guidelines recommend average maximum salinity concentrations for uses such as irrigation and landscaping. These guidelines generally recommend less than 1,000 milligrams per liter (mg/L) of total dissolved solids (TDS); however, customer needs typically dictate the ultimate TDS target concentration. Coastal treatment plants typically have a higher TDS concentration than treatment plants located inland. Many users located along the coast have adapted to using higher salinity water, while inland customers are accustomed to lower TDS concentrations associated with their recycled water supplies.

In Phase II, the analysis also included salinity management issues. The SCCWRRS recognized the potential impact of salinity on groundwater due to groundwater recharge with recycled water. As a result, opportunities for reducing the salinity of recycled water, as well as pipelines for exporting brine, were incorporated into the analysis. Desalters and regional brine lines represent key components of several of the short-term projects.

3.6 Analytical Process

The analysis consisted of using the planning tools to develop and evaluate recycled water projects in both a short-term and long-term planning horizon. The short-term projects form the building blocks of the long-term regional recycling strategy for southern California.

The long-term regional recycling strategy for southern California consists of a conservative estimate of future levels of recycling, as well as the identification of potential opportunities to increase levels of recycling. Potential opportunities include additional reuse types, such as groundwater recharge and surface storage augmentation. The long-term alternative analysis consisted of two separate reuse scenarios, which included increasing recycled water demand through indirect potable reuse, and increasing recycled water supply by reusing supplies with historically high concentrations of salinity.

3.6.1 Planned Recycled Water Commitments

The recycled water projects were developed by projecting the available recycled water supply for a given planning horizon and allocating the water to available demands. The information collected during the data review formed the basis for developing the projections. Using reported data from local agencies, the analysis first projected the existing and planned recycled water commitments. The existing recycled water commitments consisted of the annual recycled water flow supplied to users by the year 2000. The planned recycled water commitments were based upon the existing commitments, plus any planned increases for these users for the planning horizon under consideration. These commitments are an important consideration in the development of the available recycled water supply, since this water is already allocated. All of the other future demands listed in the database were made available for the analyses.

3.6.2 Projected Available Supply

The available supply was developed by taking into consideration the treatment capacity of the treatment facilities, as well as the existing and planned reclamation levels. First, the existing and planned treatment facility capacity for secondary and tertiary levels of treatment was examined. Where the flow was expected to be significantly less than the reported capacity, information on the projected flow to the treatment facilities was also collected.

Using this information, the potential available recycled water supply was projected for the analyses. First, the secondary capacity was compared to the tertiary capacity, and if the tertiary capacity was less than the secondary capacity, the analysis projected an increase in tertiary treatment capacity with an associated cost to increase the treatment capacity. This information was reviewed with local agencies and amended as required. The planned tertiary capacity, with any additional projected increases, was used as the starting point for the projected available supply. The projected available supply was compared to flow projections into the treatment facility and reduced if the influent flow was projected to be significantly less than the capacity of the plant. In addition, the projected available supply was reduced by the planned recycled water commitments for the given planning horizon so that committed water would not be allocated in the analysis. Further, the salinity of the water was evaluated and, if it exceeded the target concentrations established for the analysis, additional treatment and the associated costs were applied as part of the analysis. Treatment losses as part of the additional treatment further reduced the available supply. The information on the projected available recycled water supply was reviewed with local agencies at the PAC workshops and in subsequent follow-on meetings, where necessary.

3.6.3 Short-Term and Long-Term Analysis

The short-term analysis utilized the projected available recycled water supply and the remaining demands for the short-term planning horizon. The planning tools were used to analyze the study area and develop preliminary results that were reviewed by the local agencies. Based on their feedback, the analysis was modified and the revised results were reviewed by the agencies. In some cases, the database required corrections, because the analysis revealed errors in the data. In other cases, the results of the analysis went well beyond the levels of recycling that could be achieved in the next 10 years. This process took more than 10 months to complete; requiring four workshops for each PAC to review the results and to ultimately identify 34 proposed short-term projects. The projects identify proposed levels of recycling for each of the treatment facilities, as well as potential future demands and proposed distribution systems for conveying the recycled water. The results of the short-term analysis are summarized in Section 4, and discussed in detail in Appendix C, the Short-Term Implementation Plan Report.

The long-term analysis was based on the results of the short-term analysis. The results of the long-term analysis include the proposed levels of recycling included in the proposed short-term projects, plus additional supplies and demands projected through the year 2040. The results of the long-term analysis are presented in Section 5.

3.7 A Brief Note on Recycled Water Project Economics

Planners and decision-makers not familiar with recycled water projects frequently underestimate the benefits of those projects. Typically, recycled water projects are compared to imported water or other types of water supplies available to local agencies. Such comparisons underestimate the benefits of recycled water by not recognizing the unique values of recycled water supplies. Many of these benefits are difficult to quantify, yet they are very tangible to the beneficiaries. Section 1.4 presented some of the unique attributes of recycled water that can be counted as "beneficial." While difficult to quantify, there may be high value in local or regional control of the water supply, drought resistance, environmental benefits, as well as the good public relations resulting from water and wastewater agencies practicing water-use efficiency by recycling.

Recycled water supplies are relatively reliable sources of water due to these attributes. Essentially, recycled water supplies represent a drought and water supply reliability insurance policy that protects local southern California economies by allowing potable water supplies to be stretched that much further when recycled water takes up the shortage slack. The economic benefit of water supply reliability can best be understood by considering an insurance policy. Essentially, insurance premiums bear the benefit of "peace of mind" when claims are not made against a policy. When claims are made, the investment in an insurance policy takes on a far more critical value to the beneficiaries. So it is that recycled water projects have an "insurance value" that is not fully realized until a community is hit by drought-induced water shortages or increasingly less reliable supplies. That is when recycled water projects attain their most prominent value in the community. What would this value be worth in terms of an insurance premium? That value should be considered as a reasonable additional consideration for recycled water projects above the value of other types of projects that are not as reliable.

Recycled water can relieve pressures on expanding imported water supplies that are stressing the environment. It is manufactured from treated wastewater discharges that, in some cases, represent potential environmental degradation. The economics of these avoided environmental costs, while difficult to quantify, should also be counted as a benefit of the recycled water project.

Many forms of avoided costs, not specifically attributed to the environment, also need to be taken in consideration. Cost savings from not building wastewater disposal systems or larger outfalls should be added as benefits to the recycled water project. The avoided costs of alternative imported supplies should be included as well.

Lastly, what is the value of civic pride? Water recycling is the right thing to do under appropriate economic conditions. The value of a community's pride in its decision to implement a recycling program is tangible, yet very difficult and expensive to quantify. Despite the difficulty, this type of community spirit value should also be considered as a benefit of a recycled water project.

The cost-benefit analyses that were performed for each of the short-term projects provided a reconnaissance-level estimate of a project's value and did not include a full evaluation of all benefits. Still, each of the short-term projects had positive net benefits. Clearly many more benefits were not estimated and were out of the scope of this study. More analytical economic work could be performed on each project if warranted by the project sponsors. Those benefits ought to be considered, even qualitatively, as decision-makers determine the efficacy of implementing these projects.

4 Short-Term Analytical Results

4.1 Contents of this Section

Summary of the Short-Term Implementation Plan
Summary of the Short-Term Analytical Approach
Short-Term Implementation Plan: Regional Projects
Short-Term Implementation Plan: Single-Agency Projects

4.2 Summary of Short-Term Implementation Plan

The results of the short-term analysis are presented in the Short-Term Implementation Plan (STIP) Report, which is contained in Appendix C. The objective of the STIP Report is to use local recycled water project initiatives and incorporate a visionary regional component into them.

As a result of the analysis, the PAC identified 34 projects distributed across southern California for short-term implementation, and a STIP was developed for each of the projects. These projects were not compared against each other, nor were they selected from a list of alternatives. Rather, the components evolved from the specific plans of the local agencies as presented during 1999, with consideration for the long-term horizon, including potential opportunities to expand recycling toward a comprehensive regional system. Of these projects, 15 projects were identified as regional projects. Because of the increased complexity associated with the regional projects, the PAC directed additional analyses for each of the 15 projects, which included more detailed evaluation of the cost estimates, as well as examination of implementation issues potentially affecting these projects. This information is included in each of the regional project STIPs presented in the STIP Report. The other 19 projects were determined to be more economically beneficial as single-agency projects. Incorporating them into regional systems did not increase their economic benefits. Together the 34 STIPs form the building blocks of the long-term regional recycling strategy for southern California.

The locations of the 34 short-term projects are shown in Figure 4-1. Table 4-1 presents the yield; capital, operation and maintenance (O&M), and unit costs; and net benefit (benefit minus cost) for the projects. The 15 regional projects are listed separately, while the single-agency projects are aggregated as one line at the bottom of the table. The economic analyses concluded that the benefits of regional water recycling projects are diverse. The 34 projects include broader societal benefits, as well as benefits to their ratepayers and local communities. Avoided alternative water supply costs, avoided wastewater discharge costs, and the associated avoided environmental damage all contribute to the broader societal benefits of both the regional, as well as the single-agency recycled water projects.

Figure 4-1
Identified Short-Term Implementation Plan Projects

TABLE 4-1
Summary of Short-Term Implementation Plan Projects (Real 2000$)

Name	Yield (AFY)	Cost: Capital (Million $)	Cost: Annual O&M[1] (Million $)	Cost: Unit Cost[2] ($/ac-ft)	Net Benefit[3] (Million $)
Calleguas[4]	24,900	112.7	3.7	400 - 500	219.6
East San Gabriel	6,700	74.2	1.5	800 - 1,000	12.8
West Basin	42,600	199.0	31.4	1,000 - 1,300	65.8
Central Basin	16,700	104.7	1.2	400 - 500	139.9
North Orange County	1,100	10.1	0.1	700 - 800	5.0
Central Orange County[4]	93,100	546.5	25.9	600 - 800	467.6
Upper Oso	4,100	38.7	0.9	800 - 1,000	10.2
San Juan	16,300	98.8	3.8	600 - 700	90.6
Encina[4,5]	3,500	31.4	1.6	1,000 - 1,200	1.7
San Pasqual	8,200	58.1	3.2	800 - 1,000	41.1
North City	9,600	71.7	3.8	800 - 1,000	21.3
South Bay	15,600	83.0	4.5	600 - 700	54.7
Chino Basin	66,100	219.6	10.0	300 - 400	567.7
San Bernardino	51,600	83.2	19.7	500 - 600	314.2
Eastern-Limited	23,300	174.4	7.5	700 - 900	64.8
Single-Agency Projects[6]	68,100	346.7	13.6	500 - 600	482.8
Total	**451,500**	**2,252.8**	**132.4**	**600 - 700**	**2,559.8**

Footnotes:

[1]Capital and O&M costs are without contingency.

[2]Unit costs are based on a 30-year period of analysis, 2% inflation rate, and a real discount rate of 4.779%. The high-end unit costs reflect an additional 25% overall project contingency. The total unit cost is computed using the sum total of the projected yield, capital cost, and O&M costs.

[3]Economic calculations are based on a 30-year period of analysis, 2% inflation rate, and a real discount rate of 4.779% for the Total Society perspective.

[4]These projects are authorized Title XVI projects, which represent approximately 109,500 AFY of recycled water that is included in the projected total yield.

[5]An earlier phase of this project is an authorized Title XVI project. The proposed single-agency project reflects an expansion of the previously planned project.

[6]Single-Agency Projects consist of the following: Alamitos[4], Beaumont, Big Bear, Burbank, Camp Pendleton, Corona, Fallbrook, LA/Glendale, Long Beach[4], Long Beach Wetlands, March, Oceanside, Rancho Santa Fe, Redlands, Riverside, Running Springs, San Fernando Valley, Santee Basin[4], Yucaipa. These projects are discussed in Section 4.5. Details are presented in Appendix C, *The Short-Term Implementation Plan*.

4.3 Summary of the Short-Term Analytical Approach

The short-term analysis resulted in the development of 34 STIPs. Each STIP builds on the existing (operational or under construction by the year 2000) and planned (to be constructed by the year 2010) recycled water projects for each STIP area. To develop the proposed STIPs, the existing recycled water projects were evaluated. Working with representatives from the local agencies, the evaluation included: (a) identification of the existing treatment levels, capacity, and flow for each of the plants; (b) examination of the existing plans for development or expansion of the current systems; and (c) discussion of additional opportunities for water recycling beyond agencies plans. The result of this evaluation is a database of information that forms the foundation for developing the proposed STIPs. Each STIP presents additional opportunities for the use of recycled water that are outgrowths of the existing programs and plans.

Each proposed STIP includes projected system expansions and improvements, as well as the associated cost estimates to construct, operate and maintain the facilities. In addition, the STIPs include an economic analysis of the proposed alternative. In the economic analysis, three separate perspectives are analyzed: *Total Society, Southern California Region*, and *All Agencies*.

- *Total Society* perspective represents the most extensive geographic calculations of societal benefits of all three perspectives. The total society perspective is an important component of the regional analysis and helps in the development of cost-sharing arrangements and other funding mechanisms.
- *Southern California Region* perspective represents societal economic benefits from a more localized geographic perspective. This perspective is also needed for a regional analysis to help in the development of cost-sharing arrangements and other funding mechanisms.
- The *All Agencies* perspective includes a narrower geographic perspective from the viewpoint of affected water, wastewater, groundwater, and recycled water agencies that would be involved in the proposed projects as a part of this short-term plan. The *All Agencies* perspective looks at agency costs and benefits and does not include the broader benefits identified in the *Total Society* and *Southern California Region* perspectives. The *All Agencies* perspective could ultimately be used during cost-sharing negotiations between agencies that are co-sponsoring a project.

The Total Society and Southern California Region perspectives present the economic image, about which the national and regional entities are concerned. The All Agencies perspective includes all of the affected water, wastewater, groundwater, and recycled water agencies that would be involved in the proposed projects as a part of the STIPs. Appendix B presents a detailed discussion on the economic perspectives, methods, data, and assumptions that form the basis for the economic analysis.

4.4 Short-Term Implementation Plan: Regional Projects

Based on the short-term analysis and guidance from the PAC participants, 15 short-term projects were identified as regional STIPs, as follows:

- Calleguas
- East San Gabriel
- West Basin
- Central Basin
- North Orange County
- Central Orange County
- Upper Oso
- San Juan

- Encina
- San Pasqual Valley
- North City
- South Bay
- Chino Basin
- San Bernardino
- Eastern

Additional analysis and refinements were performed on these projects. In addition, issues potentially affecting implementation were identified. The results of this analysis are summarized in the following sections and are presented in detail in the STIP Report included as Appendix C.

4.4.1 Calleguas

The primary focus of the Calleguas STIP is to link the seven major recycled water systems in Ventura County into one system. This allows the agencies to benefit from a collaborative effort with respect to their project economics, regulatory issues, and financing ability. The proposed Calleguas STIP connects the Calleguas MWD, Camrosa Water District, City of Camarillo, County of Ventura Waterworks District No. 1, Las Virgenes MWD, Simi Valley County Sanitation District (CSD), and City of Thousand Oaks recycled water systems. The proposed Calleguas STIP consists of the following major components:

- Expand the Tapia Water Reclamation Facility (WRF) recycled water distribution system into Tierra Rejada.
- Upgrade the Camarillo Water Reclamation Plant (WRP) to tertiary treatment and expand the distribution system.
- Construct the Conejo Creek Diversion Project, which is supplied by the Hill Canyon Wastewater Treatment Plant (WWTP) via discharge to Conejo Creek.
- Construct Phase I of the Calleguas Regional Brineline and desalters.
- Expand the Simi Valley Water Quality Control Plant (WQCP), Moorpark WWTP, and Camrosa WRF distribution systems.

The proposed project provides various new recycled water users with over 24,900 AFY of recycled water in five different localized systems. In addition, the Calleguas STIP includes the Calleguas Regional Brineline and the Conejo Creek Diversion Project.

For this STIP, the net benefit under each of the economic perspectives is positive. Several large users, including the 13,600 AFY Conejo Creek Diversion Project, create substantial water supply savings. These project benefits are large, greatly exceeding the direct project costs, resulting in an overall positive net benefit across all three economic perspectives. Sensitivity analyses for the Calleguas STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The Calleguas STIP is one of the largest and most complex projects in the study due to the number of agencies and the size of the project area, which encompasses much of Ventura

County. Successful implementation of the project requires the various local agencies to cooperate and coordinate on a regional basis. The first step in creating a regional recycled water effort is to form a Project Coordination Committee (PCC). The PCC membership consists of representatives from the agencies potentially impacted by the project. The PCC acts as the decision-making forum for the Calleguas STIP and provides for equal representation. A cooperative working relationship has already been established in this area through the Calleguas Creek Watershed Study. In this study, agencies worked together in a PCC under the umbrella of the Calleguas MWD that acted as project sponsor to lead and coordinate the study activities. The next step is to identify a project sponsor. The project sponsor coordinates participation of the various affected agencies and manages the technical and financial aspects of the project, as well as overseeing the PCC. For the Calleguas STIP, Calleguas MWD and Las Virgenes MWD are the logical choices to share the role as project sponsors. A joint-venture agreement already exists between Calleguas and Las Virgenes that allows the agencies to implement mutually beneficial projects.

4.4.2 East San Gabriel

The proposed East San Gabriel STIP is an important step toward the establishment of a regional system in Los Angeles County. The project connects the San Jose Creek WRP and Pomona WRP via the recycled water distribution systems for the City of Industry, Walnut Valley Water District (WD), Rowland Heights WD, and City of Pomona. The proposed STIP enables the Rowland, Walnut, and Pomona distribution systems to receive recycled water from the San Jose Creek WRP. The existing distribution systems utilize full flow from the Pomona WRP during the summer months, and supplement their recycled water distribution systems with imported water and groundwater during periods of high demand. Flow interruptions are experienced in these distribution systems during peak demand when the pressurized system at the Pomona WRP has mechanical, as well as contractual priority on supply. The proposed project creates a more reliable water supply for present water users and meets 6,700 AFY of new demand.

The net benefit under each of the economic perspectives is positive. A high unit cost, which is primarily due to the lack of large demands in the area, is causing the net benefits to be only marginally positive compared to total estimated project costs. A change in project costs or avoided supply costs of 10 to 15 percent could cause the net benefits to be reduced to zero or less. However, a change in the water quality regulations associated with discharge requirements could cause the avoided wastewater discharge costs to rise dramatically, because both the San Jose and Pomona WRPs currently discharge into streams.

In the East San Gabriel STIP area, the manner in which recycled water supply issues are handled is the key to project implementation. A regional approach eliminates project redundancy, however, a regional consensus approach will be required, with the Three Valleys MWD as the lead agency for this project for several reasons:

- Three Valleys MWD is already studying the issues involved in implementing the proposed plan to connect the Pomona WRP with the San Jose Creek WRP.
- Three Valleys MWD is not currently supplying recycled water; therefore, it will not be involved in any of the ongoing institutional issues.
- The agency is a water wholesaler.

Once a lead agency is identified, a project structure will be necessary. The project structure that will most likely maximize benefits in the area is a Joint Powers Authority (JPA). The JPA could be set up to mirror the existing Three Valleys MWD arrangements with retailers. The JPA would own and maintain the capital facilities and the retail agencies would record and report monthly recycled water usage to the JPA.

4.4.3 West Basin

The proposed West Basin STIP is an important step toward the establishment of a regional system in Los Angeles County. The proposed STIP expands on the West Basin MWD existing system, and connects the West Basin MWD system with the City of Los Angeles Harbor Project. The West Basin STIP supplies approximately 42,600 AFY of recycled water to various new demands in the Gardena, Los Angeles, and Palos Verdes area, including a seawater intrusion barrier. The recycled water supplies from the West Basin STIP have the additional benefit of providing a beneficial alternative to wastewater discharges to Santa Monica Bay and associated environmental and recreational costs. In addition, this STIP includes the Los Angeles Harbor Project system, which is a distribution system to convey recycled water from the Terminal Island WWTP to various users north of the facility and a proposed seawater intrusion barrier.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the proposed West Basin STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The City of Los Angeles is under an agreement with the Los Angeles RWQCB to implement a reclamation program in order to avoid expansion of their outfall. The agreement calls for the City of Los Angeles Department of Public Works to implement reclamation in three phases: initial phase of 5 million gallons per day (mgd), intermediate phase of 12 mgd, and ultimate phase of 22 mgd. The agreement stipulated that the City of Los Angeles will proceed with the first 5 mgd phase, and then the other facilities would be constructed, as they proved feasible. For this analysis, the total estimated avoided construction cost of this outfall is estimated to be approximately $50 million, which is prorated down based on the amount of reclamation proposed in this STIP.

The proposed West Basin STIP involves multiple agencies, including one wholesale water agency, one groundwater management agency, two sanitation districts, and 13 retail water agencies. The West Basin MWD is already the primary supplier of recycled water in this region, and has successfully implemented recycling projects in most of the areas in the past. A Memorandum of Understanding (MOU) enacted between all the agencies involved in the project will facilitate the process. The MOU documents that all parties agree to the basic concepts of the project and will work together to define a mutually beneficial project.

Despite the number of local agencies present in the West Basin STIP, the West Basin MWD is a logical candidate to assume the role as the project sponsor for several reasons, which include the following:

- West Basin MWD is the major supplier of recycled water in the area.
- Much of the proposed STIP is a build-out of the West Basin MWD Master Plan.

Following the identification of a lead agency, a project structure is developed and agreed upon. The existing West Basin MWD recycled water arrangements are applicable to the proposed project, especially in the West Basin MWD service area.

4.4.4 Central Basin

The primary focus of the proposed Central Basin STIP is to continue developing links between several major recycled water systems in Los Angeles County. In addition, the proposed Central Basin STIP expands the existing Central Basin MWD distribution system by supplying new users in the communities of Bell Gardens, Huntington Park, Paramount, Pico Rivera, Santa Fe Springs, and Vernon. The project uses recycled water from Los Coyotes WRP and San Jose Creek WRP, in addition to available capacity in the existing Central Basin MWD recycled water distribution system. The proposed STIP supplies an additional 16,700 AFY of recycled water to potential users by the year 2010. The proposed Central Basin STIP provides an important link between the proposed San Gabriel Valley and West Basin STIPs. Implementation of the proposed Central Basin STIP builds upon the existing connections between the three planning areas, which improves the reliability and redundancy of the local water supply for all three systems.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the proposed Central Basin STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The proposed Central Basin STIP encompasses an area that is institutionally complex, with many local and regional agencies potentially involved in the implementation of the project. The Central Basin STIP expands the role of the Central Basin MWD as the primary supplier of recycled water in this region, which makes Central Basin MWD a logical candidate to be the lead agency. Central Basin MWD has a strong presence in the area, in addition to existing working agreements with many of the cities.

However, the ongoing institutional concerns that exist between the City of Vernon and the Central Basin MWD have prevented implementation of this project in the past. The formation of a PCC consisting of representatives from the various local agencies involved in the proposed STIP may facilitate project implementation, as well as providing a forum for conflict resolution.

4.4.5 North Orange County

The proposed North Orange County STIP provides an important opportunity to link the recycled water systems of Los Angeles County with the systems of Orange County. As proposed, the project utilizes recycled water generated in Los Angeles County to supply approximately 1,100 AFY of recycled water to new users in the Cities of Santa Fe Springs, La Palma and Buena Park. Implementation of the proposed STIP creates an extension into north Orange County that provides an opportunity to connect with the Central Orange County STIP recycled water systems (described in Section 4.3.6).

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the proposed STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The North Orange County STIP involves agencies in Los Angeles and Orange counties, including two wholesale water agencies, two groundwater management agencies, two sanitation districts, and seven retail water agencies. To further complicate the institutional arena, the project will come under the purview of two regulating agencies, the Los Angeles RWQCB and the Santa Ana RWQCB. The meeting held under the leadership of Reclamation was the first step towards defining roles for implementation. The Central Basin MWD is a likely choice to be the project sponsor for the following reasons:

- The project has been investigated by Central Basin MWD and their board of directors has expressed willingness in the past to implement it.
- The project extends the Central Basin MWD Century distribution system.
- OCWD staff resources are limited due to the implementation efforts of the Groundwater Replenishment System (GWRS) project.

The existing Central Basin MWD recycled water arrangements are applicable to the proposed STIP. Central Basin MWD owns and maintains the capital facilities, and the retail agencies read the recycled water meter and report monthly recycled water usage to Central Basin MWD. This structure has proven successful in the past because all agencies remain whole financially.

4.4.6 Central Orange County

The proposed Central Orange County STIP continues developing links between several major recycled water systems in central Orange County, which improves the reliability and redundancy of the systems for present users. In addition, implementation of the new recycled water supply precludes the need for an Orange County Sanitation District (OCSD) outfall expansion or construction of a second outfall, while also reducing the dependence on imported water supplies for groundwater recharge. The proposed Central Orange County STIP supplies approximately 93,100 AFY of recycled water to various new users both in the central Orange County area, as well as users located in the cities of Anaheim, Fullerton, and Placentia. The project consists of the following components:

- Expansion of the Irvine Ranch WD recycled water distribution system.
- Expansion of the Green Acres Project (GAP) recycled water system.
- Construction of the GWRS, a new 100 mgd recycled water facility, which will be used to supply a groundwater recharge project and a seawater intrusion barrier.
- Construction of the Orange County Regional Brineline.

The project continues developing connections between Orange County Water District (OCWD) and the Irvine Ranch WD, as well as expanding the service area to include new users in Newport Beach, Huntington Beach, Anaheim, Placentia, and Fullerton.

The overall net benefit as viewed under all three economic perspectives is positive. The large groundwater recharge site and seawater intrusion barrier create substantial water supply savings and help to produce relatively low unit costs. In addition, the avoided cost of a second outfall at OCSD Plant 1 was estimated to be approximately $150 million. All of these factors contribute to an overall positive net benefit for the STIP. Sensitivity analyses for the Central Orange County STIP demonstrated that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The proposed Central Orange County STIP potentially affects many local agencies in the planning area. Successful implementation of the proposed STIP requires the various local agencies to cooperate and coordinate on a regional basis, with OCSD and OCWD sharing the role of sponsoring the project.

In addition, the development of a MOU may facilitate agency interaction. Under the MOU, the affected agencies agree to work together to implement the Central Orange County STIP. The MOU defines roles and guidelines regarding the implementation of the STIP. Under the MOU, the affected agencies work together to resolve issues regarding financing, benefit and cost tradeoffs, and institutional issues.

4.4.7 Upper Oso

The primary focus of the Upper Oso STIP is to continue expanding and connecting the recycled water distribution systems of the Aliso Water Management Agency (AWMA), El Toro WD, Los Alisos WD, Moulton Niguel WD, and Santa Margarita WD into a regional system. This project allows the agencies to benefit from a collaborative effort with respect to their project economics, regulatory issues, and financing ability. The proposed project supplies various landscape and agricultural irrigation customers with approximately 4,100 AFY of recycled water.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the Upper Oso STIP demonstrated that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The proposed Upper Oso STIP potentially affects many local agencies in the planning area. Successful implementation of the proposed STIP requires the various local agencies to cooperate and coordinate on a regional basis. The basic framework for this type of arrangement has been set by the creation of agencies such as SOCRA and AWMA. Both of these agencies have multiple member agencies that work together and share flow at facilities.

One institutional issue for consideration is to identify which local agency will supply potential customers that are located east of the Interstate 5 Freeway. For several reasons, the Los Alisos WD is better suited to supply these customers, despite their proximity to the El Toro WD. Currently, the El Toro WD supplies disinfected secondary treated water to one golf course in Leisure World. In order to supply recycled water to these new users, the reclamation facility will require treatment upgrades to produce recycled water that meets regulatory requirements for disinfected tertiary recycled water. However, the Los Alisos WD facility has additional supply and requires customers that are not in close proximity to the treatment facility, since it uses the residence time during conveyance to meet the disinfection contact time requirements. Excess flows from the Los Alisos WD recycled water system currently are sold to the Santa Margarita WD. In addition, agreements are required with the Los Alisos WD to purchase excess capacity to help offset seasonal shortages at other facilities.

4.4.8 San Juan

The San Juan STIP continues to expand and connect the recycled water systems of the City of San Clemente, City of San Juan Capistrano, and the Santa Margarita WD into a regional system. The project allows the agencies to benefit from a collaborative effort with respect to their project economics, regulatory issues, and financing ability. The proposed project creates a more reliable water supply for present users. Approximately 16,300 AFY of recycled water is supplied to various new recycled water users, which include groundwater recharge, landscape irrigation, and other miscellaneous users.

For this STIP, the net benefit under each of the economic perspectives is positive. Sensitivity analyses for the San Juan STIP demonstrated that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The proposed San Juan STIP potentially affects many local agencies in the planning area. Successful implementation of the proposed STIP requires the various local agencies to cooperate and coordinate on a regional basis. The basic framework for this type of arrangement has been set by the creation of agencies such as SOCRA and South East Regional Reclamation Authority (SERRA). Both of these agencies have multiple member agencies that work together and share flow at facilities.

One issue requiring resolution is the equitable distribution of cost and flows from the Jay B. Latham WWTP. The City of San Juan Capistrano/Capo Valley WD requires recycled water supply for their planned recycled water project and, currently, their recycled water system is supplied using nonpotable groundwater, because the agency does not own a treatment plant. Possible sources for supply include the Jay B. Latham WWTP and the Chiquita WRP. The Chiquita WRP has flow available, except during the summer when peak seasonal demands typically use all of the available supply. As a result, Santa Margarita WD cannot guarantee a reliable seasonal recycled water supply for San Juan Capistrano/Capo Valley WD. Alternately, the Jay B. Latham WWTP requires treatment facility upgrades before it can be used as a source of recycled water. Despite the costs associated with the upgrade, the Jay B. Latham WWTP provides an alternative, reliable source of recycled water for the City of San Juan Capistrano/Capo Valley WD.

4.4.9 Encina

The proposed Encina STIP combines the Encina Basin Water Reclamation Program with the San Elijo JPA Water Reclamation Program. The project builds on planned and existing connections between four treatment facilities located in north San Diego County, and is a logical addition to a recycled water distribution system potentially extending from the North City WRP through San Elijo and into Carlsbad. The proposed project provides various new recycled water users with approximately 3,500 AFY. As proposed, the Encina STIP consists of three major components, as follows:

- Construction of the new Carlsbad WRP and distribution system.
- Expansion of the Meadowlark WRP and distribution system.
- Expansion of the San Elijo WRP and distribution system.

The net benefit under each of the economic perspectives is positive. These results are sensitive to both the estimated project costs and the avoided water supply costs.

Construction of the first phase (4 mgd) of the Carlsbad WRP results in approximately $4 million in avoided construction costs. The avoided costs include reduced costs from downsizing future flow equalization ponds required for the Encina Water Pollution Control Facility (WPCF), and approximately $2 million in avoided potable water pipeline construction costs.

The proposed Encina STIP potentially involves many agencies, including one water wholesaler, three water retailers, and five wastewater agencies. Successful implementation of the proposed STIP requires the various agencies to cooperate and coordinate on a regional basis. The SDCWA could provide the regional framework for the development and implementation of the project. In addition to the proposed project, several water reclamation projects are currently undergoing implementation in the area. Implementation of the Encina STIP requires coordination with the ongoing reclamation projects to maximize the opportunities for reuse and to avoid duplication of efforts.

4.4.10 San Pasqual Valley

The proposed San Pasqual Valley STIP consists of replacing the existing San Pasqual WRF with a new, larger facility and expanding the Escondido and 4-S Ranch recycled water systems. As proposed, the San Pasqual Valley STIP consists of the following four major components:

- Expansion of San Pasqual WRF and distribution system.
- Expansion of Hale Avenue Resource Recovery Facility (RRF) to tertiary treatment and construction of the distribution system.
- Expansion of the 4-S Ranch Wastewater Treatment Plant (WTP).
- Construction of the Industrial Brine Export System.

The proposed project provides approximately 8,200 AFY of recycled water to various new landscape and agricultural irrigation users, as well as a groundwater recharge site.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the San Pasqual Valley STIP demonstrated that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The San Pasqual Valley STIP involves several different agencies, including one water wholesaler, five water retailers, and three wastewater agencies. The SDCWA could provide the regional framework for the development and implementation of the project.

4.4.11 North City

The primary focus of the North City STIP is to expand the North City water recycling project. The North City STIP planning area occupies a central location in San Diego County, and provides an important opportunity to link the recycled water systems in San Diego County into a regional water recycling system. As proposed, the project utilizes recycled water from the North City WRP to supply approximately 9,600 AFY of recycled water to various new landscape and agricultural irrigation users located throughout the planning area.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the North City STIP demonstrated that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or avoided wastewater and water supply costs.

The proposed North City STIP involves facilities that are owned and operated by the City of San Diego. The project may extend into the Olivenhain WD service area, as well as other communities and service areas. Therefore, support from these local communities and public agencies may be required to avoid negative public-perception issues and to avoid any institutional conflicts from the affected communities.

The 1994 Ocean Pollution Reduction Act (OPRA) was an important factor that influenced the City of San Diego to construct the 30 mgd North City WRP. OPRA allowed the City of San Diego to apply for a Federal secondary treatment waiver for the 240 mgd Point Loma WWTP. As part of this legislation, however, OPRA also requires the City of San Diego to construct 45 mgd of recycled water production capacity by the year 2010.

This proposed North City STIP is one of several alternatives for expanding the North City recycled water system that is under evaluation by the City of San Diego. The proposed STIP is not intended to be the final solution, but is presented as a feasible alternative requiring further evaluation and development for implementation.

4.4.12 South Bay

The proposed South Bay STIP expands several recycled water projects in south San Diego County and supplies recycled water to Mexico. The proposed South Bay STIP consists of the following major components:

- Expand the Otay WD recycled water system.
- Supply recycled water from the South Bay WRP to the Otay WD.
- Supply recycled water to the Tia Juana Valley County Water District (CWD) proposed groundwater recharge project, and to a proposed groundwater recharge site in Mexico.

The proposed project supplies approximately 15,600 AFY of recycled water to various new landscape irrigation and industrial users in south San Diego County, as well as to two proposed groundwater recharge projects located along the Tijuana River. One of the proposed groundwater recharge projects is located in Mexico. The other proposed project utilizes recycled water to recharge the lower Tijuana River Valley groundwater basin to improve the water quality and augment the local water supply. The proposed STIP utilizes recycled water from the Ralph W. Chapman WRF and the South Bay WRP. The recycled water supplies have the additional benefit of providing an alternative to ocean discharge.

The net benefit under each of the economic perspectives is positive. These results are sensitive, however, to both the estimated project costs and the avoided water supply costs.

Successful implementation of the proposed STIP requires the various agencies to cooperate and coordinate on a regional basis. Due to their relatively large water recycling program, the City of San Diego is the likely candidate to be the lead agency for the South Bay STIP. In addition, the SDCWA could provide the regional framework for the development and implementation of the project.

A significant challenge to implementation of the South Bay STIP is the identification, negotiation, and execution of the permits and approvals required to sell recycled water to users in Mexico. Many State of California and Federal agency and regulatory approvals will likely be required for recycled water sales to private entities or government agencies located in Mexico. In addition, obtaining institutional and regulatory approval for groundwater recharge within Mexico may prove to be a significant challenge. Although Tijuana groundwater is used for municipal use, all Mexican groundwater is within the jurisdiction of the federal Mexican government. Therefore, all levels of Mexican government are likely to be involved in the review and approval of a plan to recharge groundwater with recycled water. Recycled water use by the City of Tijuana industrial customers falls within the jurisdiction of Mexican authorities and, therefore, may prove to be less of a challenge.

4.4.13 Chino Basin

The primary focus of the proposed Chino Basin STIP is to expand the existing recycled water projects and enhance salinity management in the planning area. The proposed project builds upon the local recycled water systems and develops additional connections between these systems. In addition, the proposed STIP includes a significant volume of groundwater recharge using recycled water. The proposed Chino Basin STIP consists of the following major components:

- Expand the Inland Empire Utilities Agency (IEUA) recycled water distribution system to include utilizing recycled water to recharge multiple groundwater recharge sites.
- Develop the Western Riverside County WWTP recycled water system.
- Expand the Chino Basin Desalters.

The proposed STIP utilizes recycled water from six tertiary treatment facilities to supply approximately 66,100 AFY of recycled water to various users, of which approximately 39,000 AFY will be used for groundwater recharge. The proposed STIP also plays an important role in salinity management through the incorporation of the proposed expansion of the Chino Basin Desalters.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the proposed STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

Successful implementation of the Chino Basin STIP requires the various agencies to cooperate and coordinate on a regional basis. Due to their relatively large water recycling program, IEUA will likely be the lead agency for the Chino Basin STIP.

Another potential issue facing this project is the additional water rights claim that the OCWD has placed on return flows in the Santa Ana River downstream of treatment plants in the Inland Empire. Currently, none of the parties with a stake in the claim is acting on it; however, recognition of this claim may potentially affect the volume of recycled water used in the planning area.

4.4.14 San Bernardino

The primary focus of the San Bernardino STIP is to utilize recycled water to improve the local groundwater quality through the Riverside – Colton Conjunctive Use Project, potentially creating a new local supply of groundwater. Implementation of the proposed STIP removes poor quality water from the groundwater basin and replace it with higher quality recycled water and natural runoff. The proposed STIP also supplies recycled water to new agricultural and industrial users in the communities of Colton and Rialto. The project allocates approximately 51,600 AFY of recycled water from the Rialto WWTP and the Rapid Infiltration/Extraction (RIX) WRP.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the proposed STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The proposed San Bernardino STIP potentially affects many agencies within the planning area. Successful implementation of the proposed STIP requires the various agencies to cooperate and coordinate on a regional basis. SAWPA is already leading the effort to garner support for this project. Implementation of this project likely requires the participation and support of OCWD. OCWD is a member agency of SAWPA and has expressed a willingness to participate in discussions.

4.4.15 Eastern – Full

Implementation of the proposed Eastern-Full STIP depends on full implementation of the recycled water discharges specified by agencies involved in the *Four Party Agreement*. The *Four-Party Agreement* is an agreement between Eastern MWD, Rancho California WD, Fallbrook Public Utilities District (PUD), and Camp Pendleton Marine Corps Base (MCB) regarding the discharge of recycled water to the Santa Margarita River for groundwater recharge. This STIP is an alternative look at the Eastern planning area, and is prepared in conjunction with the Eastern-Limited STIP, which is a limited interpretation and implementation of the *Four-Party Agreement*.

The primary focus of the proposed Eastern-Full STIP is to continue developing links between several major recycled water systems in the Eastern planning area. The proposed Eastern-Full STIP consists of the following:

- Expand the existing Eastern MWD recycled water system.
- Full implementation of the *Four-Party Agreement.*
- Provide an in-lieu water exchange with the Soboba Indians.
- Provide recycled water to the Lake Elsinore area.

The project utilizes recycled water from eight recycled water facilities to supply approximately 26,600 AFY of recycled water to various new users that include local landscape irrigation users, industrial users, and citrus growers in the Valle Vista area. The proposed Eastern-Full STIP also includes the following components:

- Menifee Desalter
- South Perris Desalter
- Temecula Valley Brineline

The Menifee Desalter and the South Perris Desalter are part of a proposed conjunctive-use project to improve groundwater quality by replacing the high-salinity groundwater with imported water. These two desalter projects are part of the planned Eastern MWD conjunctive-use project that has a goal of integrating the use of imported, recycled, and local groundwater supplies. This is accomplished by desalinating groundwater located near the two desalters. Eventually, the overall project could yield as much as 100,000 acre-feet (ac-ft) of conjunctive-use storage.

The net benefit under each of the economic perspectives is positive. Sensitivity analyses for the proposed STIP showed that this result was robust, with net benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs.

The Eastern-Full STIP includes two wholesale water agencies, three groundwater management agencies, five wastewater agencies, and eight retail water agencies. To further complicate the institutional arena, the *Four-Party Agreement* adds two additional agencies that are not physically part of the planning area, but institutionally are included in the STIP. These agencies include the Fallbrook PUD and Camp Pendleton MCB. At first glance, the list of agencies impacted by the STIP is very large; however, a number of these agencies are already either working together, or involved in dialogues to address common issues.

One of the issues potentially affecting implementation of this STIP is the *Four-Party Agreement*. The four agencies directly involved in the *Four-Party Agreement* include the Eastern MWD, Rancho California WD, Fallbrook PUD, and Camp Pendleton MCB. The agencies have worked cooperatively in the past and have established an open dialogue. Currently, the four agencies have implemented the 2 mgd pilot study to address the viability of a larger-scale stream discharge. However, disagreement exists among the agencies as to the interpretation of the *Four-Party Agreement* and direction of future water recycling efforts by the Eastern MWD and Rancho California WD. The Eastern MWD and Rancho California WD contend that the *Four-Party Agreement* does not commit either agency to additional stream discharges to the Santa Margarita River above the existing 2 mgd project. Fallbrook PUD and Camp Pendleton MCB contend that, if larger-scale stream discharge proves environmentally feasible, the agreement requires Eastern MWD and Rancho California WD to implement such a discharge for downstream beneficial use and to provide wellhead demineralization facilities within the lower Santa Margarita River Basin. The dialogue between the affected parties in the *Four-Party Agreement* needs to continue in an effort to resolve the discharge issue in a mutually beneficial and agreeable manner.

4.4.16 Eastern – Limited

The proposed Eastern-Limited STIP includes limited implementation of the recycled water discharges specified by agencies involved in the *Four Party Agreement*. This STIP is an alternative look at the Eastern planning area, and is prepared in conjunction with the Eastern-Full STIP. Under the Eastern-Limited STIP, implementation of the *Four-Party Agreement* consists of continuing the current 2 mgd pilot study, and maintaining current levels of recycled water discharge to the Santa Margarita River. The limited implementation of the *Four-Party Agreement* results in significantly less water discharging to the Santa Margarita River than in the Eastern-Full STIP.

The proposed Eastern-Limited STIP utilizes recycled water from eight recycled water facilities to supply approximately 23,300 AFY of recycled water to local landscape irrigation users, industrial users, and citrus growers in the Valle Vista area. The proposed Eastern-Limited STIP also includes the same desalters and brineline for salinity management identified in the Eastern-Full STIP.

For this STIP, the overall net benefit as viewed under all three economic perspectives is positive. Additional analysis indicates that the potential net benefits for this project are somewhat sensitive to the overall project costs and the potential price of the future avoided water supply costs. A change of 20 percent in either one of these categories could cause the net benefits to become negative. However, since all of the treatment plants discharge to streams, the potential for changes in the discharge regulations could result in a much higher avoided wastewater cost, which would further increase the overall positive net benefits.

4.5 Short-Term Implementation Plan: Single-Agency Projects

During the feasibility analysis, 19 single-agency projects were identified. These projects potentially supply over 60 mgd of recycled water to end-users located within three PAC areas, as follows:

- Los Angeles Basin Region:
  - Alamitos
  - Burbank
  - LA/Glendale
  - Long Beach
  - Long Beach Wetlands
  - San Fernando Valley
- Inland Empire Region:
  - Beaumont
  - Big Bear
  - Corona
  - March
  - Redlands
  - Riverside
  - Running Springs
  - Yucaipa
- San Diego Region:
  - Camp Pendleton
  - Fallbrook
  - Oceanside
  - Rancho Santa Fe
  - Santee Basin

The projects identified in this chapter represent the most optimal and feasible opportunities to meet their recycled water demands despite the fact that these projects are not regional in scope, and in many cases, they are proposed for implementation by a single agency. The SCCWRRS process determined that the benefits of these projects could not be improved by linking them regionally. To the extent that these projects reduce the need for groundwater or imported supplies, the potential production from these projects is an integral part of the regional solution for water supply reliability in southern California.

4.5.1 Los Angeles Basin Region

Six proposed projects are located in the Los Angeles Basin Region and are described in the following paragraphs.

4.5.1.1 Alamitos

The proposed Alamitos STIP includes the Alamitos Barrier Project, which is a planned advanced treatment facility used to supply the Alamitos Seawater Intrusion Barrier. The Alamitos Seawater Intrusion Barrier is a series of injections wells located along the San Gabriel River in Long Beach. The injection wells are currently in operation, injecting potable water into the barrier through injection wells owned and operated by the Los Angeles County DPW. The Alamitos Barrier Project consists of an advanced treatment facility providing membrane treatment and disinfection of recycled water supplied by the LACSD's existing Long Beach WRP. These additional treatment steps are needed to comply with regulatory requirements associated with direct injection of recycled water into the barrier.

Implementation of the Alamitos STIP requires construction of approximately 2 miles of new pipeline and additional pumping capacity. The production from the project reduces the demand for imported supplies in southern California and results in a regional benefit for all groundwater users in the Central and Orange County groundwater basins. Currently, imported water from the MWDSC is used for the seawater intrusion barrier. By replacing up to half of the supply with recycled water from the Alamitos Barrier Project, water supply reliability is increased.

4.5.1.2 Burbank

The proposed Burbank STIP builds upon the existing local recycled water project that delivers approximately 9 mgd from the Burbank WRP, which currently supplies approximately 1 mgd for landscape irrigation uses. Unused recycled water from this plant is discharged to the Los Angeles River.

In the proposed Burbank STIP, the projected available recycled water supply is approximately 8 mgd, of which approximately 3.3 mgd is allocated to more than 30 landscape irrigation and industrial customers. Implementation of the Burbank STIP requires construction of approximately 14 miles of new pipeline and additional pumping capacity to supply recycled water to new users.

4.5.1.3 LA/Glendale

The proposed LA/Glendale STIP builds upon the existing local recycled water system, utilizing recycled water from the existing 20 mgd LA/Glendale WRP, which currently supplies approximately 5 mgd for landscape irrigation uses. The remainder is discharged to the Los Angeles River.

In the proposed LA/Glendale STIP, the projected available recycled water supply is approximately 15 mgd, which is allocated to landscape irrigation and industrial customers in Glendale, Los Angeles and Pasadena. Implementation of the LA/Glendale STIP requires construction of approximately 21 miles of new pipeline and additional pumping capacity to supply recycled water to new users. The proposed STIP uses available capacity in the existing recycled water distribution system.

4.5.1.4 Long Beach

The proposed Long Beach STIP builds upon Long Beach Water Department's existing local recycled water system, utilizing recycled water from LACSD's existing 25 mgd Long Beach WRP. The Long Beach WRP currently supplies approximately 7.5 mgd of recycled water for landscape irrigation and industrial uses.

In the proposed Long Beach STIP, the projected year 2010 available recycled water supply is approximately 17.5 mgd, of which approximately 6 mgd is allocated to landscape irrigation and industrial customers. Implementation of the Long Beach STIP requires construction of approximately 33 miles of new pipeline and additional pumping capacity to supply recycled water to new users.

4.5.1.5 Long Beach Wetlands

The proposed Long Beach Wetlands STIP will utilize recycled water from the proposed Long Beach Wetlands Project to supply local demands. The proposed project will treat approximately 0.5 mgd of diverted flows from the Los Angeles River. Urban runoff will be treated using natural processes consisting of waterfalls and ponds situated in a flood overflow channel. The proposed project allocates approximately 0.4 mgd of recycled water for landscape irrigation purposes. Implementation of the innovative Long Beach Wetlands STIP requires construction of approximately 2 miles of new pipeline and additional pumping capacity to supply recycled water to new users.

4.5.1.6 San Fernando Valley

The proposed San Fernando Valley STIP consists of further development of the East Valley Project and expansion of the existing reclamation distribution system. The proposed project utilizes available recycled water supply from the existing 80 mgd Donald C. Tillman Treatment Plant, which currently supplies approximately 35 mgd to various users for landscape irrigation and groundwater recharge purposes and recreational impoundment at Lake Balboa.

In the proposed San Fernando Valley STIP, the projected available recycled water supply is approximately 25 mgd. Implementation of the STIP includes Phase 2 of the East Valley Project. The STIP delivers an additional 9 mgd of recycled water to the Pacoima and Hansen Spreading Grounds and other industrial and landscape irrigation users.

Water recycling projects such as this improve the overall reliability of the Los Angeles water supply by reducing the city's dependency on imported water. By improving reliability of the San Fernando groundwater basin, the project also indirectly benefits the Cities of Burbank, Glendale, and San Fernando.

4.5.2 San Diego Region

Five proposed single-agency projects are located in the San Diego Region and are described in the following paragraphs.

4.5.2.1 Camp Pendleton

The proposed Camp Pendleton STIP utilizes flow from five existing treatment facilities located at Camp Pendleton MCB and consists of two major components. The first component consists of Camp Pendleton WWTPs #2, 3, and 9, which are used to supply recycled water to recharge the Santa Margarita Groundwater Basin. The projected available supply is approximately 4.7 mgd, all of which is allocated in the Camp Pendleton STIP. Implementation of the first component requires construction of approximately 13.5 miles of new pipeline and additional pumping capacity to convey recycled water to the groundwater recharge site.

The second component consists of upgrading Camp Pendleton WWTP #13 to tertiary treatment and utilizing recycled water to supply various local users. The projected available supply by 2010 is approximately 2.5 mgd, all of which is allocated to more than 10 landscape irrigation users. Implementation of the second component requires construction of approximately 9 miles of new pipeline and additional pumping capacity to convey recycled water to new users.

4.5.2.2 Fallbrook

The proposed Fallbrook STIP builds upon the existing recycled water project. Fallbrook PUD owns and operates the 2.7 mgd tertiary treatment Fallbrook #1 Plant. Currently, there are no plans to expand the treatment capacity by 2010. The facility supplies approximately 0.8 mgd of recycled water to existing users and discharges excess treated effluent via a land outfall that connects to the La Salina WWTP ocean outfall. Plant #1 fully allocates all available recycled water in the summer; however, the facility can supply additional users with recycled water if seasonal storage were provided to capture excess winter flows currently discharged to the ocean.

The projected available supply for 2010 is approximately 1.2 mgd, all of which is allocated in the proposed Fallbrook STIP to several agricultural and landscape irrigation users. Implementation of the Fallbrook STIP requires construction of approximately 6 miles of new pipeline and additional pumping capacity to supply recycled water to new users.

4.5.2.3 Oceanside

The proposed Oceanside STIP builds upon the existing recycled water project by further using recycled water from the San Luis Rey WWTP, which is owned and operated by the City of Oceanside. San Luis Rey WWTP is a tertiary treatment facility with 10.7 mgd of secondary treatment capacity and 0.7 mgd of tertiary treatment capacity. The facility has plans to expand to 13.5 mgd and 2.5 mgd of secondary and tertiary treatment capacity, respectively, by 2010. The total projected treated effluent is estimated to be less than 5 mgd by 2010. About 0.3 mgd of recycled water is presently supplied to local users.

The projected available supply for 2010 is approximately 4.7 mgd, all of which is allocated in the proposed Oceanside STIP to several types of users. The potential demands include groundwater recharge of the Mission Basin and a mix of landscape irrigation and agricultural users. Implementation of the Oceanside STIP requires construction of approximately 7 miles of new pipeline and additional pumping capacity.

4.5.2.4 Rancho Santa Fe

The proposed Rancho Santa Fe STIP builds upon local plans to develop a water recycling project by using recycled water from the Rancho Santa Fe WPCF, which is operated by the Rancho Santa Fe Community Services District. Rancho Santa Fe WPCF is a 0.5 mgd secondary treatment facility that is planned for expansion to 0.8 mgd and upgrade to tertiary treatment by 2010. The facility supplies all of its 0.5 mgd of recycled water to local users.

The projected available supply for 2010 is approximately 0.3 mgd, all of which is allocated in the proposed Rancho Santa Fe STIP to several local landscape irrigation and agricultural users. Implementation of the Rancho Santa Fe STIP requires construction of approximately 2 miles of new pipeline and additional pumping capacity.

4.5.2.5 Santee Basin

The proposed Santee STIP builds upon the existing local water recycling project by using additional recycled water from the Santee Basin WRF, which is operated by Padre Dam MWD. Santee Basin WRF is a 2 mgd tertiary treatment facility that is planned for expansion to 4 mgd by 2010. Currently, the facility supplies 1.5 mgd of recycled water to existing users.

The projected available supply for 2010 is approximately 2.5 mgd, all of which is allocated in the proposed Santee STIP to the Santee-El Monte groundwater recharge site and several local landscape irrigation users. Implementation of the Santee STIP requires construction of approximately 8 miles of new pipeline and additional pumping capacity.

4.5.3 Inland Empire Region

Eight proposed projects are located in the Inland Empire Region and are described in the following paragraphs.

4.5.3.1 Beaumont

The proposed Beaumont STIP utilizes recycled water from the Beaumont WWTP #1. The facility is a 1.4 mgd tertiary treatment facility that is owned and operated by the City of Beaumont, and there are currently has no plans to expand its capacity by 2010. Excess flow from the facility is discharged to percolation ponds.

In the proposed STIP, all of the projected available 1.4 mgd of recycled water supply is supplied to several landscape irrigation customers. Implementation of the project requires the construction of approximately 8 miles of new pipeline and additional pumping capacity.

4.5.3.2 Big Bear

The proposed Big Bear STIP utilizes recycled water from the Big Bear Area RWA WWTF. The Big Bear Area RWA WWTF is a 2.7 mgd tertiary treatment facility that is owned and operated by the Big Bear Area RWA. The plant is planned for expansion to 3.5 mgd by 2010. The treatment facility currently supplies approximately 1.2 mgd of recycled water to local landscape irrigation and environmental uses. Disposal of excess flow from the plant occurs through irrigation of fodder crops in the Lucerne Valley.

The projected available recycled water supply for 2010 is approximately 2.3 mgd, of which approximately 2 mgd is allocated in the proposed Big Bear STIP. The recycled water is provided to several types of users, which include landscape irrigation, environmental, and groundwater recharge sites in the Big Bear area. The Big Bear STIP requires the construction of approximately 7 miles of new pipeline and additional pumping capacity.

4.5.3.3 Corona

The proposed Corona STIP builds upon the local recycled water plans of the City of Corona, utilizing recycled water from three treatment facilities: Corona WWTP #1, 2, and 3. The Corona STIP includes the delivery of approximately 1.3 mgd of recycled water from Corona WWTP #1 as part of existing commitments related to several judgments and interagency agreements. The projected available supply for 2010 is approximately 18.5 mgd, of which approximately 8 mgd is allocated to more than 60 users for landscape irrigation and agricultural purposes. Implementation of the Corona STIP requires construction of approximately 44 miles of new pipeline and additional pumping capacity to supply recycled water to new users.

4.5.3.4 March

The proposed March STIP builds upon the existing March Air Force Base (AFB) WWTP local project, a 1.2 mgd secondary treatment facility operated by Western MWD in conjunction with the U. S. Air Force. Currently, there are no plans to expand the plant's capacity by 2010. The facility presently supplies nearly 0.8 mgd of recycled water to the March AFB Golf Course.

Approximately 0.4 mgd of recycled water, projected to be available by 2010, is allocated to two users for landscape irrigation by the March STIP. Implementation of the proposed March STIP requires construction of approximately 2 miles of new pipeline and additional pumping capacity.

4.5.3.5 Redlands

The proposed Redlands STIP consists of upgrading the Redlands WWTP to tertiary treatment and supplying a portion of the recycled water to various local users. The Redlands WWTP is a 9 mgd secondary treatment facility that is owned and operated by the City of Redlands. Currently, there are not any plans to upgrade the treatment level or to expand the plant capacity by 2010. The projected available supply by 2010 is approximately 9.0 mgd. The proposed Redlands STIP allocates 3.1 mgd to several local agricultural and landscape irrigation users. The project requires the construction of approximately 3 miles of new pipeline and additional pumping capacity.

4.5.3.6 Riverside

The proposed Riverside STIP utilizes recycled water from the 40 mgd Riverside Regional WQCP, which is owned and operated by the City of Riverside. There are plans to expand the tertiary treatment facility to 50 mgd by the year 2010. The Riverside STIP includes approximately 12 mgd of recycled water from the Riverside Regional WQCP as part of existing commitments related to several judgments and interagency agreements.

The projected available supply for 2010 is approximately 38 mgd, of which approximately 3.3 mgd is allocated to six users for landscape irrigation and industrial purposes. Implementation of the Riverside STIP requires construction of approximately 3 miles of new pipeline and additional pumping capacity to supply recycled water to new users.

4.5.3.7 Running Springs

The proposed Running Springs STIP consists of upgrading the existing treatment facility to tertiary treatment and utilizing the recycled water for local uses. The Running Springs Treatment Plant is a 1 mgd secondary treatment facility that is owned and operated by the Running Springs WD. The treatment facility is planned for expansion to 1.5 mgd of secondary treatment by 2010, and it disposes the treated effluent via percolation ponds.

The projected available supply for 2010 is approximately 1.5 mgd, of which approximately 1 mgd is allocated in the proposed Running Springs STIP. The proposed STIP includes upgrading the treatment facility to tertiary treatment. The recycled water is used to create and maintain a greenbelt to provide fire protection along the southern mountain community boundary. The project requires the construction of approximately 2 miles of new pipeline and additional pumping capacity.

4.5.3.8 Yucaipa

The proposed Yucaipa STIP utilizes recycled water from the Henry N. Wocholz WWTP, which is owned and operated by the City of Yucaipa. The treatment facility is a 4.5 mgd tertiary treatment facility planned for expansion to 6 mgd by 2010. The Henry N. Wocholz WWTP currently supplies approximately 1.8 mgd to existing recycled water users.

The projected available recycled water supply for 2010 is approximately 4.2 mgd, all of which is allocated to more than 10 landscape irrigation users in the proposed Yucaipa STIP. The project requires the construction of approximately 12 miles of new pipeline and additional pumping capacity.

5 Long-Term Regional Recycling Strategy

5.1 Contents of this Section

5.2 Introduction

The development of the long-term recycling strategy was the final step in the SCCWRRS process. The long-term analysis consisted of a conservative estimate of future levels of recycling, as well as the identification of potential opportunities to increase levels of recycling. The planning tools were used to generate regional reclamation distribution systems for review and consideration by the PAC participants. The product of this analysis was a proposed long-term regional recycling strategy that was based upon the current plans of local agencies. The analysis utilized the planned treatment facility expansions as potential sources of recycled water, and allocated the recycled water to demands that were projected to be available by the year 2040. The potential demands included those demands that were not allocated supply in the short-term analysis, as well as projected new demands. The result of this analysis is a conservative estimate of the level of recycling that can reasonably be achieved by the year 2040 as an outgrowth of implementing the STIPs.

Given the uncertainties of a 40-year planning horizon, additional iterations to further refine the long-term regional networks were not conducted. Instead, the SCCWRRS analysis examined additional potential opportunities to expand upon the projected level of recycling. These alternatives were compared to the baseline, conservative estimate of long-term recycling. Other recycling opportunities were overlaid on the baseline long-term condition to project increases in recycled water use, as well as estimated costs. The alternatives analysis focused on maximizing reuse through state-of-the-art reuse types, such as groundwater recharge and surface storage augmentation.

The alternatives analysis consisted of two separate reuse scenarios. One scenario examined increasing recycled water demand through indirect potable reuse, while the other scenario evaluated increasing recycled water supplies by reusing wastewater supplies with historically high salinity concentrations. The analysis of indirect potable reuse examined using additional groundwater recharge sites, as well as the implementation of surface storage augmentation. For the analysis of historically high salinity supplies, treatment facilities with high-recycled water treatment costs due to poor quality effluent were utilized as potential supply sources. This approach allowed for evaluation of virtually all of the rest of the wastewater stream not used in earlier analyses due to relative expense or the need for long-term public education processes to gain acceptance for the project.

5.3 Long-Term Regional Recycling

5.3.1 Projected Levels of Long-Term Supply and Demand

Developing the long-term regional reclamation distribution systems for the long-term analysis consisted of projecting the long-term supply that will potentially be available, expanding upon the results of the short-term analysis, and connecting additional recycled water users.

To estimate the potential available supply by the year 2040, the treatment facilities that supplied recycled water for the short-term projects were utilized. The treatment facilities were included if additional supply was available or if their capacities were planned for expansion by the local agencies. In addition, eight treatment facilities were not included in the long-term baseline analysis due to projected high costs of treating effluent with historically high salinity concentrations. These facilities included the following:

- Encina Water Pollution Control Facility (WPCF)
- Hyperion WWTP
- Joint Water Pollution Control Plant (WPCP)
- La Salina WWTP
- OCSD Plant 1
- OCSD Plant 2
- Point Loma WWTP
- South Bay Secondary WWTP

Currently, water recycling from the Encina WPCF, Hyperion WWTP, and OCSD Plant 1 occurs through off-site tertiary treatment facilities. The flow from these off-site facilities has been considered in the analysis, as described in the STIP Report in Appendix C. The long-term baseline analysis, however, did not include recycled water supplied directly from the listed wastewater facilities due to their poor effluent quality.

For developing the long-term regional alternatives, the current regulatory climate was applied to the analysis for the year 2040. For the purposes of the analysis, recycled water supplies are assumed to meet a minimum of full Title 22 requirements for disinfected tertiary recycled water, which specifies a range of treatment options for varying degrees of public contact. Under Title 22, “disinfected tertiary recycled water” corresponds to the most stringent treatment standards and facilitates the highest degree of public contact with the recycled water.

5.3.2 Summary of Long-Term Analysis

Following the development of projected long-term recycling levels, the planning tools were used to develop project alternatives. The results of the short-term analysis were used as a starting point for this analysis, and the product of the analysis is a conservative projection of recycled water use over the next 40 years. The planning tools were used to develop proposed reclamation distribution systems that included the short-term results, as well as to estimate the engineering and economic costs and benefits of the projects. The results of the long-term analysis are included in Table 5-1. Additional discussion for each of the PAC regions included in the analysis is presented below.

TABLE 5-1
Results of the Long-Term Analysis

Region	Demand Satisfied by 2010 (AFY)[1]	Additional Demand Satisfied By 2040 (AFY)[2]	Total Demand Satisfied (AFY)[3]
Los Angeles Basin	128,100	96,400	224,500
Orange County	114,600	52,500	167,100
San Diego	50,300	65,200	115,500
Inland Empire	158,500	82,200	240,700
Total	**451,500**	**296,300**	**747,800**

Footnotes:

[1]New demand satisfied by allocating recycled water as part of the short-term analysis.

[2]New demand satisfied in the long-term analysis. The demand includes only the demand connected in the long-term analysis and is incremental to the demand that was satisfied in the short-term analysis.

[3]Cumulative demand satisfied by the year 2040, which is a summation of the demand satisfied by 2010 and by 2040.

5.3.3 Los Angeles Basin Region

The Los Angeles Basin Region baseline condition was built on four regional and three single-agency projects, which were part of the STIP for this region. The projects were expanded by increasing treatment plant capacities to their year 2040 projected levels to meet new conventional use demands. The baseline condition for the Los Angeles Basin Region consisted of increasing reuse at 13 of the 22 treatment facilities in the region. The increased flow was utilized to satisfy approximately 96,400 AFY of new recycled water demand.

5.3.3.1 Proposed Project

The long-term analysis for the Los Angeles Basin Region consisted of connecting new users in the Carson, Culver City, Los Angeles, Marina Del Rey, North Orange County, Palos Verdes, Pasadena, San Fernando Valley, San Gabriel Valley, Simi Valley, and Torrance areas. Figure 5-1 presents the proposed layout for the Los Angeles Basin Region.

In the long-term analysis, six types of reuse were supplied recycled water, which included agricultural, groundwater recharge, industrial, landscape, miscellaneous, and seawater intrusion barrier. The groundwater recharge and seawater intrusion barrier sites included in the long-term analysis represent an increase of 25,300 AFY over the proposed volumes in the short-term analysis.

Implementation of this project will require increasing the size of several proposed reclamation distribution systems previously presented in the STIPs, as follows:

- Upsizing pipelines in Simi Valley and extending the proposed system to supply new users in the eastern portion of Simi Valley.
- Upsizing the trunk line that links the East Valley Project with the Donald C. Tillman WRP so that new users in the San Fernando Valley can be supplied.
- Upsizing the trunk line that proceeds north from the Pomona WRP to supply the year 2040 demands of existing users.

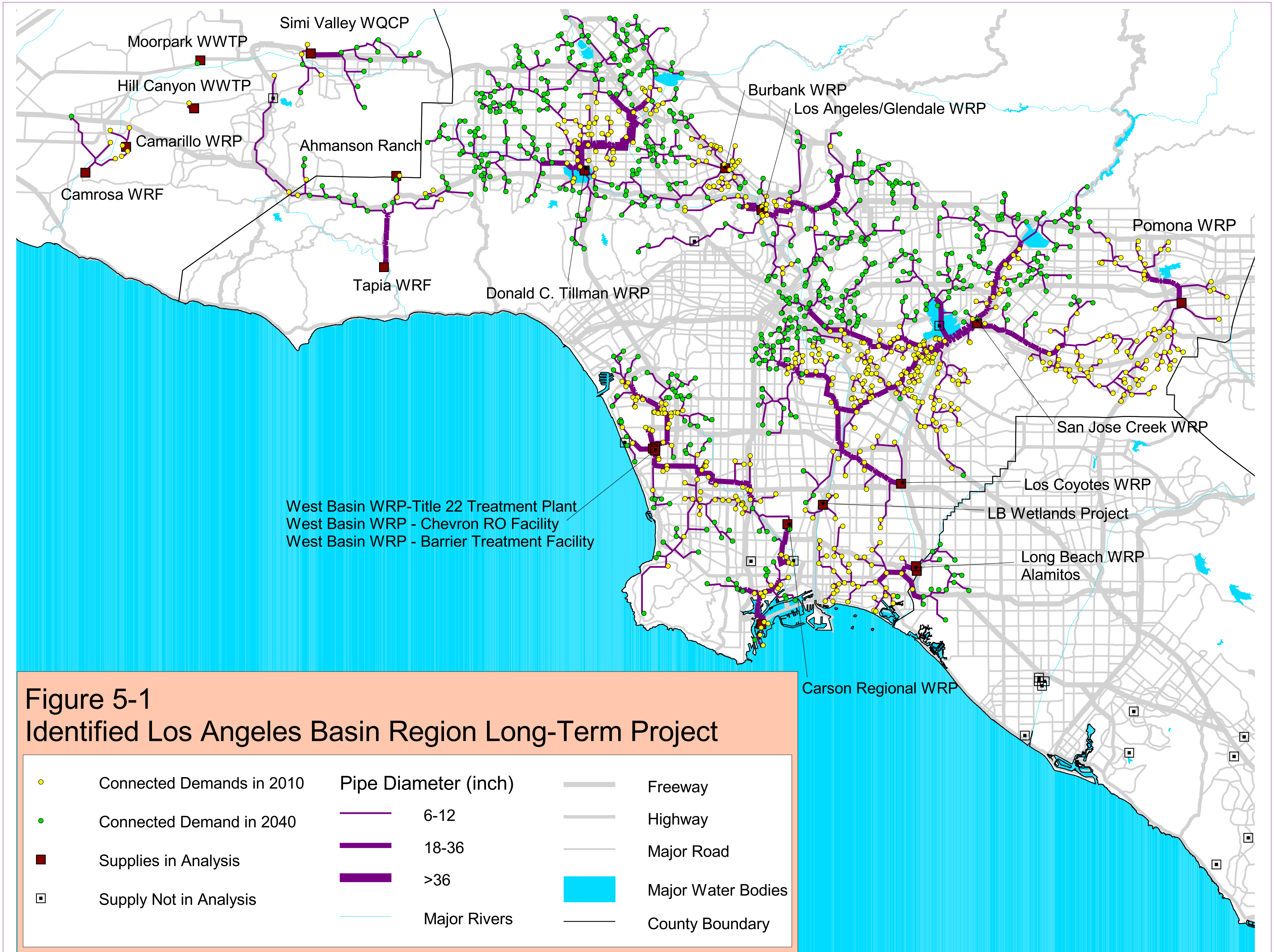


Figure 5-1
Identified Los Angeles Basin Region Long-Term Project

- Upsizing the trunk line that proceeds south from the San Jose Creek WRP.
- Extending the West Basin System into the Culver City and Marina del Rey area.
- Extending the LA/Glendale WRP distribution system into the Pasadena area.
- Extending the Long Beach distribution system into north Orange County.

The results of the Los Angeles Basin Region long-term analysis also include the build-out of the Calleguas Regional Brineline. The brineline is an important component of the long-term strategy, because it provides an outlet for waste produced in the desalination process and acts as the backbone for a regional system in Ventura County. This brineline will link the outfall near Ormand Beach to the Camrosa WRP, Moorpark WRP, Hill Canyon WRP, and Simi Valley WRP. The brineline construction is planned to occur in four phases. The initial phase of the project was included in the cost of the Calleguas STIP. The remaining three phases of the project were included in the long-term analysis.

5.3.3.2 Results

The Los Angeles Basin Region long-term strategy allocates an increment of 96,400 AFY to the existing recycling that is planned by local agencies by 2040. The estimated capital cost for the proposed increment of recycling for 2040 is approximately $823 million, and the estimated O&M cost is approximately $42 million per year. The project has an overall positive net benefit.

5.3.4 Orange County Region

The Orange County Region baseline condition was built on the four regional STIPs. The STIPs were expanded by increasing treatment plant capacities to their year 2040 projected levels to meet additional demands. The baseline analysis evaluated meeting new conventional use demands. The baseline condition in the Orange County Region consisted of increasing reuse at six of the treatment facilities and one of the reservoirs in the area. This increased flow was utilized to satisfy approximately 52,500 AFY of new demand by 2040.

5.3.4.1 Proposed Project

The long-term analysis in the Orange County Region consisted of connecting new users in the Anaheim, Anaheim Hills, Buena Park, Cypress, Fullerton, Garden Grove, Laguna Niguel, San Juan Capistrano, and Yorba Linda areas. Figure 5-2 provides the proposed layout for the Orange County Region.

Twelve treatment facilities and three reservoirs in the Orange County area were used to supply more than 183 mgd of recycled water for the long-term analysis.

In the long-term analysis for the Orange County Region, seven types of reuse were supplied with recycled water. The reuse types include agricultural, environmental, groundwater recharge, industrial, landscape, miscellaneous, and seawater intrusion barrier. The groundwater recharge and seawater intrusion barrier sites represent an increase of 78,400 AFY over the proposed volumes in the STIPs. Implementation of this project will require increasing the size or expanding several proposed reclamation distribution systems in the STIPs, which include the following:

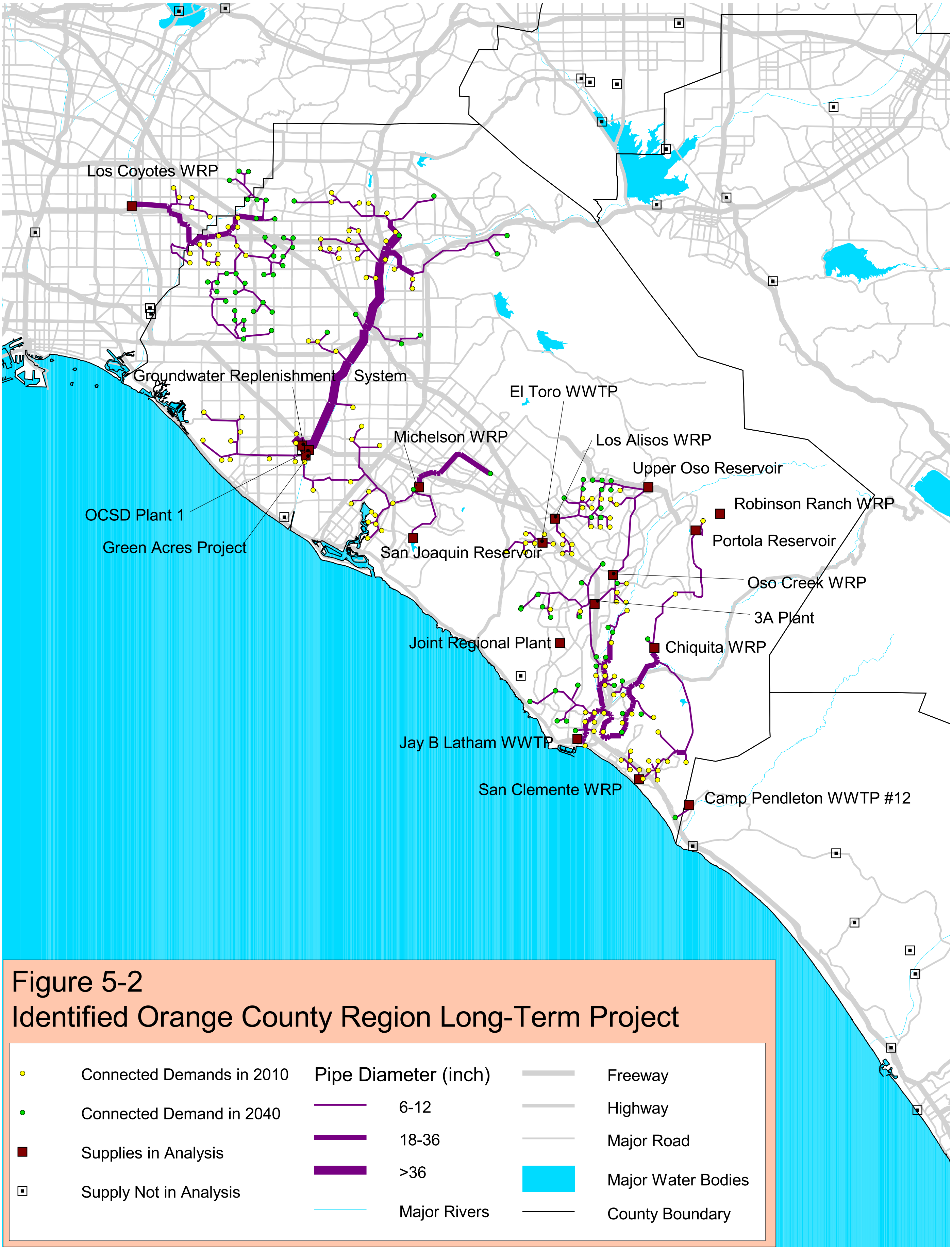


Figure 5-2
Identified Orange County Region Long-Term Project

- Upsizing the trunk line from the GWRS that extends north to the Kramer Basin.
- Upsizing the trunk line from the Jay B. Latham WRP to supply the year 2040 demands of existing and new users.

In addition, the Orange County Region long-term strategy establishes connections between the seven treatment facilities and reservoirs located in south Orange County to create one regional system.

5.3.4.2 Results

The Orange County Region long-term strategy allocates an increment of 52,500 AFY to the existing recycling that is planned by local agencies by 2040. The estimated capital cost for the proposed increment of recycling for 2040 is approximately $519 million and the estimated O&M cost is approximately $29 million per year. The project has an overall positive net benefit.

5.3.5 San Diego Region

The San Diego Region baseline condition was built on the three regional and four single-agency STIPs that are presented in the STIP Report included in Appendix C. The STIPs were expanded by increasing treatment plant capacities to their year 2040 projected levels. The baseline condition for the San Diego Region consisted of reuse from 20 treatment facilities in the United States and four treatment facilities in Mexico. This flow from these facilities was utilized to satisfy approximately 65,200 AFY of new demand.

5.3.5.1 Proposed Project

The long-term analysis for the San Diego Region consisted of connecting new users in the Carlsbad, Escondido, Oceanside, Olivenhain, and Santee areas, as well as users in northern Mexico. Figure 5-3 presents the proposed layout for the San Diego Region.

There are 24 treatment facilities in the San Diego Region, which were projected to supply more than 133 mgd of recycled water in the long-term analysis. Included in the analysis were plant expansions at eight of the treatment facilities in the area.

The long-term analysis also included four treatment facilities located in Mexico. These facilities will have a combined capacity of approximately 12 mgd by the year 2040. The four treatment facilities in Mexico are as follows:

- La Morita
- Lomas de Rosarito
- Monte de Los Olivos
- Tecolate-La Gloria

The entire flow produced at these facilities is utilized to meet demands within Mexico.

In the long-term analysis for the San Diego Region, seven types of reuse were supplied with recycled water. These uses included sensitive and tolerant agricultural irrigation, environmental, groundwater recharge, industrial, landscape, and seawater intrusion barrier. The environmental, groundwater recharge and seawater intrusion barrier sites

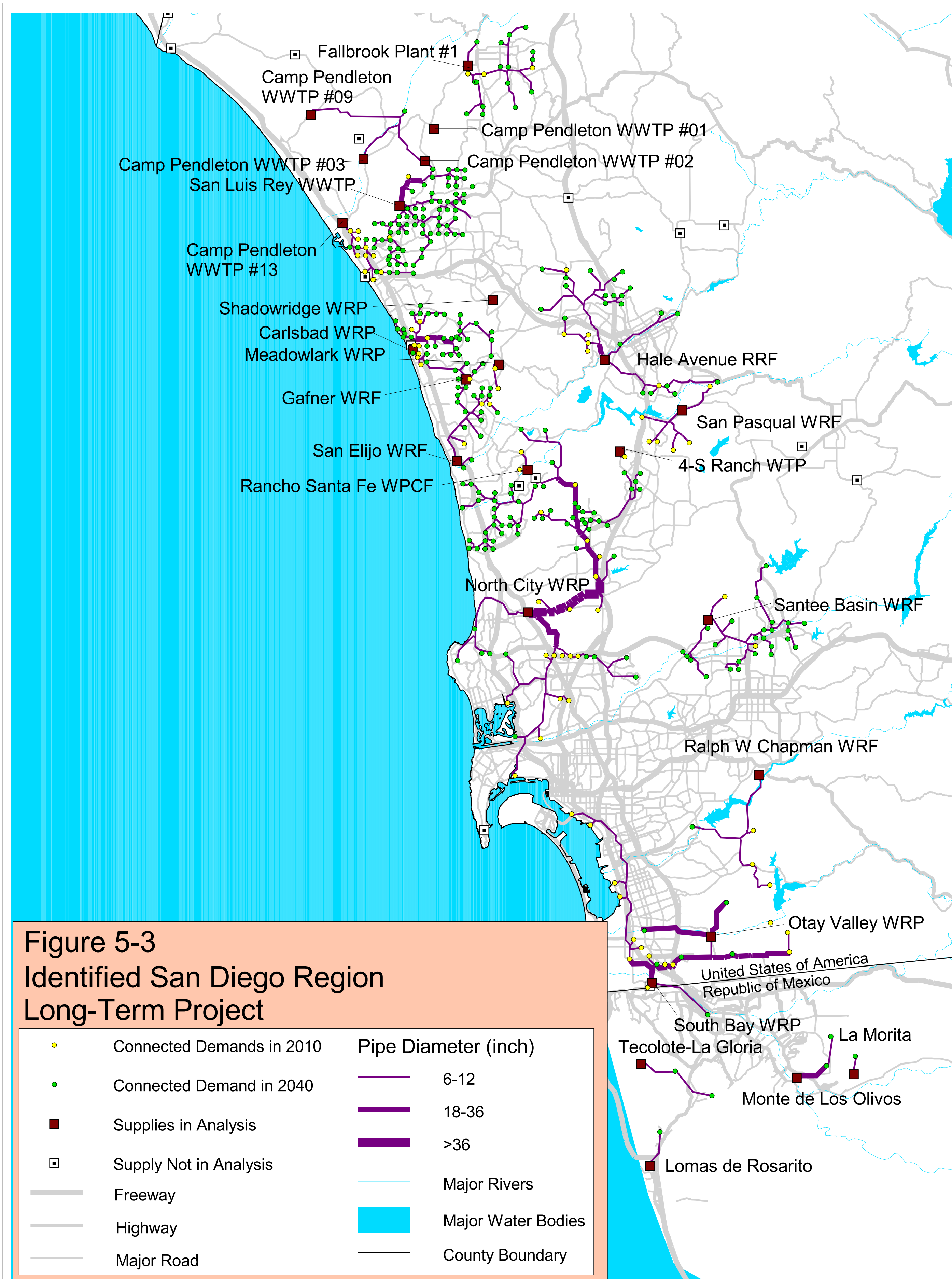


Figure 5-3
Identified San Diego Region Long-Term Project

represent an increase of 14,800 AFY over the proposed volumes in the STIPs. The Demin III Seawater Intrusion Barrier is an additional groundwater recharge site included as part of the 2040 analysis.

Project implementation will require upsizing or realigning three proposed pipeline distribution systems presented in the STIP Report, which include the following:

- Upsizing the trunk lines that are projected to extend north into the Olivenhain Water District area from the existing optimized North City WRP distribution system.
- Upsizing the trunk line of the Carlsbad WRP that extends north from the plant.
- Upsizing of the San Luis Rey WWTP trunk lines.

5.3.5.2 Results

The San Diego Region long-term strategy allocates an increment of 65,200 AFY to the existing recycling that is planned by local agencies by 2040. The estimated capital cost for the proposed increment of recycling for 2040 is approximately $597 million and the estimated O&M cost is approximately $29 million per year. The project has an overall positive net benefit.

5.3.6 Inland Empire Region

The Inland Empire Region baseline condition was built on the three regional and four single-agency STIPs presented in the STIP Report. The STIPs were expanded by increasing treatment plant capacities to their year 2040 projected levels. The Inland Empire Region baseline conditions were evaluated to meet new conventional use demands. The baseline condition in the Inland Empire Region consists of increasing production at 15 of the treatment facilities in the area. This increased quantity of flow is utilized to satisfy approximately 82,200 AFY of new demand.

5.3.6.1 Proposed Project

The long-term analysis for the Inland Empire Region consisted of connecting new users in the Alberhill, Hemet, Rancho Cucamonga, Riverside, San Bernardino, Upland, and Yucaipa areas. The long-term strategy also includes the Chino Basin, Menifee, and Perris Desalters, the Riverside-Colton Conjunctive Use Project, and the Temecula Valley Brineline. Figure 5-4 presents the proposed layout for the Inland Empire Region.

The long-term analysis considered 28 treatment facilities located in the Inland Empire Region. These facilities were projected to supply more than 277 mgd for the long-term analysis. Included in this amount are plant expansions at 15 of the treatment facilities in the area.

Seven types of reuse were supplied with recycled water, including sensitive and tolerant agricultural irrigation, environmental, groundwater recharge, industrial, landscape, and miscellaneous. The groundwater recharge and environmental sites represent an increase of 15,900 AFY over the proposed volumes in the STIPs.

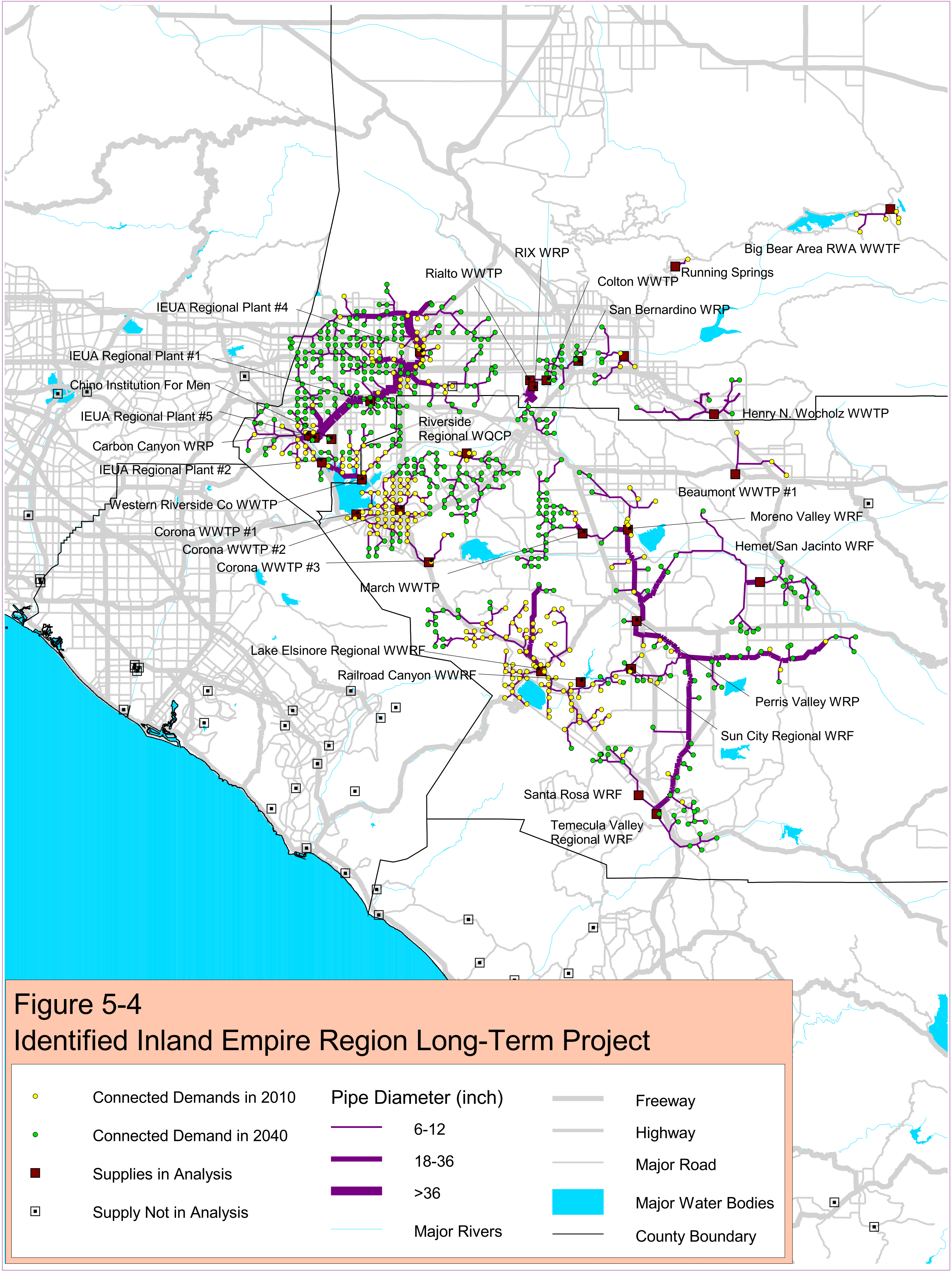


Figure 5-4
Identified Inland Empire Region Long-Term Project

Implementation of this project will require upsizing or realigning several proposed pipeline distribution systems previously presented in the STIPs, which include the following:

- Upsizing the trunk line from the Carbon Canyon WRP extending north to the IEUA Regional Plant #1.
- Upsizing the trunk line from the RIX WRP to the Riverside-Colton Conjunctive Use Site.
- Upsizing the pipeline between the Temecula Valley WRF and the west Hemet area.
- Upsizing the pipeline between IEUA Regional Plant #1 and IEUA Regional Plant #4.

The long-term strategy also incorporates the Chino, Menifee, and Perris desalters, the Riverside-Colton Conjunctive Use Project, as well as the Temecula Valley Brineline. The Chino Desalters will provide 40 mgd of desalination, which will result in an assimilative capacity allowing more recycled water recharge of over 69,600 AFY in the groundwater basin. The Menifee and Perris Desalters will be constructed in the Perris area and will provide 24 mgd of desalination with an assimilative capacity of approximately 42,000 AFY. These desalters will also help offset salt loading in the Eastern MWD service area; however, only 60 percent of the assimilative capacity will be required to offset the projected salinity contribution from recycled water use in the Eastern MWD service area.

In addition to the desalters, the long-term strategy includes the Temecula Valley Brineline, which will connect Temecula Valley with the Temescal Valley Regional Interceptor (TVRI) line. This line will be used to dispose of brine from the Santa Rosa WRP, as well as industrial waste generated by industrial users in the Murietta and Temecula areas.

5.3.6.2 Results

The Inland Empire Region long-term strategy allocates an increment of 82,200 AFY to the existing recycling that is planned by local agencies by 2040. The estimated capital cost for the proposed increment of recycling for 2040 is approximately $547 million and the estimated O&M cost is approximately $42 million per year. The project has an overall positive net benefit.

5.3.6.3 Santa Ana River Analysis

As a part of the long-term analysis of using reclaimed water in the Inland Empire Region, the effects to the flows in the Santa Ana River were examined. Previous studies by SAWPA and the OCWD have been conducted to investigate the impacts on the river flows to Orange County of reclaiming the wastewater discharges of the Inland Empire wastewater treatment plants. Because the flow in the river supplies most of the water that replenishes the Orange County Groundwater Basin, this upstream reclamation is of particular concern to the OCWD. Any reduction in flow, especially during the dry summer months or drought periods, could reduce the amount of available flow for recharge into the groundwater basin. Several treatment facilities are required by legal judgments and interagency agreements to discharge a specified amount of treated effluent flow to satisfy downstream base river flow commitments in the Santa Ana River. The judgments and agreements collectively are referred to as the Prado Settlement, which specifies base flow quantities and quality to the Santa Ana River. The facilities addressed by the Prado Settlement were assumed to continue discharging to the Santa Ana River and, therefore, considered unavailable for allocation as part of the SCCWRRS. Table 5-2 presents the assumed committed flows to the Santa Ana River per the Prado Settlement.

TABLE 5-2
Assumed Committed Flows to Santa Ana River

Treatment Facility	Flow (AFY)
Riverside Regional WQCP	13,420
IEUA Regional Plant #1	16,875
Corona #1	1,430
Colton WWTP (via RIX)	2,450
San Bernardino WRP (via RIX)	16,000
Total	**50,175**

For this analysis, only the total amount of wastewater discharge contributing to the Santa Ana River flow was considered. Natural runoff and/or other contributing flows were not considered. Table 5-3 presents a summary of the wastewater discharges to the Santa Ana River based on the projected recycling of wastewater given the current projected levels of reclamation, as well as the projected levels under the SCCWRRS analyses.

TABLE 5-3
Summary of Wastewater Discharges to Santa Ana River

	Flow (AFY)		
Year	2000	2010	2040
Total Estimated Wastewater Generation	271,000	364,000	684,000
Recycled Water Commitments[1]	68,000	88,000	86,000
Discharge to Santa Ana River	**203,000**	**276,000**	**598,000**
Projected Additional Reclamation[2]	n/a	129,000	210,000
Projected Discharge to Santa Ana River	**203,000**	**147,000**	**388,000**

Footnotes:

[1] Allocated recycled water to existing users, as well as planned allocation increases to these users.

[2] Additional recycled water allocations as a result of the short-term and long-term analyses.

As shown in the table, if the total potential levels of recycling for the short-term projects are achieved, the total treatment facility discharge to the Santa Ana River is projected to decrease, potentially impacting the flow available to Orange County. However, by 2040, these flows would increase due to the expansion of several wastewater plants, even if the projected long-term recycling levels were achieved. The potential for reduced discharges to the Santa Ana River is an issue requiring further examination, because of the water rights issues associated with those discharges. In addition, agreements between Orange County and the upstream dischargers may be required to avoid potential implementation barriers to water recycling projects in the Upper Santa Ana River Watershed area. Figure 5-5 is a graphical presentation of the same analysis, including the discharges to the Santa Ana River that are required by the Prado Settlement.

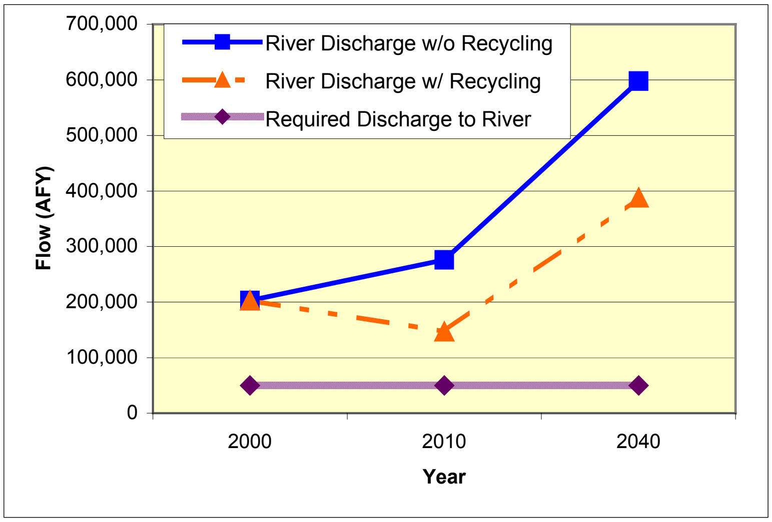


FIGURE 5-5
Summary of Wastewater Discharges to the Santa Ana River

5.4 Opportunities for Additional Recycling

The SCCWRRS analysis examined additional potential opportunities to expand upon the projected level of recycling. These alternatives were compared to the baseline of the Long-Term Recycling Strategy. The alternative analysis consisted of two separate reuse scenarios, as follows:

- Increasing recycled water demand through indirect potable reuse.
- Increasing recycled water supply by reusing supplies with historically high salinity.

5.4.1 Description of the Alternatives Analysis

The long-term alternative analysis consists of expanding the long-term baseline condition by connecting demands and supplies that may not be acceptable or economical for reuse under the current regulatory and technological climate. In the alternative analysis, a visionary approach was taken to evaluate how reuse might be maximized in the future if changes occur in public perception, regulatory constraints, institutional agreements, population growth, and/or water supply issues. Due to the visionary nature of the alternative analysis, it is difficult to project what the future holds with respect to these issues. As a result, determining the quantity as well as the types of reuse that will actually be acceptable in the future is difficult to ascertain. The evaluation of alternatives was prepared to provide insight to the possibilities for maximizing reuse in the future.

The alternative analysis focused on maximizing reuse from two perspectives, as follows:

- Increasing indirect potable reuse by utilizing additional groundwater recharge sites and through the implementation of surface storage augmentation.

- Reusing water from supplies with historically high salinity.

For the groundwater recharge analysis, a number of recharge sites were supplied with recycled water that, in previous analyses, had been excluded from consideration due to their proximity to water supply wells, existing groundwater contamination, or high groundwater levels. The surface storage augmentation analysis consisted of supplying a sampling of reservoirs with recycled water to acquire a representative composite of the cost of implementing surface water augmentation.

For analysis of the supplies with historically high salinity, eight wastewater treatment facilities were examined as potential sources of supply, as follows:

- Encina WPCF
- Hyperion WWTP
- Joint WPCP
- La Salina WWTP
- OCSD Plant 1
- OCSD Plant 2
- Point Loma WWTP
- South Bay Secondary WWTP

These facilities will require additional treatment to meet regulatory requirements due to the high salinity associated with their influent. In addition, these treatment facilities will require treatment plant upgrades to meet Title 22 tertiary treatment standards. For the alternatives analysis, wastewater from the Point Loma WWTP will be reclaimed at an upstream location. The Mission Valley WRP was included in the analysis to reclaim the Point Loma WWTP wastewater. This facility does not exist, but was included in the analysis to project the cost of recycling water from the Point Loma WWTP.

5.4.2 Results of Alternatives Analysis

Figure 5-6 presents the non-quantitative results of the comparison of the long-term baseline with the alternative analyses. The figure is presented qualitatively because of the variable nature of long-term quantitative analyses. Important qualitative generalizations were identified concerning long-term recycling options that serve a useful purpose of informing decision-makers. The figure illustrates that the process of utilizing expensive supplies or connecting additional groundwater recharge sites may significantly increase the yield of a reuse project, potentially without significantly increasing the unit cost in the long term. However, implementation of surface storage augmentation will increase unit costs relatively, while generating larger yields of reuse.

These alternatives offer the potential for increasing the opportunities, but they also face many challenges to implementation, including regulatory, public perception, and institutional issues. In the future, society will need to evaluate these options against alternative water management options to determine quantitatively whether these long-term recycling options are feasible. It is not the intent of this report to address that issue.

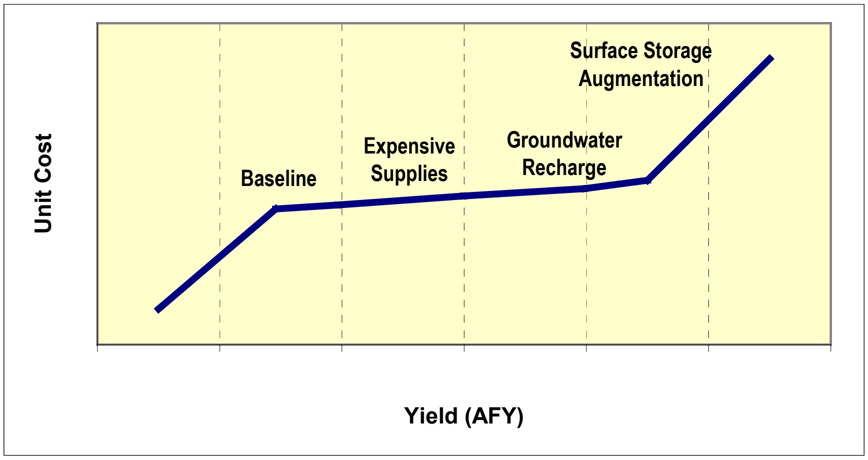


FIGURE 5-6
Comparison of the Baseline and Alternatives Analysis

5.5 Summary

The long-term analysis consists of expanding the STIPs to project long-term regional reclamation systems throughout southern California. Two analyses were performed as part of the long-term strategy: the baseline condition and aggressive but visionary alternatives to increase projected levels of recycling in the future.

The long-term baseline condition was developed first. The baseline condition utilized conventional types of reuse to satisfy recycled water demands out to 2040. The long-term baseline condition projected recycling in 2040 using a regional approach. The second analysis evaluated a strategy of including additional reuse demands and supplies to maximize reuse. The objective of the alternative analysis was to derive a qualitative result of the effects of using recycled water to meet additional reuse demands, as well as the effect of supplying water from sources where production of recycled water is less cost effective in the present economic context. These alternatives would require significant changes in the regulatory, public perception, and water supply reliability in order to have any probability of implementation. Still, the long-term analysis demonstrates that these supplies are available if society is willing to pursue them.

6 Summary

6.1 Contents of this Section

6.2 Introduction

In Phase II, the SCCWRRS built upon the success of local recycling projects by developing an implementable strategy. The Phase II analyses identified a regional strategy that makes use of the four geographic regions: Los Angeles Basin, Orange County, San Diego County, and Inland Empire. Included in the long-term strategy are 34 projects for short-term implementation. The short-term projects encompass opportunities for innovative solutions and will form the framework for future growth. Phase II of SCCWRRS relied on the use of planning tools and facilitated regional PAC dialogue to create a robust decision analysis process. The analysis generated proposed corridors along which recycling could occur and the cost and benefits for the proposed recycled water systems. In addition, the decision-making process aided the process of identification of project sponsors and suggested arrangements to resolve institutional constraints to make projects happen. The process was iterative and eventually yielded both short-term and long-term projects.

6.3 Summary of Analyses

Phase II of the SCCWRRS resulted in the development of projects for short-term implementation, as well as a long-term strategy for regional recycling. The results of the short-term analysis are presented in the STIP Report, presented in Appendix C. The objective of the STIP Report is to use local recycled water project initiatives and incorporate a visionary regional component into them. As a result of the short-term analysis, the PACs identified 34 projects distributed across southern California for short-term implementation, and a STIP was developed for each of the projects. Each proposed STIP includes projected system expansions and improvements, as well as the associated cost estimates to construct, operate and maintain the facilities. In addition, the STIP includes an economic analysis of the proposed project. The total potential yield of the 34 projects is approximately 451,500 AFY with a unit cost ranging from $600 per ac-ft to $700 per ac-ft and an estimated total net benefit of $2.56 billion.

Developing the long-term regional reclamation distribution systems for the long-term analysis consisted of projecting the long-term supply and demand potentially available by the year 2040 and expanding upon the results of the short-term analysis. The planning tools were used to develop the projects that included the short-term results, as well as to estimate the engineering and economic costs and benefits. The total potential demand connected in the long-term analysis is approximately 296,300 AFY. This demand is incremental to the demand that was satisfied in the short-term analysis and the associated net benefit for the long-term projects is positive. The total potential demand satisfied as a result of both the short-term and long-term analyses is approximately 747,800 AFY.

Due to numerous implementation barriers, regional water recycling as defined in the SCCWRRS will not be achieved quickly; however, the benefits of regional recycling are clearly seen in several existing large-scale water recycling projects. During the SCCWRRS, a regional coalition of more than 70 local agencies has been established, and through the direction and guidance of these agencies, various short-term and long-term recycling projects were identified for implementation. The cooperative effort demonstrated by the many participants of SCCWRRS has generated 34 projects for implementation by 2010, as well as the development of a long-term regional recycling strategy for projects through 2040. The short-term projects represent a significant commitment to recycling by southern California water and wastewater agencies. The excitement and motivation of the local agencies for these projects will be demonstrated by their ability to continue as a regional coalition to implement the short-term projects and to identify additional opportunities to expand the use of recycled water. Reclamation supports their efforts to continue that work, and to identify funding opportunities. Reclamation will continue to facilitate the regional partnership to investigate further recycled water projects, and the continuing dialogue and evaluation of the long-term plans.

Appendix A

Engineering Costs and Assumptions

Appendix A
Engineering Costs and Assumptions

A.1 Introduction

The purpose of this appendix is to present the cost criteria and assumptions used in the SCCWRRS. The cost assumptions for treatment, pipelines, pump stations, diurnal storage, and end-user retrofits are discussed, as well as the basis for these costs. These costs and assumptions were developed to estimate proposed concept project costs over the entire study area under as many conditions as possible. However, specific local exceptions or other unusual conditions were not accounted for unless local agencies provided specific cost estimates for project components. The specific agencies that provided cost estimates are discussed in more detail in this report.

Project components consist of the following elements: treatment, pipeline, pumping, diurnal storage, and end-user retrofit. Most of these project components comprise both capital and noncapital (e.g., O&M) costs. As discussed below, the annual O&M costs are converted to a present-worth value, and then added to the capital costs to derive a total present-worth cost for purposes of estimating project unit costs.

Note that the costs and criteria used in this study were developed specifically for use in this study. As discussed below, numerous assumptions and standardization of the data have been made due to the vast size of the study area and the amount of data contained in the geographic information system (GIS) database.

A.1.1 Approach

As a part of the SCCWRRS, a GIS-based model called the ADM has been developed. The ADM was used to create distribution networks and to help allocate and distribute recycled water from supplies to demands. The model consists of numerous arc macro language (AML) files, which run on ARC/INFO software. The model and the accompanying GIS databases are used to develop recycled water distribution networks that maximize reuse in a cost-effective manner under various conditions and assumptions.

Adjustments to the ADM-generated networks are made based on engineering judgement, local agency input, and other factors. Distribution networks are adjusted accordingly and costs are subsequently regenerated in order to derive the final cost estimate for the system. In some cases, the local agency has provided a more detailed cost estimate for a project component. In these cases, the standard cost estimates were replaced with agency-provided costs.

Costs discussed in this appendix do not include any contingencies or nonspecific costs, which are computed subsequent to all of the component costs. Nonspecific costs are applied to each component and are used to account for cost uncertainties in the unit costs, aggressive contracting environment, and missing costs such as land acquisition. An overall project contingency is applied to the sum of all the component costs and is used to provide a high-end range for the estimated costs. This project contingency is used to account for overall project uncertainties such as missing component costs, changes in the recycled water regulations, and excessive permitting or mitigation programs.

The standard costs discussed in this appendix are used in both the ADM and in performing the more detailed analyses outside the ADM. As appropriate, whenever more detailed cost estimates were provided by local agencies, these costs were used in lieu of the standard costs. Presented here are the standard cost assumptions used in the study.

A.1.2 Economic Criteria

To compare the estimated costs for the various alternatives, a baseline economic criterion is required. In this project, all costs are computed on a present-worth basis. This is achieved by computing all O&M costs, equipment replacement costs, and any other future costs to a present-worth value by use of a discount rate.

All present-worth costs are based on cost indices that are measures of the average change in prices over time. For this study, The Engineering News Record's (ENR's) Construction Cost Index (CCI) is used. This index is widely used for studies and estimates of construction projects and is published quarterly in ENR. All costs in this study are based on a CCI of 7,000, which is representative of costs in the southern California area for the year 2000.

The time horizon for economic comparison is 30 years, based on the life of bonds to finance the project. A discount rate of 6.875 percent is assumed based on Reclamation's current evaluation criteria. Annual expenditures, such as O&M, are determined by estimating the costs to operate and maintain a system for one year, and are assumed to increase each year during the study period by the estimated real inflation rate of 2.0 percent.

A.1.3 Treatment Costs

A.1.3.1 Costs

Treatment costs for wastewater reuse are based on the capital and O&M costs necessary to bring each individual treatment plant to Title 22 water-quality standards. These costs include both conventional treatment of wastewater flows and advanced treatment, which can include desalination by RO to meet the requirements for finished water and TDS. The required level of treatment varies for each plant, because the cost is dependent on the required level of treatment for discharge, the existing level and capacity of treatment, and the projected quantity of flow for each treatment plant.

Any necessary upgrades or expansions required to meet minimum discharge conditions are not considered as costs for generating recycled water, because they would be required even without the proposed recycled water concepts. Plants that discharge into the ocean typically require a minimum of secondary treatment, whereas plants that discharge to streams are typically required to treat their effluent to tertiary levels. Several treatment plants have extenuating circumstances beyond these two general rules and have been adjusted accordingly to reflect their specific conditions.

U.S. Environmental Protection Agency (USEPA) irrigation guidelines recommend a TDS level of no more than 1,000 mg/L. In addition, local California recycled water programs have found that most landscape plants and turf can tolerate up to 1,000 mg/L. To account for fluctuations in TDS levels from treatment plants, it is assumed in this study that the cost for treating the water should be based on a more conservative water-quality level. Hence, a TDS level of 900 mg/L was chosen as the maximum TDS level for any treatment plant producing recycled water. In some cases, agencies may have indicated that their current recycled water users were using higher levels of TDS. For those cases, the minimum TDS level of 900 mg/L was not applied.

Although other water-quality parameters determine whether recycled water meets Title 22 conditions, for this study, the TDS levels are used to determine the advanced treatment costs necessary to produce recycled water. TDS levels are selected as the water-quality parameter in determining costs, because it is typically the most expensive parameter to address, and because of the consistent availability of TDS data for both users and suppliers.

In addition to meeting Title 22 requirements, treatment costs are also based on meeting individual-demand treatment requirements, and any BPOs, which are set by the local RWQCBs. Again, TDS was the parameter used to determine the additional water-quality costs for these users based on further advanced or RO treatment. In addition, certain demand types, such as surface storage augmentation and some groundwater recharge applications, require full RO processes. The costs for this additional treatment are calculated in the same manner as for advanced treatment for the treatment plants.

Treatment costs are estimated for those facilities that are not currently planned to maximize their production of Title 22 recycled water. No costs are assigned to those treatment plants where the production of recycled water is equal to the estimated capacity of the plant, nor to those plants where upgrades or expansions are planned during this period. All capital costs for treatment include costs for construction, engineering, planning, and administration of the capital expenditures. Costs for acquisition of additional land are not included, as data on the current site size of the treatment plants was not collected as a part of this study. In cases where the local agencies provided more detailed cost estimates for expansions of their treatment plants, these cost estimates were used in lieu of the general SCCWRRS cost curves. Table A-1 below summarizes the general cost assumptions used for expanding secondary, tertiary, and advanced or RO processes.

TABLE A-1
Phase II Treatment Cost Assumptions

Component	Treatment Process		
	Secondary	**Tertiary**	**Advanced (RO)**
Construction	\$3/gpd capacity	\$1.5/gpd capacity	\$1.5/gpd capacity
Capital Recovery Factor	1.13	1.13	1.13
Engineering/ Administration Factor	1.28	1.28	1.28
Total Capital	\$4.34/gpd capacity	\$2.17/gpd capacity	\$2.17/gpd capacity
Annual O&M	\$0.141/1,000 gpd capacity	$11.9 \times Q_{[AFY]}^{1.2}$	$135.7 \times Q_{[AFY]}^{1.157}$

Notes:

gpd = gallons per day

AFY = acre feet per year

Q = flow

The capital recovery factors are to account for replacing equipment every 20 years, and in cases where the equipment is approximately 50 percent of the total cost. The engineering/administrative factor accounts for all planning, engineering, and administrative costs associated with the capital expenditures.

Costs for the advanced treatment process are based on the amount of TDS that needs to be removed from the effluent flow. Although there are some choices in the type and configuration of available treatment technologies that can reduce TDS levels, for the purposes of this study, the traditional RO process is used to estimate order of magnitude costs. Additionally, future technologies may evolve before 2010, which may make the RO process obsolete. Figure A-1 shows a schematic diagram of the flowstreams involved in the RO treatment process. Note that some water will be lost as concentrate due to the RO treatment. Costs for brine disposal are estimated separately from the treatment costs and are estimated outside of the ADM analysis.

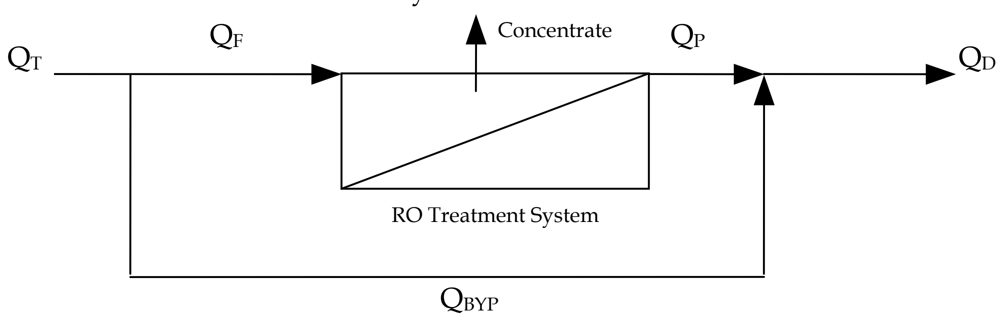


Figure A-1. RO Treatment Process

Where:

- Q_T = Total flow
- Q_F = Feed flow into the RO treatment system
- Q_{BYP} = Flow rate of the bypass
- Q_P = Flow rate of the RO permeate
- Q_D = Total outflow or flow required by the demand

The following calculation is used to determine the size of the RO treatment system and is based on the desired water quantity (Q_D), desired TDS requirement (TDS_D), source's TDS (TDS_S), and an assumed membrane salt passage (R) and membrane loss (L):

$$Q_F = \frac{(TDS_S - TDS_D)}{1 - R - L + (R \times L) \times TDS_S} \cdot Q_D$$

For this study, the membrane loss ratio (L) is assumed to be 20 percent, and the assumed salt passage rate (R) is 10 percent. In cases where agencies supplied specific data on their treatment processes, this data was used in lieu of the SCCWRRS assumptions.

A.1.3.2 Allocation of Supply

In allocating the supply of recycled water from each treatment plant, several factors must be considered including the following: existing and proposed plant capacity, projected flow, commitments, and seasonal peaking factors. In general, the local agencies provided the pertinent information for each treatment plant. However, seasonal peaking factors for the connected users had to be considered when allocating supply from the treatment plant as a part of this study. Peak-season conditions occur when all users, both seasonal and nonseasonal, are operating. Off-peak conditions typically occur during the winter months when only the industrial and other year-round users are still using recycled water.

For this study, it was generally assumed that all groundwater recharge, industrial, agriculture, and environmental users could be operated year-round, and hence require zero to minimal seasonal peaking. Only the landscape irrigation users were assumed to require seasonal peaking of flows, because they tend to require much more flow in the summer months than in the winter months. For the purposes of this study, it was assumed that the peak seasonal flow rate would be 2 times the average annual flow rate, which is equivalent to a user operating only 6 months out of the year. Although this may not be the exact peaking factor for all landscape irrigation users, it is a good approximation of what can occur on a systemwide basis for nonpotable systems. Therefore, supply capacity was allocated from the treatment plants at a rate that was twice the landscape irrigation user's annual average flow. Hence, allocating flow to landscape irrigation users causes treatment plants to have excess flow available in the winter periods, which goes unused unless a local agency has identified any existing seasonal storage facility. Seasonal storage facilities allow for increased peak-season use by storing the excess off-peak flow for use in the peak or summer seasons.

Although groundwater basins can have seasonal variations in recycled water demand due to recharge operations or seasonal storm events, these instances are examined on a case by case basis due to the vast differences from one region to another. Basins identified by the local agencies as being restricted to peak or off-peak periods of recycled water use were treated similar to the landscape irrigation users, or as otherwise necessary, to avoid double-costing of treatment and distribution costs. In addition, adjustments were made to any other users identified by the local agencies as having seasonal use patterns that differ from typical water use patterns. Agricultural users in particular can have demands that vary from area to area and depend on the crop type.

A.1.4 Pipeline Route Costs

While the following sections discuss the details of how the pipeline cost estimates are derived, it is important to remember that the most important results are not the estimated pipelines themselves, but the general routes and configuration of the network. As a regional planning study, it is important to emphasize that the final network, pipeline routes, and pipe sizes are preliminary estimates, which have been derived only to estimates the total system's pipeline costs and show the trunkline routes between the major supplies and demands.

Pipelines are typically sized and built to distribute the maximum flow expected for each reach or segment in the distribution network. In this study, the pipeline costs are based on the accumulated peak flows of the demands that are connected to the supplies.

Costs are calculated by first determining a base cost for each pipe size for a base land use condition. For this study, the rural or barren land condition is used as the base condition. Cost factors for other land uses are then applied to this base cost to derive an approximate pipeline cost for a wide range of conditions that may be encountered in the study area. Lastly, cost factors for elevation changes are applied to account for construction on steep terrain.

The base unit cost estimates and the factors for land use and elevation changes are described in the next section. In addition, the criteria for the sizing of the pipelines are discussed.

A.1.4.1 Base Costs

Costs for pipe sizes ranging from 6 inches to 144 inches in diameter were developed for use in the study. Costs for the pipeline include capital costs and O&M costs. Pumping costs are not included in the pipeline costs, but are accounted for separately (see Section A.1.5). The O&M costs account only for the annual inspection and maintenance of the pipelines within the distribution system. These costs are estimated to be approximately 0.50 percent of the actual construction costs on an annual basis.

The capital costs are estimated for a wide range of conditions that exist in the study area. Costs are developed for trenched pipelines as well as tunneled pipelines. In addition, the numerous types of land use are accounted for in the costs. Also included in the capital costs are the costs associated with the planning, engineering (design), administration, and permitting. These costs are estimated to be 23 percent of the base construction costs, which include all of the necessary appurtenances normally required for pipelines. These costs are calculated as a percentage of the estimated base construction cost of the pipeline.

A base-unit construction cost for each pipe size was estimated assuming a rural or open land-use condition. These costs were compared to the cost estimates of the above-mentioned sources, as well as recent bids from pipeline contractors on local water and recycled water projects. All costs were adjusted to the study's CCI of 7,000 and a rural land-use condition. Adjustments to the original base cost estimate for each pipe size were made based on the compared data to achieve a best fit. Only minimal data for the larger pipe sizes, 60 inches and greater, was available. In addition, the costs for the 6- to 18-inch pipes tend to vary greatly depending on land use and type of pipe. Therefore, the accuracy of these smaller and larger pipe sizes may be less than the middle-range pipe sizes of 24 to 48 inches.

Although the material selected for a pipeline can affect the cost of the pipeline, this factor is not considered due to the uncertainty and range of conditions evaluated in the study. Many pipe types were included in the sources and the bids, and all of these pipe types were included in the comparison. Therefore, the estimated costs tend to represent an average cost of the possible materials for each pipe's size. No land-acquisition costs are included in the base pipeline costs. Table A-2 shows the total capital base costs for the various pipe sizes used in the study.

TABLE A-2
Pipeline Size and Base Costs[1,2]

Diameter (inches)	Roughness Coefficient (C)	Peak Flow Rate (gpm)		Low Flow		High Flow		Total Capital Costs[3] ($/LF)
		Low	High	HL per 1,000 feet	Velocity (fps)	HL per 1,000 feet	Velocity (fps)	
6	120	0	310	0	0	9.9	3.5	57
12	120	310	1,736	0.3	0.9	8.2	4.9	90
18	120	1,736	3,968	1.1	2.2	5.3	5	133
24	120	3,968	7,068	1.3	2.8	3.8	5	176
30	120	7,068	10,975	1.3	3.2	2.9	5	224
36	120	10,975	17,361	1.2	3.5	2.8	5.5	276
48	120	17,361	34,102	0.7	3.1	2.4	6	416
60	120	34,102	62,004	0.8	3.9	2.4	7	585
72	120	62,004	101,376	1	4.9	2.5	8	788
84	120	101,376	138,269	1.2	5.9	2.1	8	1,012
96	120	138,269	180,432	1.1	6.1	1.8	8	1,252
108	120	180,432	228,175	1	6.3	1.6	8	1,513
120	120	228,175	282,118	0.9	6.5	1.4	8	1,789
132	120	282,118	341,022	0.9	6.6	1.2	8	2,076
144	120	341,022	406,126	0.8	6.7	1.1	8	2,375

Notes:
(1) Prices are based on Engineering News Record's CCI of 7,000.
(2) Base pipeline costs are based on a rural land-use condition.
(3) Total capital costs include a base construction cost and an additional 23% to account for planning, engineering, administration, and permitting costs.

fps = feet per second
LF = linear feet
HL = head loss

A.1.4.2 Land-Use Factors

Land use surrounding the pipeline construction corridor has a significant impact on installation costs. Pipeline construction in open country has little or no utility interference or traffic control requirements, whereas construction in urban areas can be significantly complicated by these conditions.

The U.S. EPA published a technical report in 1978 entitled *Construction Costs for Municipal Wastewater Conveyance Systems: 1973-1977,* and then updated this report in 1982. This report includes “cultural modifiers” or multipliers for sanitary sewer construction costs according to various land-use categories. These categories include open country or rural, suburban residential, dense residential, and commercial industrial land uses. CH2M HILL has reviewed the applicability of using these factors to estimate pressure pipe construction costs. Several previous construction projects have been evaluated with these factors. This evaluation indicates that these factors are useful in developing estimates that closely parallel actual bid data and specific cost estimates prepared for pipelines representing these conditions.

For this analysis, a baseline condition is established to represent a multiplier at 1.00. This baseline condition assumes a rural or barren land interface in which minimal land-acquisition costs are incurred. The EPA category multipliers are then normalized to this baseline condition. No land-acquisition costs are included in the urban or built-up land-use categories as it is assumed that the pipelines would generally be constructed within the public street right-of-ways, which would not require any land acquisition.

Because the GIS land uses cover a much wider range of conditions than is covered in the EPA's publications, many of the land-use multipliers have been estimated based on EPA's work and by CH2M HILL construction estimators. Numerous cost estimates and construction bids for applicable conditions were used in developing the land-use multipliers. Some multipliers had to be estimated without comparison to bids, because pipeline construction data was not available for some of the more uncommon land uses in the database.

Table A-3 shows a complete listing of the GIS land-use categories and the associated land-use multiplier. Costs for boring-and-jacking and/or tunneling of pipelines can be extremely varied depending on pipe size and site conditions. An average tunneling cost is assumed for those land uses that would typically require tunneling. Land uses that typically require tunneling include crossing streams, freeways, highways, railroads, rivers, and canals. The multiplier for these is 5.33 as shown in Table A-3.

Rivers, streams, and canals can also be subject to wet conditions. However, since many of the rivers and streams in California are dry for parts of the year, no increase in the tunneling factor is needed as it is assumed that the pipeline would not be constructed during the rainy season. In fact, many rivers and streams may not even require tunneling as the pipe could be constructed in an open trench without diversion of the river. Because of the vast size and varied terrain covered by the rivers and streams database, the average tunneling factor of 5.33 is used for these categories.

Areas where construction of a pipeline is considered extremely impractical, if not impossible, have been given the highest multipliers of 7.50 or 10.00. These areas include airports, wetlands, bays, and estuaries. A high multiplier is used for these areas in an attempt to discourage the ADM from routing the pipeline through these zones.

A factor that is less than the base factor of 1.00 is used for areas that have been deemed to be favorable for construction of recycled water pipelines. Following freeways are favorable construction zones as Caltrans has adopted a statewide policy that supports construction of recycled water systems within their right-of-way. This is due in part to the numerous landscaping areas that Caltrans maintains using recycled water when available. Following rivers, canals, and existing pipelines is also favorable, because the land-acquisition costs can be minimal since these areas tend to be publicly owned lands or relatively open areas with minimal potential conflicts from other utility lines. For these favorable areas, the land-use factor is computed by taking the land-use factor of the adjacent land-use category and multiplying by 0.80. Applying a direct multiplier of 0.80 is not practical, because some of the areas may be in congested sections where no open space exists along these zones.

TABLE A-3
Pipeline Land-Use Cost Factors

Land-Use Factors	
Description/Item	**Norm. to Rural**
Urban/Built-Up Land	
Residential	1.20
Commercial	1.53
Industrial	1.53
Transportation, Communication	1.53
Airports, Transportation Centers	10.00
Mixed/Other Urban	1.35
Agricultural Land (all types)	1.00
Forest and Rangeland (all types)	1.00
Water Bodies	
Wetlands	7.50
Streams and Canals	5.33
Bays and Estuaries	7.50
Lakes & Reservoirs	10.00
Open Space	1.00
Unknown	1.00
Barren Lands	
Dry Salt Flats	1.00
Beaches	5.33
Sandy Areas Other Than Beaches	.75
Bare Exposed Rock and Tundra	7.00
Strip Mines, Quarries, and Gravel Pits	1.20
Transitional Areas	1.20
Mixed Barren Land	1.20

Freeways/Highways/Railroads	
Description/Item	**Norm. to Rural**
Freeways	
To Cross	5.33
To Follow (Factor Times Underlying Land Use)	0.80
To Cross Freeway Interchanges	10.00
Highways	
To Cross	5.33
To Follow (Factor Times Underlying Land Use)	0.80
Railroads	
To Cross Only	5.33

Hydrography	
Description/Item	**Norm. to Rural**
Rivers	
To Cross	5.33
To Follow (Factor Times Underlying Land Use)	0.80
Canals	
To Cross	5.33
To Follow (Factor Times Underlying Land Use)	0.80

Existing Recycled Water Pipelines	
Description/Item	**Norm. to Rural**
Pipelines with No Excess Capacity	0.80
Pipelines with Excess Capacity	0.00

Recycled water pipelines with excess capacity were identified by local agencies. Because these pipelines were previously constructed or will be constructed by 2000, they can be considered as having no cost in conveying future recycled water supplies. Therefore, these pipelines have been given a land-use factor of zero in order to make them free to use as a part of the SCCWRRS.

A.1.4.3 Elevation Factors

Pipelines constructed over steep terrain typically cost more due to construction difficulties. In general, pipeline construction costs increase when ground slopes begin to exceed

10 percent, and costs begin to increase dramatically when slopes exceed 20 percent. Areas with slopes above 40 to 50 percent are usually impractical for pipeline construction, and therefore, extremely high cost factors are applied in order to avoid these areas. Table A-4 shows the pipeline cost factors used for estimating costs in steep terrain areas.

TABLE A-4
Pipeline Slope Cost Factors

Degree of Slope	Cost Factor
0-10	1.00
10-20	1.15
20-30	1.50
30-40	2.00
40-50	6.00
50-60	10.00
60 and above	20.00

A.1.4.4 Pipeline Sizing

In order to determine the size of pipe required, a pipe size-flow range table has been established. In this table, the minimum and maximum allowable flows for each pipe size are determined based on the peak flow rate. Table A-2 shows the pipe sizes and the maximum and minimum peak flow rates allowed for each pipe size.

Peak flow rates are based on peaking of demands on a daily basis over an entire system. Some diurnal storage is also assumed to either exist already, or is estimated as a part of the analysis (discussed later in this appendix). For this study, only the landscape irrigation users are peaked because all other user types can typically use water throughout the day, or use water in coordination with a local water purveyor's water-supply program designed to minimize peak flows in the system. For landscape irrigation users, a daily peaking factor of 2.5 times the average annual flow is assumed on a systemwide basis in determining the pipe size. This value is not the same, nor is it used in the same manner, as the seasonal peaking factor.

The pipe sizes are calculated using the Hazen-Williams Formula. Although the type of pipe can affect the friction coefficient for a pipeline, a "C" value of 120 is used for all pipelines because this is the typical value used to size most pipelines.

The sizing of pressure pipelines is based on a combination of head loss (friction) and maximum velocity. A high head-loss rate means that extra pumping would be required. For this study, a maximum head loss of 10 feet per 1,000 feet of pipe is considered acceptable for sizing the pipes. Only the 6-inch pipe is controlled by this head-loss criterion. Pipes smaller than 6 inches are not considered for this study.

Velocities in the smaller pipes are usually kept to a maximum of 5 fps in order to limit forces and pressures on the pipes. As shown in Table A-2, the maximum flow allowed in pipe sizes of 12 to 30 inches is controlled by the 5.0-fps maximum velocity. For pipes sized between 30 and 60 inches, the velocity is allowed to gradually increase from 5 to 8 fps. For pipes larger than 60 inches, it is usually standard to allow the maximum velocity to go as high as 8 fps.

Table A-2 shows the range of flows allowed for each pipe size is based on either the velocity or the head-loss criteria. Although the table lists the minimum flow for each pipe size, in reality, it is possible for less flow to pass through the pipes.

A.1.5 Pumping Costs

In determining the pump station and pumping costs, several sources were investigated. These included studies or cost-estimating guides by the Metropolitan Water District of Southern California (MWDSC), City of Los Angeles, City of San Diego, U.S. EPA, Reclamation, and various CH2M HILL projects. Cost curves and cost tables from these sources were adjusted to the CCI for this study of 7,000. These costs were then compared to various construction bids for the pump stations listed in those sources.

While some sources established pump station cost curves based on total flow only, others considered both total flow and total head in the form of horsepower (hp). For this study, consideration of hp is deemed more appropriate given the wide range of possible scenarios for which the pumping costs are being estimated.

Although the number and type of pump stations can affect the cost of the pump station, these factors are not considered in the pump cost due to the uncertainties and range of possible conditions. Pumping costs are generated in two fashions for this study. The ADM is able to estimate pumping costs for an entire system by accumulating the total required hp and using the cost formula described below. When a distribution system has elevation changes that would cause the system pressure to drop below the minimum working pressure necessary to convey and serve reclaimed water to customers, then a booster pump station becomes necessary. The pump costs and locations are then reconfigured manually to account for the need for booster pump stations. The minimum pressure necessary in a system will vary depending on the type of users connected to the system.

Main pump stations are located at all of the treatment plants producing recycled water. Booster pump stations are located along the trunk pipelines downstream of the main pumps in the approximate areas where the elevation changes would cause the pressure to be less than the required minimum.

Costs for both main and booster pump stations are estimated by determining the maximum hp required at each station. The hp required is based on the total flow through the pump station and the maximum head needed at each pump station.

Unless local agencies indicate otherwise, it is assumed that all pump stations will be new, and that there are no existing facilities available for use that would otherwise reduce the capital costs. Land-acquisition costs for pump stations are not included in the cost estimate, because many treatment plants already have adequate space for additional or new pump stations, and because land-acquisition costs can vary dramatically from area to area. These costs are accounted for in the nonspecific costs as discussed earlier.

A.1.5.1 Capital Costs

All capital cost estimates for pump stations include costs for construction, engineering, planning, and administration of the capital expenditures. Engineering, planning, and administrative costs are estimated to be approximately 15 percent of the total construction cost. As discussed above, costs for acquisition of additional land are not included. The following equation was derived based on the above-mentioned sources for the construction cost of a pump station:

Capital cost = $\$24{,}600 \times hp_{peak}^{\;0.68}$

Where:

hp_{peak} = peak brake horsepower (all users on at the same time)

$$= \frac{Q_{peak}[gpm] \times \left(\Delta Elev + h_{Lpeak} + P_O\right)}{3956} \times \frac{1}{Efficiency}$$

Where:

Efficiency = 75 percent (wire to water)

$\Delta Elev + h_{L\text{-}peak} + P_O$ = total head in pipeline segment (feet)

P_O = Initial or boosting pressure

$h_{L\text{-}peak}$= friction loss under peak flow rate along pipeline based on Hazen-Williams Formula

$$= \frac{10.44 \times L \times \left(\dfrac{Q_{peak}[AFY]}{1.6128}\right)^{1.85}}{C^{1.85} \times Diam[in]^{4.8655}}$$

Where:

L = Length of pipeline in feet

C = 120 (Hazen-Williams Coefficient for friction)

Diam = the pipe diameter in inches based on the peak flow rate

The pressure in the pipelines connecting to treatment plants (P_O) is typically set to 70 pounds per square inch (psi), because this is an average or midrange operating pressure for most water distribution systems. Typical irrigation demands require an operating pressure of approximately 50 psi, while industrial and other user types may require the same pressure that they currently receive from potable distribution systems. These pressures can vary depending on the system, but the maximum limit is usually about 100 psi. This initial operation pressure is established at all pipes connecting to the treatment plant. The boosting pressure for booster pumps will vary according to the elevation change in the system and the required minimum head for the users on the system.

A.1.5.2 O&M Costs

O&M costs include labor, equipment replacement, and electrical power usage. Annual expenditures for labor and equipment replacement are based on the initial construction cost of the pump station. The following equation is used to estimate the annual O&M labor and equipment replacement costs (O&M$_{LE}$) for each pump station:

Annual O&M$_{LE}$ = $10,000 + 5 percent of construction costs

Electrical costs for pumping are estimated by applying the average flow for the network over a 24-hour period of operation. Normally, the cost for power would be determined by estimating the average flows over specific periods of the day as the cost of electricity varies throughout the day. Use of an average flow method is more appropriate in this study due to the vast size of the data, as well as the numerous users in the database who would receive water during nonpeak hours.

Many of the demands are landscaping areas where water is applied during the night hours when electrical rates are lower. In addition, some demands, like surface reservoirs, groundwater basins, and large industrial users, would receive water on a continuous basis throughout the day. Because most of the landscape irrigation and agricultural users tend to be seasonal users and are expected to operate only about 6 months of the year, electrical costs for pumping are computed under two separate operating conditions, peak and off-peak. Under the peak condition, it is assumed that all users will be using recycled water for 6 months, and electrical pumping costs are computed on that basis. Under the off-peak condition, which occurs during the other 6 months, the electrical pumping costs for only nonseasonal users are computed. Because the flows in the system will differ in each 6-month period, the total system hp required for each condition must be computed separately. Electrical costs for each 6-month condition are computed by using the following annualized equations, which are prorated for the 6-month period:

Assumed cost for electricity = $0.10/kilowatt-hour

Annual electrical cost = $\$0.10 \times hp_{ave} \times 24hrs \times Time \times 0.7457 \dfrac{kw-hr}{hp}$

Where:

Time = 6 months

hp$_{ave}$ = the average brake horsepower

$$= \frac{Q_{avg}[gpm] \times \left(\Delta Elev + h_{L-avg} + P_O\right)}{3956} \times \frac{1}{Efficiency}$$

$$= \frac{Q_{avg}[AFY]/1.6128 \times (\Delta Elev + h_{L-avg} + P_O)}{3956} \times \frac{1}{0.75}$$

Where:

Q_{avg} = average flow

H_{L-avg} = friction loss along pipeline based on Hazen-Williams formula

A.1.6 Diurnal Storage Costs

Diurnal storage costs are applied to irrigation users, such as parks, golf courses, and urban irrigators. Agricultural users are assumed to have their own storage systems or that they can operate their systems to avoid storage requirements. Storage tanks were assumed to be aboveground steel tanks, which provide storage for fluctuations in daily flow, not seasonal variations. Seasonal storage may be used to supplement the available summer supply and meet additional summer irrigation demand. Specific seasonal storage costs are estimated separately, as needed, and do not have any set rules or cost curves.

Storage tanks are sized for half of the maximum day irrigation demand, and are based on the assumption that half of the peak flow will need to be stored over half a day. The flow is assumed to be released over the peak half of the day in order to satisfy the daily peak demands. Construction costs are based on a unit cost of $0.50 per gallon of storage. Engineering, planning, and administrative costs are estimated to be approximately 15 percent of the total construction cost. Total capital costs are based on the following formula:

$$\text{Capital cost} = 1.15 \times \$0.50 \times Q_{peak}\left(afy\right) \times 892.8\left(\frac{gpd}{afy}\right) \times \frac{1}{2}\,day$$

Annual O&M costs for diurnal storage tanks are assumed to be 0.5 percent of construction costs.

A.1.7 End-User Retrofit Costs

End-user retrofit costs are for facilities and infrastructure at the user's end, which are necessary in order for the user to connect and be supplied with recycled water. Most landscape irrigation and industrial users require some sort of retrofitting in order to isolate the potable and nonpotable water systems. Other user types, such as groundwater recharge and agricultural users, can also require retrofitting when installing a recycled water system. However, this is usually not typical because many groundwater recharge basins and agricultural users use raw water as a supply source, and therefore, little or no retrofitting would be required in switching to or supplementing with recycled water. In the few cases where retrofits are known to be needed for these other user types, local agencies have provided the retrofit costs.

Retrofit costs can vary widely depending on the potable water system configuration and the size of the demand. Based on several recycled water retrofit projects, an average construction cost of $1,000 per acre-foot per year was derived for this study. Engineering and administrative fees are estimated to be approximately 25 percent of the construction costs, which brings the total unit capital cost to $1,250 per acre-foot per year. O&M costs are assumed to be zero, because these costs are typically borne by the customer and would be no different than O&M costs for the potable water system.

Appendix B

Economic Methods, Structure, Data, and Assumptions

Appendix B
Economic Methods, Structure, Data, and Assumptions

B.1 Introduction

The SCCWRRS has developed economic analysis methods and tools to assess the costs and benefits of the various project scenarios under consideration in this STIP Report. The main economic tool is the EDM, which is a spreadsheet-based calculation engine that enacts methods of cost-benefit and cost-effectiveness analysis that are tailored to southern California's recycled water and reuse investments. This appendix summarizes the methods, structure, data, and assumptions used in the EDM as a part of the economic analysis.

This appendix is separated into the following sections:

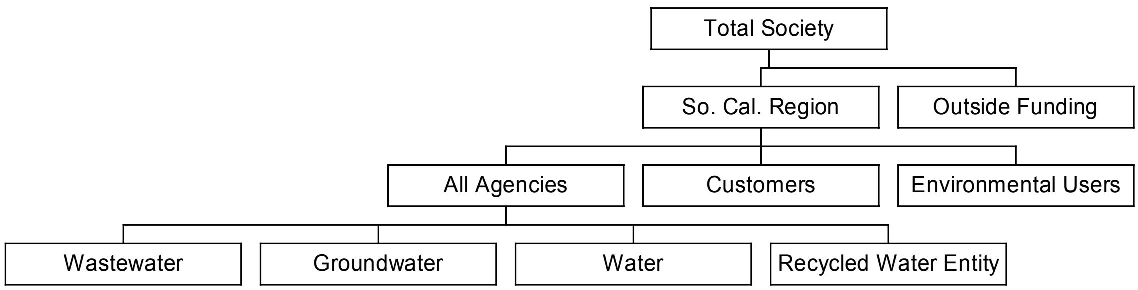
- Introduction
- Terminology
- Approach
- Identified Costs and Benefits
- Assumptions Common to All Scenarios
- Area-Specific Assumptions

B.2 Terminology

When analyzing water recycling projects it is important to distinguish *resource* costs and benefits from *revenue* costs and benefits. An example of a resource cost is the cost of building the treatment plant—to build the plant, one must give up concrete, steel, and hours of labor. An example of a revenue cost is a payment made by customers to the wastewater agency that is providing the recycled water—this revenue cost is an exchange of money between customer and agency, rather than giving up resources such as concrete, steel, and labor. The important reason to distinguish "resource" from "revenue" costs and benefits is that it prevents double counting when costs or benefits are summed from different agency and customer perspectives to get the total costs or benefits faced by society as a whole.

As a part of this study, different *perspectives of analysis* are investigated when considering a recycled water project (see Figure B-1). Important perspectives include those of the wastewater agency, water agency, customers, the southern California region, and total society as a whole. A breakdown of the pertinent entities within the economic structure is discussed in the next section. When evaluating agency and customer perspectives, a cost in one perspective may be a benefit in the other. For example, payments made by customers to the wastewater agency are costs to the customer and benefits to the wastewater agency. However, from the total society perspective (or southern California) this payment nets to zero because the cost (a revenue cost) is exactly equal and opposite to the benefit (a revenue benefit). From the total society perspective, no resources (concrete, steel, hours of labor) are gained or lost as a result of revenue flows, so when costs and benefits are summed from different agencies and customers, only resource costs and benefits are summed, not revenue costs and benefits. Revenue costs and benefits are included when considering an agency or customer perspective.

FIGURE B-1
Economic Perspectives



Sometimes there is not a clearly established rule or convention regarding whether an item should be categorized as a cost or a benefit of a recycled water project. Should the avoided costs of fresh water supply due to recycling be considered a negative cost (avoided cost) or a positive benefit? When calculating *net present value* (NPV = Benefits – Costs) as a decision criterion, it does not matter whether the avoided water supply costs are categorized as a cost or a benefit of recycling; the NPV result will be the same. However, the use of a benefit-cost ratio can clearly be influenced by the categorization as a cost or a benefit. For this reason, the analysis focuses on NPV for evaluations. Any comparison of project alternatives using *cost-effectiveness* as decision criterion (expressed as cost per acre-foot or cost per million gallons) should be conducted on the basis of net costs for the same reason. In this study, the cost-effectiveness calculations are solely based on the resource costs to the total society. To avoid possible confusion, explicit and consistently applied categories of costs and benefits are defined. For example, the convention is that avoided water supply costs are categorized as a benefit of water recycling.

The general *inflation rate* is the general rate of growth in prices. The inflation rate is distinguished from the *real growth rate* in that real growth is the growth in costs or benefits after adjusting for inflation. If a stream of costs or benefits is the same from year to year other than the effect of inflation, then such costs or benefits experience a real growth rate of zero percent. Costs or benefits may grow in real terms (increase more than inflation) because additional real resources are involved or because of increasing scarcity. For example, the cost of future water supplies in many locations in California is expected to increase in real terms, because new sources of water are expected to require more expensive facilities than those constructed in the past because lower-cost water sources are already exploited.

The *interest rate* is the cost of capital to finance the recycled water project. Different agencies may face somewhat different costs of capital, but in the age of global capital markets, agencies of similar financial condition and risk profile should face similar interest rates. Customer interest rates are generally higher. Interest rates can be expressed in real or nominal terms, depending on whether they have been adjusted for inflation.

A *discount rate* is a measure of how a customer, agency, or total society values costs and benefits that occur at different periods in time. Generally, one values costs and benefits more highly if they occur sooner rather than later. One would rather receive a dollar today rather than in 10 years because if one receives the dollar today, it can be invested and grow to be more than a dollar in 10 years (even after adjusting for inflation). Discount rates depend on the other opportunities available to each of the respective perspectives. The most common way to choose the discount rate for an agency is to look at its cost of capital, which is a reflection of the capital markets it faces, and thus, the opportunities for investment other than water recycling. Total society discount rates are most often selected by considering projected interest rates on long-term government bonds. Frequently, a higher discount rate is selected for customers because they often demonstrate shorter-term preferences (e.g., high credit card interest rates for residential customers or corporate "hurdle" rates for business customers).

In the analysis, a distinction is made between treatment plant (POTW) capacity, recycled water project capacity, and reclamation project yield. POTW capacity is the total capacity at the wastewater facility that could potentially be recycled—the maximum recycled water potential. In contrast, the *recycled water project capacity* is the capacity of the particular recycling project being evaluated in a decision analysis; often the project capacity will be only a portion of the POTW capacity. The *reclamation project yield* is the actual recycled water that is produced and sold by the recycled water project.

One particular type of benefit will arise when a recycled water project allows agencies to avoid spending for alternative supplies or projects. The economic analysis is constructed to recognize these "avoided cost" benefits where they are appropriate. Where these are included, they should be identified as the costs that would need to be incurred if the project does not go forward, but will no longer be required if the project is implemented. Examples of such "avoidable" costs are detailed below:

- A water agency may avoid variable, pumping and/or treatment costs if it can reduce its need for water supplies from existing sources. Fixed costs associated with existing sources cannot generally be reduced, and so should not be included as avoided costs.
- If a water agency is considering new supply sources or is facing a treatment plant constraint, a recycled water project may allow it to reduce both the fixed and variable costs associated with those planned new investments. Where new fixed costs can be reduced, these should be included in the avoided cost estimate.
- A wastewater agency may use a recycled water project to enable it to avoid other projects, such as the construction of additional ocean outfalls, or implementation of source reduction programs. Where these projects are made unnecessary by the recycled water project, the costs of those projects are avoided, and should be included as benefits in the analysis.

B.3 Approach

B.3.1 Institutional Structure and Assumptions

The economic analysis is designed with a particular default institutional structure that reflects the majority of recycled water projects to date. The default institutional structure has the following participants:

1. **Recycled Water Entity.** The recycled water entity is a placeholder institutional arrangement that represents the agency, agencies, or joint-powers agreement that will finance and operate the water-recycling project. It also sells the water to water agencies at a wholesale rate. By defining the recycled water entity by project, the analysis structure allows for evaluation of the regional costs of the project.

2. **Wastewater Agencies.** If the recycled water project is being undertaken to meet a mandatory regulation, the wastewater agency will also have avoided costs from the least-costly alternative way to comply with the regulation. Lack of regulatory compliance is not considered a viable alternative.

3. **Water Agencies.** Water agencies may lose revenues associated with end-use sales. They may also reduce their water supply costs by that level of costs that are avoidable. However, most often the water agency will sell the recycled water to the customer, after buying it from the recycled water entity. Recycled water may be priced at a discount to fresh water.

4. **Customers.** The customers pay for any plumbing modifications that are required onsite, and in return get the decrease in water bills if the recycled water is priced at a discount to fresh water.

5. **Southern California Region and Total Society**. These aggregate perspectives of analysis (see Figure B-1) allow the analysis to generate results that speak to regional- and national-level decision-makers involved in policy and planning.

This default institutional arrangement is not the only, or necessarily the best, arrangement that could be developed. Instead, the results in the summary page of the EDM allow the user to see where the costs and benefits flow under this institutional arrangement. Where costs and benefits are not well matched, the institutional arrangements in the model can be altered to improve the distribution of costs and benefits.

B.3.2 Purpose of the EDM

An important advantage of the approach taken in the economic model is that it provides a means of making consistent quantitative comparisons between costs and benefits. The cost-benefit analysis method requires "apples to apples" comparisons that account for inflation, real growth, different interest rates faced by agencies, and different discount rates for total society, agencies, and customers. Examples of the costs of building a water-recycling project include the equipment, materials, and labor needed to construct plants and pipelines. Examples of benefits from building a recycled water project include improved stream flows due to reduced water diversion and avoided costs of new water supply acquisitions or wastewater disposal programs.

A key goal of the recycled water and reuse program is to find regional water recycling projects that might not be apparent because of local concerns or institutional barriers. One agency might not want to risk the loss of drought-year fresh water supply due to "use it or lose it" contract provisions. Cost-effective pairs of recycled water producers and customers might be separated by duplication of service rules. Agencies might be reluctant to invest in recycled water if customer demand is highly uncertain; the question then becomes, "If you build it, will they come?" The economic model can help determine the economic value of lowering these institutional barriers. Perhaps more important, the EDM sets the stage for future negotiations regarding financial arrangements that could be beneficial to all of the participants in a proposed project.

In the approach to the EDM, efforts have been made to provide transparency to the reader of text and spreadsheet files. All of the data files are organized by substantive category and there are no hidden data fields or assumptions. Likewise, the EDM provides the user a range of automatic tools to analyze the uncertainty in data values that are used so that the reader can assess not only the result, but also the sensitivity of the result to different assumptions and data inputs. The EDM provides extensive graphical results that assist in understanding the uncertainties involved in such inputs as the project costs, discount rates, and avoided costs.

B.4 Identified Costs and Benefits

Table B-1 summarizes the costs and benefits identified for each of the perspectives as part of the SCCWRRS analyses. The first column indicates the perspective of analysis, and the second and third columns identify the costs and benefits to those perspectives. Note that each of the identified costs or benefits is defined as a "resource" (Res) or "revenue" (Rev) cost or benefit. When looking at the total society and regional perspectives, only the resource costs and benefits are summed in order to avoid double counting of transfer payments.

The costs to the southern California region are the sum of the resource costs to all of the agency, customer, and environmental perspectives in the region. The capital portion includes capital not covered by grants. Capital costs are financed with subsidized interest rates, should such a loan exist from other funding sources. Likewise, the benefits to the southern California region are the sum of the resource benefits to all of the agency, customer, and environmental perspectives in the region.

The costs to the total society are the same as for the southern California regional perspectives, except the full cost of capital projects, including grants and interest rate subsidies, are included. Likewise, the benefits to the total society are the same as for the southern California region. If there are resource benefits outside the region, these should be included as well.

In the next two sections, the general and specific assumptions for each area are discussed in detail. Assumptions about the breakdown of costs and benefits between the different entities and the specific values assumed are presented.

Table B-1
Identifying Costs and Benefits for Perspectives of Analysis

Perspective	Costs	Benefits
Total Society	* Treatment Capital Costs (Res) * Pipeline Capital Costs (Res) * O&M Costs (Res) * On-Site Capital Costs (Res) * On-Site O&M Costs (Res) (Capital is complete cost, including State/Fed grant) (Capital costs financed with full interest rate)	* Avoided Costs of Supply (Res) * Salvage Value of Plants and Pipes (Res) * Reduced Wastewater Discharge Costs (Res) * Environmental Benefits (Res)
Southern California Regional Perspective	* Treatment Capital Costs (Res) * Pipeline Capital Costs (Res) * O&M Costs (Res) * On-Site Capital Costs (Res) * On-Site O&M Costs (Res) (Capital is portion not covered by State/Fed grant) (Cap. financed with low State/Fed interest rate, if available)	* Avoided Costs of Supply (Res) * Salvage Value of Plants and Pipes (Res) * Reduced Wastewater Discharge Costs (Res) * Environmental Benefits (Res)
All Agencies	* Treatment Capital Costs (Res) * Pipeline Capital Costs (Res) * O&M Costs (Res) * Revenue Impacts from Reduction in Fresh W Sales (Rev) (Capital is portion not covered by State/Fed grant) (Cap. financed with low State/Fed interest rate, if available)	* Avoided Costs of Supply (Res) * Salvage Value of Plants and Pipes (Res) * Reduced Wastewater Discharge Costs (Res) * Avoided Supply Purchase from Wholsalers (Rev)
Water Recycling Entity	* Treatment Capital Costs (Res) * Pipeline Capital Costs (Res) * O&M Costs (Res) (Capital and O&M is portion not covered by State/Fed grant) (Cap. financed with low State/Fed interest rate, if available)	* Revenue from RW Sales (Rev) * Salvage Value of Plants and Pipes (Res)
Wholesaler	* Revenue Impact from Reduction in Fresh W Sales to Intermediate Wholesaler (Rev)	* Avoided Costs of Supply (Res)
Intermediate Wholesaler	* Revenue Impact from Reduction in Fresh W Sales to Retailer (Rev)	* Avoided Supply Purchase from Wholesaler (Rev)
Retail Water Agencies	* Revenue Impact from Reduction in Fresh W Sales (Rev)	* Avoided Supply Purchase from Intermediate Wholsaler (Rev)
Waste Water Agencies		* Reduced Wastewater Discharge Costs (Res)
Groundwater Agency	* Purchase Price of Reclaimed Recharge Water (Rev)	* Avoided Purchase of Fresh Recharge Water (Rev)
Customers	* On-Site Capital Costs (Res) * On-Site O&M Costs (Res)	* RW Price Discount (Rev)
Environmental Uses	* On-Site Capital Costs (Res) * On-Site O&M Costs (Res)	* Environmental Benefits (Res)

Footnotes:

"Res" indicates resource cost or benefit

"Rev" indicates revenue cost or benefit

WH = wholesale agency, W = water agency, C = customer, WW = wastewater agency, GW = groundwater agency

B.5 Assumptions Common to All Scenarios

B.5.1 General Assumptions

The following assumptions are common to all of the scenarios in the analyses:

- General inflation rate: 2 percent
- Real (inflation adjusted) growth in recycled water project construction costs: 0 percent
- Discount Rate: 6.875 percent (nominal)
- Period of analysis: 30 years
- Finance Period: 30 years
- Construction takes place in 2009; operation begins in 2010
- Environmental benefits (and costs) will be analyzed by an environmental assessment team at another point in the SCCWRRS process. This phase of the analysis does not include the valuation of environmental benefits in dollar terms.

B.5.2 Recycled Water Entity

As previously discussed, the Recycled Water Entity is the institution that bears the costs of construction and operation of the recycled water project, and it receives revenues from the sale of recycled water. The analysis uses this institutional arrangement assumption for the planning phase of the SCCWRRS project. For the later feasibility phase, when the financial arrangements will be considered explicitly, this institutional arrangement can be modified to reflect the financing alternatives under consideration.

The capital and O&M costs of the project, which are incurred by the Recycled Water Entity, are generated as a part of the feasibility analysis. The project team has coordinated to ensure that feasibility analysis results are consistent in assumptions with those used in the economic analysis.

One important assumption in developing the project costs is the issue of lagging development or non-development of the actual projects or markets. Lagging development refers to the amount of time between the start of capital expenditures on a project to the actual final build-out of that project. Recycled water projects can often take 8 to 10 years to fully subscribe all of its users onto the system, and any potential cost for this lag time has not been accounted for in this analysis. In addition, some capital avoided costs associated with a recycled water project will typically require that all, or at least a major portion of, the projected demands be connected to the system. The recycled water purveyor, as well as the agency bearing the avoided costs, assumes the capital risk associated with the failure to fully develop the recycled system.

Another important cost assumption is to use the feasibility analysis' "middle of the road" estimates, rather than a conservative figure with projectwide contingency. The base-case engineering cost analysis includes an item by item nonspecific cost category, which in most cases is 20 percent of the item cost estimate. For example, the treatment facility construction will have an additional 20 percent estimated cost from items that are not accounted for as a line item in the cost analysis. The base analysis also includes a 25-percent projectwide contingency cost estimate to represent a financially conservative figure. For the analysis, the 25-percent projectwide contingency is not included; instead, the "middle of the road" estimates that include item and nonspecific costs are used. The uncertainty analysis includes the capability to test cost assumptions, plus or minus, over any specified range.

Salvage value is accounted for as a resource benefit from the perspective of the Recycled Water Entity. The method calculates the salvage value for plants and pipes with a useful life span that is greater than the period of analysis. The life span assumption is that plants last 40 years and that pipes last 60 years. The salvage value of these assets at the end of the period of analysis is calculated using straight-line depreciation as is required under state financing procedures. Salvage value can be readily calculated using other depreciation methods (such as double declining balance) by changing a spreadsheet setting.

B.5.3 MWDSC Wholesale Water Rates and Avoided Supply Costs

Table B-2 presents the wholesale water rates of the MWDSC for the period from fiscal year 1991 to 2000. Historically, MWDSC has used geographically uniform rates. MWDSC's networked water delivery system is interconnected within its service area. A policy for separating the cost of wheeling water within the region and establishing appropriate charges is expected to be developed in the next year.

Table B-2
Trends In MWDSC Wholesale Water Rates: 1991-1999 (Dollars per Acre-Foot)

Type of Service		Fiscal Year							
		91-92	92-93	93-94	94-95	95-96	96-97	97-98	98-99
Full Service (noninterruptible)	Untreated	222	269	318	335	344	344/ 349	349	349
	Treated	261	322	385	412	426	426/ 431	431	431
Interruptible	Untreated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Treated	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Interim Agricultural Program	Untreated	N/A	N/A	205	222	231	236	236	236
	Treated	N/A	N/A	248	275	289	294	294	294
Long Term Seasonal Storage Service	Untreated	130	168	208	222	229	229/ 233	233	233
	Treated	154	203	253	275	286	286/ 290	290	290
Shift Seasonal Storage Service	Untreated	130	168	208	222	229	229/ 233	233/ 244	244/ 255
	Treated	154	203	253	275	286	286/ 290	290/ 301	301/ 312
Reclaimed		84	84	113	113	113	113	113	113

Footnotes:

(4/1/91) Interruptible discount eliminated.

(5/1/94) Interim Agricultural Water Program implemented.

From fiscal years 1990 to 1996, the price of noninterruptible service increased each year, leveling off thereafter. Interruptible service was discontinued in 1991 and replaced by a new class of service, seasonal storage. In 1998, the level of seasonal storage service was further refined to distinguish long-term (year to year) and shift (within year) storage service.

The assumed projected rate for basic treated water is $492 per ac-ft in 2010, increasing by 2 percent in real terms each year thereafter ($292 per ac-ft for seasonal untreated). These rates are the basis for the revenue cost to the regional wholesaler when fresh water supply is avoided by recycling and reuse. These rates are also the basis for the revenue benefits for retail agencies who may avoid wholesale fresh water purchases.

The wholesaler (MWDSC) faces revenue costs from the reduction in sales of fresh water. The assumption is that the revenue impact is equal to the MWDSC's projected rates as described above.

The wholesaler is assumed to accrue the resource benefits from avoided supply. The assumption is that in 2010, the avoided supply costs will be $600 per ac-ft, with the high-cost transfers projected to increase approximately 2 percent per year in real terms thereafter. In addition, there is a $150 per ac-ft benefit in avoided distribution and treatment costs that include costs at the local distribution level.

B.5.4 Intermediate Level Wholesalers

In the PAC areas with intermediate level wholesalers, the default institutional arrangement is that they face revenue loss from fresh water sales to retailers and an offsetting revenue benefit in terms of reduced wholesale purchases from MWDSC. These revenue losses vary by agency and depend on each agency's intermediate wholesale water rate.

B.5.5 Retail Water Agencies and Customers

The revenue impact from the reduction in fresh water sales on retail water agencies depends on projected retail water rates and on the institutional structure and financial arrangements. With the default institutional structure, the retail water rates have impacts on the retail water agency, the customer, and the recycled water entity. The retail water agency loses revenue from retail sales, and at the same time saves the revenue cost of purchasing wholesale water. The difference between the two is the net revenue impact. The customer may accrue a revenue benefit if the price of recycled water is discounted compared to fresh water. The Recycled Water Entity, if assumed to sell the recycled water, receives the sales revenues.

These assumptions allow us to compare the cost of the recycled water project to the revenues it will generate. However, the financial arrangements that will be negotiated after the current planning phase might be considerably different. The model structure provides the means to assess different financial arrangements in the future.

The following customer categories are assumed to purchase treated water:

- Landscape
- Industrial
- Parks
- Vineyards
- POTW
- Miscellaneous

The following customer categories are assumed to purchase untreated water:

- Agriculture-Sensitive
- Agriculture-Tolerant
- Reservoir Augmentation
- Groundwater Recharge
- Seawater Intrusion Barrier

In actuality, seawater intrusion barrier projects typically use treated water for injection. This would increase the avoided costs compared to using the untreated water costs. The use of treated or untreated water typically depends on the proximity of untreated supply sources and the necessity of avoiding fouling during operation. However, the use of off-season water supplies as a source for injection water would lower the avoided costs on a project. Therefore, for purposes of this analysis, the lower bound avoided cost of the untreated water is assumed for all intrusion barrier projects. If treated water is needed for a project, then the avoided costs, and hence the overall net benefits, would increase accordingly.

Retrofit costs for customers are estimated as a part of the overall project costs (see Appendix A). Revenue benefits accrue due to the assumed price discount for recycled water (10 percent discount to fresh water). The environmental user's capital costs are also estimated as a part of the overall project costs. Since this water is not actually sold, there are no revenue benefits.

B.5.6 Wastewater Agencies and Avoided Wastewater Costs

A potentially important category of benefits is derived from the ability of wastewater agencies to avoid treatment or disposal costs through water recycling and reuse. Two important examples have been identified so far as potential avoided treatment and disposal costs from water recycling: (a) ocean outfall capacity, and (b) total maximum daily load (TMDL) surface water regulations. Water recycling may reduce the need to expand ocean outfall capacity now or in the future by reducing the volume of discharge flow. Regarding TMDLs, if these regulations become very stringent, they may require expensive treatment measures for stream discharge, such as RO following tertiary treatment. Water recycling may provide a less costly means to reduce mass emissions, and thereby avoid such costs.

Before further describing the avoided wastewater discharge costs, one needs to address the key uncertainties in this category of potential benefits. The uncertainty in outfall capacity is driven by uncertainty in the rate of growth in the service area and the uncertainty in construction costs. In the case of the TMDL regulations, the uncertainty is driven by the fact that the additional regulations are expected in the future, and it is not clear what form they will take. How stringent will they be? Will they focus on mass emissions or concentration limits? These regulatory questions determine the cost of those regulations and thus the potential avoided cost of recycled water.

Generally, when identifying the costs and benefits of water recycling, costs and benefits of the project must be compared to the "no-project" alternative—that is, what would happen without the SCCWRRS project?

The case of TMDL regulations is a good example of uncertainty in the "no-project" alternative. Will the regulatory regime be more or less stringent? What will be the cost of complying with the regulations in each case? When defining the avoided costs of wastewater discharge that might result from the SCCWRRS recycled water project, an understanding of the wastewater discharge costs that would be required with the no-project alternative is needed as a base of comparison.

Example: A sanitation district discharges wastewater into surface streams and is now required to treat 50 percent primary and 50 percent secondary. Although it is speculative at this time, it may be that future regulations will require all stream dischargers to have secondary treatment. The no-project alternative, thus, may take one of two forms: the status quo 50/50-primary/secondary treatment, or 100 percent secondary treatment. What difference does this make in the avoided costs of the SCCWRRS recycled water project?

If the no-project alternative is the status quo 50/50-primary/secondary treatment, then the costs of the recycled water project include:

- Cost of plant, pipes, and O&M for the recycled water project

The benefits include:

- Avoided supply costs of imported water
- Reduced contaminant discharge by going from 50/50-primary/secondary to recycled water treatment (environmental benefit)

If the no-project is the 100 percent treatment regulatory regime, then the cost of the recycled water project includes:

- Cost of plant, pipes, and O&M for the recycled water project

The benefits include:

- Avoided supply costs of imported water
- Reduced contaminant discharge by going from 100 percent secondary to recycled water treatment (environmental benefit)
- Avoided cost of treating 50 percent to full secondary

In order to address the uncertainty in avoided costs for all the treatment plants in the study region, wastewater plants are grouped into categories depending on whether they discharge to ocean outfalls or to streams.

Each of these discharge categories is assigned a range of avoided costs representing the assumptions for high, medium, and low scenarios. In the case of stream dischargers who are likely to be subject to TMDL regulations, the range from low to high represents the range of possible regulatory stringency and impact on treatment plants. For example, stringent regulations that are costly to comply with imply high avoided costs. The standard, assumed avoided costs for the high, medium, and low scenarios for each of the discharge categories are as follows:

Ocean:	Low $0	Medium $10.90	High $21.81
Stream:	Low $0	Medium $10.00	High $200.00

For ocean discharges, the avoided costs include the cost of pumping at $11 per ac-ft for the medium level and twice that cost for the high level. For stream discharge, the recycled water project can avoid approximately $10 per ac-ft in defoaming and dechlorination costs at the medium level; at the high level is the potential for required TMDL objectives that could require RO treatment. The assumptions applied to each of the categories are built on the information gathered from the wastewater agencies and from engineering analysis. Additional avoided costs are presented in the scenario-specific description below.

B.6 Area-Specific Assumptions

B.6.1 Orange County

Orange County retail water rates are projected based on the Orange County Survey of retail water rates. The unweighted average was $604 per ac-ft in 1997, increasing by 1 percent per year. Untreated rates are assumed to be 75 percent of treated.

For the Orange County analyses, in addition to the blanket avoided wastewater disposal costs described above (outfall pumping or stream defoaming and dechlorination), there is the potential for the recycled water project to avoid construction of a new outfall pipeline. Construction of the GWRS facility would help to avoid the need for the OCSD to construct a second outfall for the OCSD Plant No. 1. In the future, the OCSD's existing outfall will not be able to handle peak flow storm events. The proposed GWRS facility will take 100 mgd of water from OCSD Plant 1. This will help save $150 million in construction costs for the second outfall. The treated recycled water would be sent back upstream to the Kraemer Basin and/or discharged into the Santa Ana River. This option is still being considered by the OCWD and the OCSD.

In addition, because of the outdated technology employed at Water Factory 21, the GWRS will save $60 million in construction costs that would be needed to rebuild the plant and $120 per ac-ft in operating costs. Water Factory 21 has a capacity of approximately 15 mgd.

B.6.2 San Diego

San Diego's projected retail water rates are developed from the San Diego survey of retail water rates, and were estimated to be $653 per ac-ft ($544 per ac-ft untreated) in 1998 by adding the MWDSC basic treated rate to SDCWA and retailer markups ($80 and $140 respectively). Retailer markups range from 2 to 7 percent until 2009, and 2 percent thereafter.

Avoided wastewater disposal costs include the outfall pumping and stream discharge benefits described above for all service areas. In addition, the Encina WPCF has some avoided costs due to the proposed construction of the first phase (4 mgd) of the Carlsbad WRP, which will be further treating effluent from the Encina WPCF for distribution into a reclaimed water system. A downsizing of some necessary future flow equalization ponds at the Encina WPCF will result in approximately $2 million in avoided costs. In addition, approximately $2 million in avoided potable water pipeline construction costs will occur as a result of implementing the Carlsbad WRP system. The estimated avoided wastewater costs have been prorated based on the ultimate projected capacity of the Carlsbad WRP (12 mgd). Therefore, the actual net benefits of the ultimate system may increase as these additional avoided costs are realized.

Another treatment plant with some additional avoided wastewater capital costs is the City of Escondido's Hale Avenue RRF. The City of San Diego estimates that it would save approximately $25 million in costs at the Hale Avenue RRF if an industrial brineline were constructed as a part of the proposed San Pasqual WRP project. This brineline would help to divert industrial discharge from the Hale Avenue plant. The City of San Diego would therefore avoid treatment charges for its flow to the Hale Avenue RRF, and would help to decrease the need to expand the Hale Avenue plant. In addition, the effluent quality of the Hale Avenue RRF plant would increase.

B.6.3 Mexico

As a part of the proposed 2010 concept projects, the City of San Diego is serving recycled water to demands in Mexico. For the City of San Diego, the recycled water is from wastewater flow that would otherwise go to the ocean. The city does not avoid fresh water supply costs by producing and selling this recycled water because it does not offset the city's demands. The conceptual framework to address this issue is described below.

A conceptual answer can be found by considering perspectives of analysis. From the city's perspective, the benefit of sales to Mexico is the revenue derived from those sales and some avoided ocean outfall pumping costs.

From the regional perspective, the analysis needs to first clearly delineate the region. The delineated regional perspective is southern California. Should Mexico be included? This is really a question at the policy level: What should the region and the regional decision-makers consider? The model should reflect the policy decision rather than vice versa. The analysis delineates the regional perspective to include Mexico, because: (a) it is consistent with regional decision-makers' viewpoints, and (b) it is more responsive to international diplomatic concerns. With this approach, the avoided water supply costs do indeed accrue to the region. The analysis would need to determine the avoided supply cost of the displaced Mexican supply or make assumptions and test for sensitivity. For the total society perspective, the case is stronger to include the avoided water supply costs for Mexico.

Note that for the SCCWRRS analysis, the focus is on the regional and total society perspectives. The agency and customer perspectives ensure the identification and accounting of all of the salient costs and benefits. This approach also sets the stage for later analyses that involve the financial considerations of the stakeholders. When considering the agency perspective, the avoided water supply costs would not likely be a benefit to the City of San Diego, but it would be relevant to the Mexican water supply entity.

B.6.4 Los Angeles/Ventura

The water rates of the LADWP are used as the benchmark in Los Angeles County. The forecasts of Los Angeles retail rates follow discussions with the LADWP finance department and are projected to be $1184 per ac-ft in 2010.

Avoided wastewater disposal costs include the outfall pumping and stream discharge benefits described above for all service areas. In addition, the Tapia plant is under an order for zero discharge during part of the year. The Las Virgenes MWD is currently considering several options to address this issue. Among the disposal options that reduce the discharge to zero and have more than adequate volume given season to season variations, the "Hidden Hills and Calabasas (Los Angeles Basin)" is the highest ranked economically (lowest cost). This option has an estimated capital cost of $2.5 million and no additional O&M costs (see Kennedy/Jenks Consultants report entitled *Creek Discharge Avoidance Study*, prepared for Las Virgenes MWD, August 1999). Only the "Mulwood Service Area" disposal option is less expensive; however, this option only supports a flow of 150 AFY, which would not completely eliminate all of the creek discharge.

Also, the City of Los Angeles is under an agreement with the Los Angeles RWQCB to implement a reclamation program to avoid expansion of their Terminal Island outfall. The agreement calls for Los Angeles County DPW to implement reclamation in three phases: 5

mgd (initial), 12 mgd, and 22 mgd (ultimate). The agreement stipulated that the LADWP would proceed with the first 5 mgd phase, and then other facilities would be constructed, as they proved feasible. For this analysis, the total estimated avoided construction cost ($50 million) of this outfall is prorated down based on the amount of reclamation being proposed in this STIP.

The oil refineries in the West Basin STIP also have some additional avoided water supply costs that are included in this analysis. Since the refineries require a nearly ultrapure water supply, their avoided water supply cost is much higher than other users. The West Basin MWD has estimated that this avoided water supply cost is around $1,000 per ac-ft.

B.6.5 Inland Empire

The Eastern MWD is used as the benchmark for water retail rates in the Inland Empire. The forecasts of retail rates are projected to be $546 per ac-ft in 2010. Avoided wastewater disposal costs include outfall pumping and stream discharge benefits described above for all service areas.

In addition, the U.S. Fish and Wildlife Service (USFWS) charges a mitigation fee of $62,700 per cfs for wastewater discharges reaching Prado Dam. This applies during habitat conservation season only, March 1 to Aug 31. No one yet has been charged, but potentially all flow above Prado Dam is applicable.

Appendix C

Short-Term Implementation Plan Report