Attachment 8

Economic Analysis – Water Supply and Water Quality Benefits

San Diego Integrated Regional Water Management Grant Application

PIN 13105

San Diego Region Implementation Grant Proposal
ATTACHMENT 8:
Economic Analysis – Water Supply and Water Quality Benefits

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INTRODUCTION

Attachment 8 identifies the high value of the water supply and water quality benefits, either quantitatively or qualitatively, for each of the projects included in this proposal. The projects described are:

Conservation Program
- Work Item #1: Implementation of Integrated Landscape and Agriculture Efficiency Programs
- Work Item #2: Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration
- Work Item #3: Over-Irrigation/Bacteria Reduction

Water Recycling Program
- Work Item #4: Santee Water Reclamation Facility Expansion Project
- Work Item #5: Recycled Water Retrofit Assistance
- Work Item #6: City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse / Reservoir Augmentation Project

Local Supply Protection and Development Program
- Work Item #7: San Vicente Reservoir Source Water Protection through Watershed Property Acquisition and Restoration
- Work Item #8: El Capitan Reservoir Watershed Acquisition Program and Restoration
- Work Item #9: Northern San Diego County Invasive Non-Native Species Control Program
- Work Item #10: Santa Margarita Conjunctive Use
- Work Item #11: Carlsbad Desalination Local Conveyance
- Work Item #12: San Diego Region Four Reservoir Intertie Project Conceptual Design
- Work Item #13: South San Diego County Water Supply Strategy
- Work Item #14: El Monte Valley Groundwater Recharge and River Restoration Project, Phases 1 and 2

Education and Outreach Program
- Work Item #15: San Diego Regional Pollution Prevention
- Work Item #16: Biofiltration Wetland Creation and Education Program
- Work Item #17: San Dieguito Watershed Management Plan Implementation
- Work Item #18: San Diego River Watershed Management Plan Implementation
- Work Item #19: City of San Diego Green Mall Porous Paving and Infiltration
- Work Item #20: Chollas Creek Runoff Reduction and Groundwater Recharge Project

As will be seen in the remainder of this Attachment, each of the projects is shown to be beneficial to the local area, Region, and State. Table A summarizes the monetized costs and benefits for each of the proposal's projects. The individual project costs as compared to the individual project benefits demonstrates the economic feasibility of each project as well as the overall proposal economic feasibility.

Table A Monetized Benefits of Proposal Work Items

Project	Requested Grant Funding	Present Value of Costs	Present Value of Monetized Water Supply & Quality Benefits	Present Value of Other Monetized Benefits	Total Present Value of Monetized Benefits
Work Item #1: Implementation of Integrated Landscape and Agriculture Efficiency Programs	$2,083,505	$4,898,882	$10,335,748	Not readily monetizable	$10,335,748
Work Item #2: Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration	$1,122,680	$1,226,524	$519,771	Not readily monetizable	$519,771
Work Item #3: Over-Irrigation/Bacteria Reduction	$231,959	$301,998	$3,964,855	Not readily monetizable	$3,964,855
Work Item #4: Santee Water Reclamation Facility Expansion Project	$3,092,784	$35,985,809	$17,453,759	$12,202,502	$29,656,261
Work Item #5: Recycled Water Retrofit Assistance	$824,742	$1,388,867	$16,089,992	$12,202,502	$28,292,494
Work Item #6: City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse / Reservoir Augmentation Project	$3,427,835	$11,300,467	$28,749,230	Not readily monetizable	$28,749,230
Work Item #7: San Vicente Reservoir Source Water Protection through Watershed Property Acquisition and Restoration	$1,160,962	$1,040,693	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #8: El Capitan Reservoir Watershed Acquisition and Restoration Program	$934,987	$1,061,048	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #9: Northern San Diego County Invasive Non-Native Species Control Program	$1,056,285	$2,478,441	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #10: Santa Margarita Conjunctive Use	$2,642,337	$182,011,788	$113,227,243	Not readily monetizable	$113,227,243
Work Item #11: Carlsbad Desalination Local Conveyance	$2,191,890	$92,365,369	$164,839,280	Not readily monetizable	$164,839,280
Work Item #12: San Diego Region Four Reservoir Intertie Project	$782,948	$2,540,735	$2,254,949	$3,038,247	$5,293,195

Project	Requested Grant Funding	Present Value of Costs	Present Value of Monetized Water Supply & Quality Benefits	Present Value of Other Monetized Benefits	Total Present Value of Monetized Benefits
Conceptual Design					
Work Item #13: South San Diego County Water Supply Strategy	$313,667	$1,079,524	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #14: El Monte Valley Groundwater Recharge and River Restoration Project, Phases 1 and 2	$2,617,956	$48,163,983	$32,485,866	$16,332,024	$48,817,890
Work Item #15: San Diego Regional Pollution Prevention	$721,649	$682,436	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #16: Biofiltration Wetland Creation and Education Program	$721,649	$1,200,609	$6,221,460	Not readily monetizable	$6,221,460
Work Item #17: San Dieguito Watershed Management Plan Implementation	$92,784	$85,960	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #18: San Diego River Watershed San Dieguito Watershed Management Plan Implementation	$103,093	$99,635	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #19: City of San Diego Green Mall Porous Paving and Infiltration	$257,732	$458,640	Not readily monetizable	Not readily monetizable	Not readily monetizable
Work Item #20: Chollas Creek Runoff Reduction and Groundwater Recharge Project	$618,557	$659,862	Not readily monetizable	Not readily monetizable	Not readily monetizable
PROPOSAL TOTAL	***$25,000,000***	***$389,031,268***	***$402,960,267***	***$31,572,773***	***$434,533,040***

This Attachment begins with a discussion on the current state of the water supply in the San Diego Region and a discussion of avoided water supply costs that will establish the 'With-Out Proposal' conditions. Following that, each of the proposed projects will be analyzed for water supply and water quality benefits.

REGIONAL WATER SUPPLY AND WATER QUALITY BACKGROUND

The San Diego Region (Region) comprises eleven parallel and similar hydrologic units that discharge to coastal bays, estuaries, or lagoons. The Region has limited local water and unreliable quantities of precipitation, and has historically depended largely on water imported from Northern California rivers, the Bay Delta, and the Colorado River for 60 years. Development of local water supply opportunities is an important step in reducing the Region's reliance on imported water supplies and increasing water supply reliability.

The San Diego Water Authority is the sole imported water wholesale agency within the Region, and all major water agencies within the San Diego Region are members of the Water Authority. Depending on hydrologic conditions, imported water supplied by the Water Authority typically comprises 70 to 90 percent of the Region's water supply, with water conservation, local surface waters, groundwater, and recycled water comprising the remaining 10 to 30 percent of supply. One of the most significant issues for the Region is the availability and reliability of its imported water supplies. The State Water Project (SWP) is the major source of imported supply followed by water from the Colorado Aqueduct. Recent legal decisions to protect the endangered Delta smelt have drastically reduced the amount of Delta pumping that can be conducted, cutting back on the volume of SWP water that can be delivered. This situation, coupled with the recent droughts affecting both the SWP and the Colorado Aqueduct and further reducing available supplies, serves as a reminder that the Region's water supply is vulnerable to events outside the Region. The Region faces a critical need for improved local supplies, and local water agencies have identified the need to increase local supplies as a key element in meeting future regional water demands.

Absent increased conservation efforts as well as cultivation of local surface water, groundwater, and recycled water supplies, the Region will continue to be vulnerable to unreliable imported supplies, and will continue to suffer the economic consequences of additional cutbacks in imported supplies. This trend of will continue until the Region develops reliable local supplies.

In addition to water supply, water quality is a major challenge facing the Region. The Regional Board has identified over 40 inland surface waters and 35 coastal waters or beach segments in the Region as not complying with applicable water quality standards. Primary water quality constituents of concern for the Region's surface waters include coliform bacteria, sediment, nutrients, salinity, metals, and toxic organic compounds. The Regional Board has completed Total Daily Maximum Loads (TMDLs) for several of these non-complying waters, and has initiated TMDLs for a number of additional impaired waters.

Avoided Cost of Imported Water

Importing water is the most reasonable alternative supply for the Region, but and without project implementation, the Region will continue to rely on imported water to meet the vast majority of its demands. Water produced by conservation, reuse, and other "local sources" will offset the need to use imported waters, which would largely be derived from the SWP and Colorado River Aqueduct (CRA), as wholesaled to SDCWA by the Metropolitan Water District of Southern California (MWD).[1] The value of adding new local supplies can be estimated based on the costs avoided by reducing local demands for imported water. This assumes that expanding local desalinated capacity beyond levels already anticipated would be more expensive than increasing imports, at the margin.[2]

[1] SDCWA also provides imported water from the Imperial Irrigation District (IID) water transfer and canal lining projects. For this analysis, we do not consider offsetting imports from IID. IID water is more expensive waters than comparable (raw) MWD imported water ($584/AF, compared to MWD Tier 1 water at $515/AF, in 2008). This implies that our estimated cost savings for avoided MWD imports is likely to be conservative (i.e., at the lower end of what is likely to be experienced for the whole portfolio). Canal lining projects produce a relatively fixed amount of water (i.e., there is a maximum quantity of water that can be saved by lining the canals), so changes in future quantities delivered are not generally relevant to this analysis.

[2] If imported water is not readily available at the levels necessary in the future to meet local demand, then the avoided water supply costs would need to be estimated based on the projected cost of expanded future use (i.e., more than currently planned) "local" desalination.

The cost savings arising from reducing demands for imported water should be estimated based on the projected future cost of imports, at the margin. This in turn requires a projection of the cost of providing additional imported water, at the levels needed in the future if local resources are not expanded as envisioned in the regional plan. The key empirical question for valuation is thus, "What is the future cost, at the margin, of acquiring another AF of imported MWD (or other imported) water, and having it delivered (and treated, where applicable) to the users of the local supply alternatives?"[3]

The water supply benefits of local water resource development and conservation projects are typically characterized according to the avoided costs of obtaining the added yields from the least expensive of the other viable supply options. For the San Diego region, these avoided water supply costs pertain to imported water, as furnished to the Region by MWD (or, via local desalination, if that were to become less expensive than the imports). Treatment and distribution costs also need to be factored into the cost of avoided imported water, because the local options typically include the cost of delivering treated water to the relevant users.

SDCWA projected M&I rates, presented in the following table, provide a sound basis for beginning the exercise of estimating the avoided cost of imported water.[4]

	SDCWA pre-Delta Ruling Forecast, Using Untreated Tier 1 MWD Rate in Melded Rate						
	2008	2009	2010	2011	2012	2013	2014
Customer Service Charge	24	26	28	33	37	41	39
Storage Charge	41	42	59	68	88	97	119
Transportation Rate	60	63	59	69	62	68	71
Untreated Melded M&I Rate	390	428	462	492	513	533	551
Melded Treatment Rate	164	170	177	184	209	212	218
Total	679	729	785	846	909	951	998
2006 Real Price	*$640*	*$667*	*$697*	*$730*	*$761*	*$773*	*$788*

However, these rate projections do not account for several relevant factors, and they pre-date the Bay-Delta court ruling and subsequent MWD signals that imported water prices were likely escalate faster than originally anticipated. Accordingly, we have developed two scenarios for making relatively modest adjustments to the SDCWA forecasted rates, one which assumes higher near-term escalation of projected MWD Tier 1 rates, and one which assumes local water resources offset Tier 2 MWD water, at the margin (rather than Tier 1).

The original SDCWA projections (above) indicate real rate of $667 per AF for 2009, but this rate is likely to be lower than will actually materialize, given developments evident since October 2007 (predominantly, the federal court ruling foreshadowing significant reductions in SWP extractions of Bay-Delta water). Our alternative projections suggest $680/AF in 2009 if higher MWD Tier 1 rate escalations are assumed, or $726/AF if a Tier 2 water is assumed as the marginal offset. For the purposes of this analysis, is has been assumed that projected imported water costs avoided, at the margin, are equal to the average of the results of the two scenarios developed as updates to the original, pre-Delta ruling SDCWA projections. These projections are shown in the following table, which portrays forecast rates in 2006 real terms, for 2008 through 2014, based on the average of the two scenarios developed here (both of which are built primarily upon original SDCWA projections, and updated per the discussion provided above). For 2015 and years beyond, we apply a real cost increase of 2.5% annually for avoided imports at the margin.[5]

[3] Cost of treatment and delivery need to be included in the avoided imported water costs, to provide a suitable "apples-to-apples" comparison of imported water costs to the local supplies. This is because the costs used in these analyses for local supplies are generally inclusive of treatment and delivery.

[4] San Diego County Water Authority, Adopted Operating Multiyear Budget, Fiscal Years 2007-2008 and 2008-2009, Section 1 page 68: Water Authority Rates and Charges on a Per-Acre-Foot Basis Calendar Years 2004-2014 M&I Rates. http://www.sdcwa.org/about/financial-operatingbudget.phtml

[5] SDCWA's original (pre-October 2007 Delta ruling) projected nominal rate increases over 6 yrs (2009 through 2014 projected, inclusive) is 147%, which is an average annual nominal rate of over 6.6%. Assuming (per State instructions) a 3% real annual rate

Averaged Projected Costs (in 2006 real dollars)										
2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
$668	*$703*	*$751*	*$786*	*$829*	*$855*	*$886*	*$908*	*$931*	*$954*	*$978*

On net, the avoided costs presented in this Attachment are considered to be conservative projections, meaning that we believe it is more likely than not that actual imported water costs, at the margin, may be higher than the levels derived here. The key factors that drive this belief include the following:

- the Authority's rate projections appear to be driven by normal years, whereas in dry years (which may occur more frequently than in the past), the demands for imports increase and upward pressure of prices escalate,
- at the margin, and especially in dry years (but also conceivably in normal ones), offset supplies may need to reflect Tier 2 water rather than Tier 1 water,
- the Tier 2-based scenario applies projected Tier 2 rates that do not account for the MWD price bump anticipated after the Bay Delta ruling,
- the Tier 1-based scenario only escalates MWD supply charges by 50% above the prior projection, and only for two years (whereas the price impact could be larger and/or of longer duration), and
- if imported waters become as scarce as is conceivable, then prices will escalate faster and local desalination (which appears to cost on the order of between $900 to $1000 per AF, and perhaps higher for delivery) may become the least expensive alternative.[6]

Thus, on net, we would expect rates seen in the future are more likely than not to exceed rates used here. Additional information on the methodology and justification for these adjusted rates can be found in Appendix 8-1.

Project Synergies

Several of the projects included in this Proposal are linked, and the coordinated implementation of each project is critical to the success of the Proposal as a whole. The Proposal has been crafted to maximize the linkages and integration between the projects within the Proposal, and projects included in the Proposal have been selected based on their ability to generate multiple benefits.

A prime example of the linkages and interdependencies within this Proposal is found between the Santee WRF Expansion Project (Work Item # 4) and the El Monte Groundwater Recharge and River Restoration Project, Phases 1 and 2 (Work Item # 14). The two projects are directly linked. The recycled water that will be used to recharge the El Monte basin will be made available through expansion of tertiary treatment capacity at the Santee WRF. The scheduling of these projects has been closely coordinated to ensure that each project can meet its individual objectives while at the same time maximizing the value of the recycled water resource that will become available.

Due to the strong integration of these projects, the benefits need to be estimated in an aggregate manner for the joint project. Then, a suitable share of the aggregate benefits can be apportioned to each individual project component based on its respective share of the aggregate cost. That is the approach used in this analysis.

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of increase in general, then SDCWA water costs will rise at a real annual rate of 3.6% above the average real rate. To be conservative in the out years of 2015 and beyond, we reduce this 3.6% real increase to 2.5%.
Note that these SDCWA rate increases were projected in mid 2007, BEFORE MWD suggested additional planned 10%+ rate hikes (to take effect in 2009 and beyond) in response to the anticipated one-third reduction in Sacramento-San Joaquin Delta deliveries, as a result of a federal court ruling (LA Times, Oct 9, 2007).

[6] Data obtained for the Poseidon Carlsbad facility indicate that the capital expense of that plant is $228 million. Amortizing those costs (using a 7% interest rate and 20 year payment period) results in an annualized capital cost of about $21.5 million. Annual O&M costs are projected at $32.3 million. Thus total annualized costs may be $53.8 million. If the facility produces desalinated water at the project rate of 56,000 AF per year, then the annualized costs run at about $960 per AF (in 2007 $s).

WATER SUPPLY & WATER QUALITY BENEFITS OF PROPOSED PROJECTS

The projects within the proposal offer significant water supply and water quality benefits to the Region. Two programs are primarily focused on water supply (Local Supply Protection and Development) and water quality (Water Quality Improvement Program). However, many of the projects in the other programs also offer or support the creation of water supply and water quality benefits.

CONSERVATION PROGRAM

Work Item #1: Implementation of Integrated Landscape and Agriculture Efficiency Programs

San Diego Agriculture

The Implementation of Integrated Landscape and Agricultural Efficiency Programs support regional efforts to increase water efficiency in the agricultural industry and in the area of landscape irrigation while also improving water quality through runoff reduction. The Water Authority will address landscape water efficiency by: 1) retrofitting sites to improve irrigation efficiency and promoting water-wise and /or California Friendly landscapes; 2) developing a web- driven water budget program to communicate water use targets to customers and to identify a regional conservation target; 3) conducting a branding study and outreach to determine how to deliver water conservation messages most effectively; and 4) developing a Regional Landscape Model Ordinance and leading regional adoption efforts and implementation of the ordinance. The programs that comprise this project have the potential to achieve approximately 3,600 AFY of water savings upon the widespread utilization of water budgets facilitated by this project.

This project will result in the water supply and quality benefits summarized in Table 1.1. The magnitude of benefits, monetized where possible, is reported in Table 1.2. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-2.

Table 1.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits		
Reduced imported water use	Monetized	Local and Regional
Water Quality		
Reduced irrigation runoff	Qualitative	Local and Regional
Reduced import of salt (TDS) into the region	Physical Quantification	Local and Regional
Other Benefits (described in Attachment 9)		
Ecosystem Restoration: Local Habitat Protection	Qualitative	Local, Regional
Water Use Efficiency Practices	Qualitative	Local, Regional
Recreation and Public Access	Qualitative	Local, Regional
Bay – Delta Habitat Protection	Qualitative	Statewide
Reduction in Greenhouse Gas Emissions	Qualitative	Statewide

Table 1.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$4.9 M
Monetizable Benefits	
Water Supply Benefits	$10.3 M
Water Quality Benefits	Not monetized
Other Benefits	Not monetized
Total Benefits	**$10.3 M**
Qualitative Benefits	**Qualitative indicator***
Improved water supply reliability	++
Reduction in pollutant loading through runoff	++
Local Habitat Protection	++
Public Education and Awareness of Water Use Efficiency Practices	+
Recreation and Public Access	+
Bay – Delta Habitat Protection	+
Reductions in Greenhouse Gas Emissions	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The present value cost of the Implementation of Integrated Landscape and Agriculture Efficiency Programs is $4.9 million. The agricultural audits will last two to four years, and the remaining portions will last five years.

The "Without Project" Baseline

If this project were not implemented, we would project an increase in the rate at which regional demands for water are growing. Less efficient and wasteful water use practices in agriculture and residential and commercial landscape irrigation would continue. This would accelerate the demand for the creation of desalination capacity and increases in imported water. Imported water increases would lead to accompanying increases in energy use and impacts to the Delta. Wasteful irrigation practices will lead to increased levels of urban and agricultural runoff; deterioration of water quality at reservoirs, lagoons and beaches; loss of active recreational opportunities; and devalued passive recreation opportunities from visual impacts, odors etc. Water agencies would lack the tools necessary to help them effectively issue water budgets in support of the statewide mandate for updated water-efficient landscape ordinances. Training and educational programs on water conservation for the general public would not be as readily available. The sharing of ideas and experiences and development of innovative water conservation practices uniquely suited to the Region made possible through the outreach and education components of this project would be delayed or executed on a smaller scale.

Water Supply and Water Quality Benefits

This project would generate various water supply and water quality improvements for the Region. Detailed water supply and water quality benefits associated with the project are presented in Appendix 8-2. Projected water supply and water quality benefits are described in detail below.

Water Supply Benefits

Avoided water costs

This project is expected to generate water savings through completion of 250 mini-audits and 125 full-scale audits, 250 commercial and 85 residential retrofits and 3,000 water budgets. Each mini-audit is expected to generate a water savings of approximately 1 AFY, and full audits are expected to produce approximately 2 AFY, for a total annual savings of 500 AFY from the audit program. The benefits are expected to be generated over the two- to four-year life of the audits. Assuming a four year life, this would generate a total of 2,000 AF in water savings. This water would otherwise be purchased from SDCWA and MWD. The cost of supplying this water is expected to grow from approximately $668 per AF in 2007 (in 2006 dollars) to $786 per AF in 2011 (in 2006 dollars). Therefore, the avoided cost of water conserved is expected to grow from $334,000 in the year 2008 (the first year audits are expected to be completed) to $393,000 per year by the year 2011. The present value of this benefit in 2006 dollars assuming a 6% discount rate is approximately $1.2 million.

This project will include completion of 250 commercial retrofits and 85 residential retrofits. Each commercial retrofit is expected to generate a water savings of approximately 2.1 AFY per irrigated acre, and each residential retrofit is expected to generate a water savings of approximately 0.06 AFY per irrigated acre, for a total annual savings of 530 AFY from the retrofit program.[7] Assuming a five year life, this would generate a total of 2,651 AF in water savings. This water would otherwise be purchased from SDCWA and MWD. The cost of supplying this water is expected to grow from approximately $668 per AF in 2007 (in 2006 dollars) to $829 per AF in 2012 (in 2006 dollars). Therefore, the avoided cost of water conserved is expected to grow from $354,000 in the year 2008 (the first year audits are expected to be completed) to $439,000 per year by the year 2012. The present value of this benefit in 2006 dollars assuming a 6% discount rate is approximately $1.6 million.

The water budget program element of this project will include implementing water budgets at 3,000 dedicated water meter sites in the Region. Each water budget is expected to generate a water savings of approximately 765 gallons per day (or 0.86 AFY), for a total annual savings of 2,571 AFY from the water budget program. Assuming a five year life, this would generate a total of 12,535 AF in water savings. This water would otherwise be purchased from SDCWA and MWD. The cost of supplying this water is expected to grow from approximately $668 per AF in 2007 (in 2006 dollars) to $829 per AF in 2012 (in 2006 dollars). Therefore, the avoided cost of water conserved is expected to grow from $1.7 million in the year 2008 (the first year of the program) to $2.1 million per year by the year 2012. The present value of this benefit in 2006 dollars assuming a 6% discount rate is approximately $7.6 million.

The landscape ordinance portion of the program will include related demonstration retrofits. Assuming that five retrofits are performed, with a water savings of 1.2 AFY per retrofit, the total water savings over the five-year life of the project will be 6 AF of water that would otherwise be purchased from SDCWA and MWD. The cost of supplying this water is expected to grow from approximately $668 per AF in 2007 (in 2006 dollars) to $829 per AF in 2012 (in 2006 dollars). Therefore, the avoided cost of water conserved is expected to grow from $4,008 in the year 2008 (the first year of the program) to $4,794 per year by the year 2012. The present value of this benefit in 2006 dollars assuming a 6% discount rate is approximately $17,700.

[7] Water savings factors of 2.1 and 0.06 AFY per irrigated acre were calculated using the Maximum Applied Water Allowance (MAWA) Method. Total estimated water savings assume an average of one irrigated acre per site. MAWA calculations are provided in Appendix 6.

The total present value of all of these benefits in 2006 dollars assuming a 6% discount rate is approximately $10.4 million.

Water Quality Benefits

Improved water quality through reduced runoff

In San Diego, water from over-irrigation that enters the storm drain system typically enters waterways (streams, bays, ocean) untreated, and is often polluted with fertilizer, pesticides, and other contaminants found in dry-weather runoff. Over-irrigating and inefficient irrigation resulting in dry-weather runoff is fairly wide-spread in San Diego.

Reduced Import of Salts into the Region

The proposed project would avoid import of total dissolved solids (commonly referred to as salts or salinity) into the region. Control of total dissolved solids (TDS) concentrations in local water bodies is a goal of the basin plan for the region. The recommended secondary drinking water standard for total dissolved solids is 500 mg/l with an upper limit of 1000 mg/l due to taste considerations. Concentrations above 500 mg/l can have significant impact on municipal and agricultural values by lowering the useful lifetime of water-using devices, and by lowering the yield of salt-sensitive crops.

Water delivered from Metropolitan Water District (MWD) typically is a blend of about 60% Colorado River water and 40% State Water Project water. Colorado River water has a salinity of around 650 mg/l, while the typical TDS value for SWP water is 250 mg/l. Combined, delivered water has a TDS value of around 490 mg/l. By avoiding import of 3,600 AF per year of imported water into the San Diego region, import of 2,200 tons of salts per year will be avoided. Over the lifetime of the project, a total of 10,600 tons of salts will not be imported into the region.

Distribution of Project Benefits and Identification of Beneficiaries

The following table summarizes the Implementation of Integrated Landscape and Agricultural Efficiency Program beneficiaries.

Table 1.3: Project Beneficiaries Summary

Local	Regional	Statewide
Retail Water Utilities, Local Residents, Businesses and Agricultural Operators; Local Species and Habitat	Residents of the Region	Bay-Delta Ecosystem, Visitors to the Region, California Citizens

Project Benefits Timeline Description

Project benefits will begin immediately upon implementation of the project.

Potential Adverse Effects from the Project

This project will not generate any adverse effects.

Uncertainty of Benefits

Projected savings through water conservation represent best estimates based on the latest available data. Actual water savings will vary. Also, computation of savings sites with for mixed meters is largely subjective to some degree, absent proven models for this purpose.

Table 1.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Projected water savings	U	Projected savings through water conservation represent best estimates based on the latest available data. Actual water savings will vary. Also, computation of savings sites with for mixed meters is largely subjective to some degree, absent proven models for this purpose.

1. Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits
++ = Likely to increase net benefits significantly
- = Likely to decrease benefits
-- = Likely to decrease net benefits significantly
U = Uncertain, could be + or -

Work Item #2: Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration

The Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration project is being implemented by the City of San Diego to provide an opportunity to offer customized commercial landscape and residential surveys along with state-of-the-art efficient irrigation hardware free-of-charge to customers maintaining irrigation systems at landscaped sites throughout the City of San Diego. A selected group of approximately 50 participating sites will also serve as a study group to demonstrate the link between use of landscape conservation hardware and observable levels of urban runoff reduction.

The giveaway program will promote further utilization (and market penetration) of up to 700 residential and commercial weather-based irrigation controllers (WBICs), also known as “smart controllers” as well as other types of distribution hardware (i.e., drip/micro spray/sprinkler heads). The project is expected to conserve at least 91 AFY of water and will reduce the extensive amount of over-watering that occurs in commercial, residential, and institution urban landscapes, thereby conserving potable water and reducing pollutant-laden dry weather urban runoff flows into sensitive receiving waters.

This project will result in the water supply and quality benefits summarized in Table 2.1. The magnitude of benefits, monetized where possible, is reported in Table 2.2. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-3.

Table 2.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits		
Reduced imported water use	Monetized	Local and Regional
Water Quality		
Reduced irrigation runoff	Qualitative	Local and Regional
Reduced import of salt (TDS) into the region	Physical Quantification	Local and Regional
Other Benefits (described in Attachment 9)		
Local Habitat Protection	Qualitative	Local, Regional
Public Education and Awareness of Water Use Efficiency Practices	Qualitative	Local, Regional
Recreation and Public Access	Qualitative	Local, Regional
Bay – Delta Habitat Protection	Qualitative	Statewide
Reductions in Greenhouse Gas Emissions	Qualitative	Statewide

Table 2.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$1.2 M
Monetizable Benefits	
Water Supply Benefits	$0.52 M
Water Quality Benefits	Not monetized
Other Benefits	Not monetized
Total Benefits	**$0.52 M**
Qualitative Benefits	**Qualitative indicator***
Improved water supply reliability	++
Reduction in pollutant loading through runoff	++
Local Habitat Protection	++
Public Education and Awareness of Water Use Efficiency Practices	++
Recreation and Public Access	+
Bay – Delta Habitat Protection	++
Reductions in Carbon Emissions	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The present value cost of the Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration Project is $1,226,523.50. The Dry Weather Runoff Reduction portion of this project will last up to 36 months with 18 months of monitoring after the irrigation is installed. The Irrigation Hardware Giveaway portion of this project will take approximately 24 months and will depend on the customer demand for the program's giveaway products and services. Detailed costs associated with the project are presented in Appendix 8-3.

The "Without Project" Baseline

Without this project, the City's urban landscape would continue to be overwatered by as much as 40,000 acre feet (AF) annually. Currently, 50% of water used by typical single-family household used for landscape irrigation; those landscapes are overwatered by about 25%. These programs would help educate water users about using the right amount of water and learning ways to conserve water.

If this project is not implemented, the City of San Diego would miss an opportunity to determine the extent to which outdoor water use-efficiency (applying the right amount of water to urban landscapes) could do the following:

- Lead to a reduction in the use of potable water

- Lead to a reduction in the quantity of dry-weather runoff (and associated pollution) entering watersheds and aquatic-based recreational areas
- Provide an opportunity for watershed management public outreach and education by publicizing and highlighting project results in the media
- Lead to conformance with and demonstration of water conservation best management practices (BMPs) and storm water permit goals, and non-point source pollution storm water BMPs
- Demonstrate the effectiveness of a scaleable project that could be implemented in other watersheds, localities and regions
- Showcase the use of "California-Friendly" plant palettes
- Educate customers through residential and commercial landscape surveys as to efficient irrigation practices, hardware, and aesthetically pleasing plant palettes that require minimal water

Water Supply and Water Quality Benefits

The Irrigation Hardware Giveaway and Runoff Reduction Demonstration Project would generate various water supply and water quality improvements in the region. Detailed water supply and water quality benefits associated with the project are presented in Appendix 8-3. Projected water supply and water quality benefits are described in detail below.

Water Supply Benefits

Avoided water costs

This project is expected to generate water savings through installation and usage of 600 residential WBICs and 100 commercial WBICs, along with an additional 50 residential WBICs installed through the dry weather runoff reduction demonstration portion of the project. A residential runoff reduction study completed by Irvine Ranch Water District in July of 2004[8] found that residential WBICs saved 41 gallons per day (gpd), while commercial WBICs saved approximately 545 gpd. The total annual water savings generated from installation of 650 residential WBICs and 100 commercial WBICs would be approximately 91 AFY.

The average lifetime of a WBIC is reported to be 25 years by the manufacturer. Manufacturers generally warranty controllers for 10 years. A ten year water savings lifetime was used, based on the assumption that future regulations and water rates will encourage conservation as well as a continued water conservation ethic, translating to ongoing management of irrigation systems. Over the 10-year life of the project, approximately 910 AF of water will be conserved using the WBICs. This water would otherwise be purchased from SDCWA and MWD. The cost of supplying this water is expected to grow from approximately $668 per AF in 2008 (in 2006 dollars) to $978 per AF in 2017 (in 2006 dollars). After that time, the cost of supplying water is assumed to grow at 2.5% real rate per year. Therefore, the avoided cost of water conserved is expected to grow from $60,800 in the year 2007 to nearly $89,000 per year by the year 2032. The present value of this benefit in 2006 dollars assuming a 6% discount rate is approximately $0.52 million.

Water Quality Benefits

Improved water quality through reduced runoff

In San Diego, water from over-irrigation that enters the storm drain system typically enters waterways (streams, bays, ocean) untreated, and is often polluted with fertilizer, pesticides, and other contaminants found in dry-weather runoff. Over-irrigating and inefficient irrigation resulting in dry-weather runoff is fairly wide-spread in San Diego.

[8] The Residential Runoff Reduction Study, Municipal Water District of Orange County, Irvine Ranch Water District, July 2004, page ES-3.

Reduced Import of Salts into the Region

The proposed project would avoid import of total dissolved solids (commonly referred to as salts or salinity) into the region. Control of total dissolved solids (TDS) concentrations in local water bodies is a goal of the basin plan for the region. The recommended secondary drinking water standard for total dissolved solids is 500 mg/l with an upper limit of 1000 mg/l due to taste considerations. Concentrations above 500 mg/l can have significant impact on municipal and agricultural values by lowering the useful lifetime of water-using devices, and by lowering the yield of salt-sensitive crops.

Water delivered from Metropolitan Water District (MWD) typically is a blend of about 60% Colorado River water and 40% State Water Project water. Colorado River water has a salinity of around 650 mg/l, while the typical TDS value for SWP water is 250 mg/l. Combined, delivered water has a TDS value of around 490 mg/l. By avoiding import of 91 AF per year of imported water into the San Diego region, import of 55 tons of salts per year will be avoided. Over the lifetime of the project, a total of 550 tons of salts will not be imported into the region.

Distribution of Project Benefits and Identification of Beneficiaries

The following table summarizes the Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration Project's beneficiaries. The City of San Diego Streets Division and the City of San Diego Storm Water Pollution Prevention Division would benefit from reduced irrigation runoff. The City of San Diego and the San Diego County Water Authority would benefit from this Project's contribution to the city and region's water savings goals, as well as increased supply reliability through conservation.

Table 2.3: Project Beneficiaries Summary

Local	Regional	Statewide
City of San Diego Streets Division City of San Diego Storm Water Pollution Prevention Division City of San Diego	San Diego County Water Authority	

Project Benefits Timeline Description

This project will generate benefits for the conservative 10-year lifespan of the project. The 10-year lifespan was based on the assumption that future regulations and water rates will encourage conservation as well as a continued water conservation ethic, translating to ongoing management of irrigation systems.

Potential Adverse Effects from the Project

This project will not generate any adverse effects.

Work Item #3: Over-Irrigation/Bacteria Reduction

This project seeks to protect and enhance water quality by reducing irrigation runoff through improved water use efficiency at eight pilot sites located within the Carlsbad HU in San Diego County. Six of the sites are very close to San Elijo Lagoon, which is an impaired 303(d) listed water body for bacteria, nutrients and sediment. The lagoon serves as a natural resource for the local community and the Region by offering open space and unimpeded views of riparian habitat. Increasing water use efficiency is a primary focus of the project, but equally important is establishing the benefits of water conservation to water quality improvements and the other associated expected benefits described here. The benefits of this project are similar to the two other projects in the Conservation program (Work Item #1 and #2). The project is focused on a concentrated area which will allow a stronger determination of the direct link between improved water use efficiency and habitat and recreation benefits to an actual impaired water body. The project is estimated to conserve approximately 353 AFY.[9]

This project will result in the water supply and quality benefits summarized below. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-4.

Table 3.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits		
Reduced imported water use	Monetized	Local and Regional
Improved water supply reliability	Qualitative	Local and Regional
Water Quality Benefits		
Reduced irrigation runoff	Qualitative	Local and Regional
Reduced import of salt (TDS) into the region	Physical Quantification	Local and Regional
Other Benefits (described in Attachment 9)		
Ecosystem Restoration	Qualitative	Local, Regional
Public Education and Awareness	Qualitative	Local, Regional
Recreation and Public Access	Qualitative	Local, Regional, Statewide
Bay – Delta Habitat Protection	Qualitative	Statewide
Reductions in Greenhouse Gas Emissions	Qualitative	Statewide

[9] Water savings were calculated based on 168 irrigated acres and a commercial retrofit water use savings factor of 2.1 AFY per irrigated acre. This water use savings factor was calculated using the Maximum Applied Water Allowance (MAWA) Method. MAWA calculations are provided in Appendix 6.

Table 3.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$0.30 M
Monetizable Benefits	
Water Supply Benefits	$4.0 M
Water Quality Benefits	Not monetized
Other Benefits	Not monetized
Total Benefits	**$4.0 M**
Qualitative Benefits	**Qualitative indicator***
Improved water supply reliability	++
Reduced irrigation runoff	++
Ecosystem Restoration	+
Public Education and Awareness	+
Recreation and Public Access	+
Bay – Delta Habitat Protection	+
Reductions in Greenhouse Gas Emissions	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The present value cost of the Over-Irrigation/Bacteria Reduction Project is $301,998. This cost assumes that one quarter of the total project costs are incurred in year 2008, one half of the costs are incurred in 2009, and the remaining one quarter are incurred in 2010. Detailed cost information associated with the project is presented in Appendix 8-4.

The "Without Project" Baseline

Without this project, overwatering would continue at the eight pilot sites, six of which are close to San Elijo Lagoon. This overwatering would continue to contribute to impairment of San Elijo Lagoon for bacteria, nutrients and sediment.

Water Supply and Water Quality Benefits

The Over-Irrigation/Bacteria Reduction Project would generate various water supply and water quality improvements in the region. These water supply and water quality benefits are described in detail below. Detailed information associated with the project, including present value calculations, is presented in Appendix 8-4.

Water Supply Benefits

Avoided water costs

This project is expected to reduce water usage by 353 AFY. The lifetime of the project is expected to be 25 years, based on an average lifespan for water-conserving equipment. Over the 25-year life of the project, over 8,800 AF of water will be conserved. This water would otherwise be purchased from SDCWA and MWD. The cost of supplying this water is expected to grow from approximately $668 per AF in 2007 (in 2006 dollars) according to published increases to $886 per AF in 2014 (in 2006 dollars). After that time, the cost of supplying water is assumed to grow at 2.5% real rate per year. Therefore, the avoided cost of water conserved is expected to grow from $59,000 in the year 2011 to over $135,000 per year by the year 2032. The present value of this benefit in 2006 dollars assuming a 6% discount rate is $4.0 M.

Water Quality Benefits

Improved Water Quality through Reduced Runoff

In San Diego, water from over-irrigation that enters the storm drain system typically enters waterways (streams, bays, ocean) untreated, and is often polluted with fertilizer, pesticides, and other contaminants found in dry-weather runoff. Over-irrigating and inefficient irrigation resulting in dry-weather runoff is fairly wide-spread in San Diego.

Reduced Import of Salts into the Region

The proposed project would avoid import of total dissolved solids (commonly referred to as salts or salinity) into the region. Control of total dissolved solids (TDS) concentrations in local water bodies is a goal of the basin plan for the region. The recommended secondary drinking water standard for total dissolved solids is 500 mg/l with an upper limit of 1000 mg/l due to taste considerations. Concentrations above 500 mg/l can have significant impact on municipal and agricultural values by lowering the useful lifetime of water-using devices, and by lowering the yield of salt-sensitive crops.

Water delivered from Metropolitan Water District (MWD) typically is a blend of about 60% Colorado River water and 40% State Water Project water. Colorado River water has a salinity of around 650 mg/l, while the typical TDS value for SWP water is 250 mg/l. Combined, delivered water has a TDS value of around 490 mg/l. By avoiding import of 353 AFY of imported water into the San Diego region, import of 213 tons of salts per year will be avoided. Over the lifetime of the project, a total of 5,334 tons of salts will not be imported into the region.

Distribution of Project Benefits and Identification of Beneficiaries

The following table summarizes the Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Demonstration Project's beneficiaries. The City of San Diego Streets Division and the City of San Diego Storm Water Pollution Prevention Division would benefit from reduced irrigation runoff. The City of San Diego and the San Diego County Water Authority would benefit from this Project's contribution to the city and region's water savings goals, as well as increased supply reliability through conservation.

Table 3.3: Project Beneficiaries Summary

Local	Regional	Statewide
City of San Diego Streets Division City of San Diego Storm Water Pollution Prevention Division City of San Diego	San Diego County Water Authority	

Project Benefits Timeline Description

This project will generate benefits for the 25-year lifespan of the project. This project lifetime is based on the average lifespan of outdoor water conserving equipment.

Potential Adverse Effects from the Project

This project will not generate any adverse effects.

WATER RECYCLING PROGRAM

Work Item #4: Santee Water Reclamation Facility Expansion Project

The Santee Water Reclamation Facility (WRF) Expansion Project includes the design and construction of facilities necessary to expand the Title 22 treatment capacity of the WRF from 2 million gallons per day (MGD) to 4 MGD (Phase 2), with further expansion to 10 MGD and advanced treatment in a subsequent phase (Phase 3). The project area is located outside the service area of the Metropolitan Water District of Southern California and within one mile of established residential and commercial development (Lakeside community in the County of San Diego).

This project is part of a coordinated effort to jointly implement two projects — the Santee WRF Project and the El Monte Valley Groundwater Recharge Project (project # 14 in this submittal) — that will enhance local supplies through an expansion of recycled water production coupled with increased groundwater recharge using recycled water. The El Monte Valley Groundwater Recharge and River Restoration Project would recharge the El Monte Valley Basin using highly treated recycled water provided by the Santee WRF.

In 2006, the Padre Dam Municipal Water District (MWD) and the Helix Water District (HWD) entered into discussions to combine these two projects that they were independently pursuing into one integrated project. The scheduling of these projects has been closely coordinated to ensure that each project can meet its individual objectives while at the same time maximizing the value of recycled water resource that will become available for groundwater recharge. Because the WRF is the closest water source to the El Monte Valley, the two projects are not just integrated, but interdependent, as well.

This integrated project will result in the following water supply and quality benefits:

- Assurance of an adequate, long-term water supply for Santee Lakes Recreation Preserve, which is supplied by the WRF;
- Promotion of the El Monte Valley Recharge Project as a model project to encourage public interest in greater use of recycled water throughout San Diego County;
- Production of a local, drought-proof water supply for 10,000 San Diego County households;
- 2,240 AF reduction in San Diego County Water Authority demand for imported water from Metropolitan Water District (with Phases I and 2; Phase 3 would increase offsets to 5,000 AFY);
- Over 80% achievement of the San Diego County Water Authority's 2020 goal for local groundwater production;
- 100% increase in the availability of economical recycled water to Padre Dam's commercial, Home Owner's Associations and large landscape customers;

This integrated project will result in the water supply and quality benefits summarized below. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-5.

Table 4.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits		
Avoided cost of additional imports	Monetized	Local and Regional
Increased financial incentives for local resources	Monetized	Local
Increased local potable groundwater supply	Qualitative	Local
Improved water supply reliability	Qualitative	Local and Regional
Water Quality Benefits		
Improved groundwater quality	Monetized	Local
Reduced wastewater discharge to Sycamore Creek and the Pacific Ocean	Physical quantification	Local, Regional, and State
Reduced Import of Salts into the Region	Physical quantification	Local, Regional
Avoided Point Loma Wastewater Treatment Plant upgrade	Monetized	Local
Avoided Santee WRF upgrade	Monetized	Local
Other Benefits (described in Attachment 9)		
High quality sand resources	Monetized	Local
Improved flood control and stormwater runoff control	Qualitative	Local and Regional
Restoration of natural habitat	Qualitative	Local and Regional
Enhanced Recreation and Public Access	Qualitative	Local and Regional
Promotion of regional collaboration	Qualitative	Regional and State
Bay-Delta Habitat Protection	Qualitative	Statewide
Reduction in Greenhouse Gas Emissions	Qualitative	Statewide
Disadvantaged community benefits	Qualitative	Local, Regional

Table 4.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$40.0 M
Monetizable Benefits	
Water Supply Benefits	
Avoided cost of additional imports	$14.4 M
Increased financial incentives for local resources	$3.0 M
Water Quality Benefits	Not monetized
Avoided O&M and treatment costs for existing wells	$0.17 M
Avoided Point Loma WWTP Upgrade	$3.6 M
Avoided Santee WRF upgrade	$3.0 M
Other Expected Benefits	
High Quality Sand Resources	$12.2 M
Total Benefits	$36.5 M
Qualitative Benefits	Qualitative indicator*
Increased local potable groundwater supply	+
Reliability of local water supply (potentially $9.9 million)	++
Improved flood control and stormwater runoff control	+
Restoration of natural habitat	++
Enhanced Recreation and Public Access	+
Promotion of regional collaboration	+
Bay-Delta Habitat Protection	+
Reduction in Greenhouse Gas Emissions	+
Disadvantaged community benefits	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Present value costs for Phase 2 of the Santee WRF Project are expected to be approximately $40.0 million[10] (in 2006 U.S.$), including construction, capital, and O&M costs over the expected 50-year project lifetime (2011-2060). The total capital costs will be $23.1 million. Expansion of the Santee WRF will take about 1.5 years to complete and will be finished by October 2010. Annual O&M costs for this project will be approximately $1.35 million (in 2006 U.S.$) and will begin to accrue in 2011 after expansion of the Santee WRF is finished. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-5.

[10] Assumed 25% of capital costs in 2008, 25% in 2009, and 50% in 2010.

The "Without Project" Baseline

Without this project, the Santee WRF would continue to discharge 2 MGD of wastewater into Sycamore Creek, which already has set total maximum daily loads (TMDLs) for nitrogen (N) and phosphorus (P). Addition of advanced treatment processes, such as reverse osmosis, would be required in the future to meet the current total maximum daily load (TMDL) limits for discharge into Sycamore Creek. Capital costs for advanced treatment are estimated at $3.3 million ($2006).

Currently, the Point Loma Wastewater Treatment Plant (WWTP) treats approximately 175 MGD of wastewater. The Point Loma WWTP will need to be upgraded to secondary treatment, at an estimated cost of $750 million in the 2018 timeframe.

Not implementing the Santee WRF Project would also prevent the El Monte Valley Groundwater Recharge and Restoration Project from occurring, as this project depends on receiving recycled water from the Santee WRF to recharge the El Monte Basin. Without the Groundwater Recharge and Restoration Project, several critical impacts would occur including: (1) increase the need for additional water supply in the future, (2) revert recharge lands to a golf course, which would eliminate the river restoration efforts, (3) reduce diversification of regional water supply, and (4) result in underutilization of existing sand resources.[11] Other impacts of not implementing these projects include continued discharge from the Santee wastewater plant—which would continue contributions of the N and P loads to Sycamore Creek.

The Padre Dam MWD is a proponent of this project and provides water, wastewater, recycled water, and recreation services for 96,700 residents of San Diego County. Padre Dam's neighbor, HWD, is a proponent for the El Monte Project and provides water service for 251,800 San Diego County residents.

Water Supply and Water Quality Benefits

The Santee Water Reclamation Facility Expansion Project is intrinsically related to the El Monte Valley Groundwater Recharge and River Restoration project (work item #14). Both projects would need to be implemented to receive the full range of water supply and water quality benefits described in detail below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-5.

Allocation of Benefits Across Projects

The discussion that follows reflects the combined (i.e., joint) benefits of the two projects operating in an integrated fashion. The total monetized present value benefits then need to be allocated between the two projects. This is done by apportioning benefits in proportion to the share of total present value costs of the combined projects. As the Santee WRF expansion accounts for 42.8% of the combined total present value cost of both projects ($40.0 million/$84.1 million = 42.8%), we assume the benefits can be allocated by the same percentage. Thus, the present value benefits assigned to the Santee WRF expansion project are 42.8% of the combined estimates, as described below.

Water Supply Benefits

<u>Avoided cost of additional imports</u>

By providing a new local water supply, the proposed Santee WRF Expansion Project and the El Monte Valley Groundwater Recharge Project would offset imported water demand by 2,240 AFY. The Water Authority supplies imported water to its member agencies. The rate for new imported water is projected to

[11] The groundwater basin is in a narrow valley with high quality sand along the San Diego River. With the river restoration project, this high quality sand will be removed.

be $786/AF in 2011 (in 2006 U.S.$). The proposed projects would avoid imported water purchases of approximately $2.0 million per year beginning in 2011. Assuming a 6% real discount rate and an escalating cost of imported water, the present value (in 2006 US$) of total avoided purchases of imported water over the 50-year project life is estimated to be approximately $34 million.

The discussion above reflects the combined (i.e., joint) benefits of the two projects operating in an integrated fashion. Apportioning benefits in proportion to the share of total present value costs of the combined projects attributed to the Santee WRF expansion (42.8%), then the present value benefits assigned to the Santee WRF expansion project is $14.5 million ($34 million * 42.8%).

Increased Financial Incentives for Local Resources

Additionally, these two projects would receive financial incentives from SDCWA and the Metropolitan Water District for offsetting the region's imported water demand with recycled water that will be produced at the Santee WRF. The incentive is $250/AFY of imported water replaced with recycled water, or approximately $560,000 annually (2,240 AF * $250/AF). Assuming a 6% real discount rate, the present value (in 2006 US$) of total financial incentives for using recycled water over the 50-year project life is estimated to be approximately $7.0 million. Apportioning these benefits between the combined projects based on the share of total present value costs attributed to the Santee WRF expansion (42.8%), then the present value benefits assigned to the Santee WRF expansion project is $3.0 million ($7.0 million * 42.8%).

Increased Local Potable Groundwater Supply

These projects enable HWD to use additional groundwater storage of 6,000 to 8,000 AF for water supply and emergency storage use.[12] The recharged El Monte Groundwater Basin will also serve for groundwater storage. Local well owners will be converted from well supply to potable water supply from the local water purveyor (Lakeside Water District). The project will convert existing wells in the zone of influence from the project's spreading basins used for percolating highly treated recycled water. The local well owners will have a more reliable and high quality potable water source for new connections to Lakeside Water District's potable water distribution system (Black and Veatch, 2006).

Improved Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. These projects will provide a local water source that will help Padre Dam MWD and HWD sustain water supplies through drought periods or import supply reductions. The additional water made available is expected to be 10% of HWD's current annual demand.

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies do indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $88 to $461 per household (updated to 2006 $s) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

The challenge for use of these values to determine a value of the project is recognizing how to reasonably interpret these survey-based household monetary values The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas these integrated projects enhance only overall reliability, but do not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the

[12] Based on a hydraulic model performed to determine the storage volume in the El Monte Basin in the vicinity of the project (Final Technical Memorandum — Investigation of Use of Raw Water for Habitat Restoration, 2006).

project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For both projects we adjust the lower bound of the literature values downward from $88 per household per year to $1.23 per household per year to adjust for the partial increase in reliability and the relatively small amount of new water supply relative to total potential shortfalls relative to demands.[13] When multiplied by the approximately 704,000 households in the greater region, the potential benefit from increased reliability is $0.87 million per year, for a present value of $10.8 million over the 50-year project lifetime. Apportioning these benefits between the combined projects based on the share of total present value costs attributed to the Santee WRF expansion (42.8%), then the present value benefit assigned to the Santee WRF expansion project is $4.6 million ($10.8 million * 42.8%). While uncertainties exist in applying values from the literature to this situation, we have included this as a conservative estimate of the monetized water supply reliability benefit for this project.

Due to uncertainties in applying values from the literature to the proposed program, we have not included this as a monetized benefit for this project. Instead, this value is provided here to give an idea of the possible magnitude associated with this benefit.

Water Quality Benefits

Avoided Groundwater Treatment Costs

Groundwater quality in the El Monte Valley is expected to improve with the implementation of these two projects. The following table summarizes several water quality parameters, current levels of these parameters, and expected levels (expected once the projects are implemented).

Table 4.3: Projected Improvements in Groundwater Quality with Project

Water Quality Parameter	Current Level	Expected Level with Project
Total dissolved solids	430-2600 mg/L	<500 mg/L (<200 mg/l long term)
Total organic carbon	4-10 mg/L	<5 mg/L (<0.2 mg/l long term)
Iron	1-260 ug/L	<100 ug/L

The improvement in groundwater quality in the El Monte Basin will result in reduced operations and maintenance (O&M) costs of existing wells by $10,000 each year. Cleaning up groundwater will also lower dissolved organic carbon content, which will reduce algae, improve taste and odor of water, and reduce treatment costs by an additional $22,400 each year (based on $10/AF savings for 2,240 AFY yield). Together, these avoided treatment costs result in a total present value savings of approximately $405,000 over the 50-year life span of the projects. Apportioning these benefits between the combined projects based on the share of total present value costs attributed to the Santee WRF expansion (42.8%), then the present value benefits assigned to the Santee WRF expansion project is $173,000 ($405,000 * 42.8%).

Reduced discharge to the Pacific Ocean and Sycamore Creek

The Point Loma WWTP currently discharges approximately 175 MGD of advanced primary effluent to the Pacific Ocean. With this project, Point Loma will discharge only 165 MGD.

[13] The contribution of the roughly 2240 AFY added by this project toward 100% reliability can be characterized relative the size of a potential 20% shortfall in regional supply. A 20% supply shortfall in the region would be about 160,000 AF (based on a projected total supply need of roughly 800,000 AF between 2010 and 2020). Expanding RW use by 2,240 AFY would offset about 1.4% of such a shortfall (2,240/160,000), implying an approximate value per household of 1.4% of $88 per year (lower bound), which equals about $1.23 per household annually.

Discharges of nitrogen (N) and phosphorous (P) to Sycamore Creek will be greatly reduced or eliminated completely when the El Monte Valley Recharge Project begins taking water from the Santee WRF. The Santee WRF currently discharges approximately 0.8 MGD on an average annual basis. With this project, up to 2 MGD of Title 22 water will be reused rather than discharged from the Santee WRF to Sycamore Creek.

With an expansion to 4.0 MGD, initially an annual average flow of 2 MGD is available to be sent to El Monte, 1.4 MGD ultimately. In this phase of the expansion, all of the excess water treated in the winter months (in excess of lake demand and current customers) is available to be sent to El Monte because the maximum month excess of 2.54 MGD at build-out is less than the estimated capacity of the El Monte Valley Basin (currently estimated to be 4.5 MGD). Under this phase of the project, if the El Monte Valley Project takes all the WRF water available to them, there would be zero discharge to Sycamore Creek and therefore no discharge of N and P to the stream.

With the 10 MGD expansion (Phase 3) an annual average of 4.5 MGD can be sent to El Monte basin. In this phase of the expansion not all of the excess water treated in the winter months (in excess of lake demand and current customers) can be sent to El Monte because the maximum month excess of 6.5 MGD at build-out is greater than the estimated capacity of the El Monte Valley Basin (currently estimated to be 4.5 MGD). Under this phase of the project, if the El Monte Valley Project takes all the WRF water available to them, there would be an annual average discharge to Sycamore Creek of 1.43 MGD or a 28% reduction to the current TMDL limits, which are based on 2 MGD discharge with N and P concentrations of 1.0 mg/l and 0.1 mg/l, respectively. The project team is currently studying the possibility of increasing flows to the El Monte basin above 4.5 MGD in the winter months. Should this be possible, discharges to Sycamore Creek could be further reduced. Additional customers can be found along the supply line to the El Monte Valley that could further reduce the N and P discharged to Sycamore Creek.

Avoided Point Loma Wastewater Treatment Plant upgrade

Phase II of this project would reduce the load of wastewater traveling through the Point Loma WWTP by 4 MGD. Currently, the WWTP treats approximately 175 MGD of wastewater. By reducing the load by 4 MGD, the Santee and El Monte Projects would reduce the amount of water treated by 2.3%. The cost to upgrade the Point Loma WWTP is currently estimated to be up to $750 million. The Santee and El Monte Projects would avoid 2.3% of this cost, or $17.1 million (2.3% * $750 million). The WWTP would likely not need any upgrades until 2018, though it is not guaranteed that the upgrade will be required at all. The total present value benefit of avoiding any upgrade costs in the year 2018 is $8.5 million. The portion of this cost attributed to the Santee Project is $3.6 million (42.8% * $8.5 million).

Avoided Santee WRF treatment upgrade

The implementation of the Santee and El Monte Projects will help avoid a water treatment upgrade at the Santee WRF. If the Santee WRF continues to discharge wastewater, they would have to pay $3.4 million to add tertiary treatment, with an additional $382,000 per year in increased operation costs ($2007). With the Santee and El Monte Projects, this cost would be avoided. The total present value benefit of avoiding treatment costs at the Santee WRF is $7.1 million. The portion of this cost attributed to the Santee Project is $3.0 million (42.7% * $7.1 million).

Reduced Import of Salts into the Region

The proposed project would avoid import of total dissolved solids (commonly referred to as salts or salinity) into the region. Control of total dissolved solids (TDS) concentrations in local water bodies is a goal of the basin plan for the region. The recommended secondary drinking water standard for total dissolved solids is 500 mg/l with an upper limit of 1000 mg/l due to taste considerations. Concentrations above 500 mg/l can have significant impact on municipal and agricultural values by lowering the useful lifetime of water-using devices, and by lowering the yield of salt-sensitive crops.

Water delivered from Metropolitan Water District (MWD) typically is a blend of about 60% Colorado River water and 40% State Water Project water. Colorado River water has a salinity of around 650 mg/l, while the typical TDS value for SWP water is 250 mg/l. Combined, delivered water has a TDS value of around 490 mg/l. By avoiding import of 2,240 AF per year of imported water into the San Diego region, import of 1,354 tons of salts per year will be avoided. Over the lifetime of the project, a total of 67,700 tons of salts will not be imported into the region. The portion of this benefit allocated to the Santee WRF project is 28,950 tons (42.8% * 67,700 tons)

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the Santee WRF Expansion and the El Monte Valley Groundwater Recharge and Restoration Project's beneficiaries. These projects would benefit surrounding residents through increased flood protection, local well owners through improved quality drinking water, the surrounding habitat through restoration (including protection of species), and SDCWA through achieving over 80% of its 2020 goals for local groundwater production.

Table 4.4: Project Beneficiaries Summary

Local	Regional	Statewide
Well owners, surrounding habitat, surrounding residents Padre Dam MWD and HWD customers Disadvantaged communities	Recreational Users of the Preserve, SDCWA, Point Loma Wastewater Treatment Facility (Avoided Capacity Expansions), MWD	Bay-Delta Ecosystem, Recreational Users of the Preserve, Visitors to Region, California Citizens, State Water Project/Delta

Project Benefits Timeline Description

The Santee WRF Expansion Project would provide benefits in excess of the 50-year project lifetime (2011-2060).

Potential Adverse Effects from the Project

With the river restoration as part of the El Monte Groundwater Recharge and Restoration Project, sediment will have to be removed. This will cause temporary noise, dust, and traffic issues.

Summary of Findings, Tables

The key water supply and water quality benefits associated with the proposed project are: improved water supply reliability and increased financial incentives for using recycled water instead of imported water. Monetary estimates for improved financial benefits have been included in the analysis to provide a relative sense of the potential magnitude of the benefit and are described in more detail below. We used this monetized benefit to compare against the cost of the project. The financial incentive of $250/AF is provided by MWD for using recycled water in place of imported water. The present value benefit of this incentive is $7.0 million; approximately $3.0 million of this is apportioned to the Santee WRF Expansion Project.

These projects will produce one benefit that can be physically quantified: reduced discharge to Sycamore Creek. Under Phase 2 of these projects, if the El Monte Valley Project takes all the WRF water available to them, there would be zero discharge to Sycamore Creek and therefore no discharge of N and P to the stream. Under Phase 3, however, if the El Monte Valley Project takes all the WRF water available to them, there would be an annual average discharge to Sycamore Creek of 1.43 MGD or a 28% reduction

to that of the current TMDL limits, which are based on 2 MGD discharge with N and P concentrations of 1.0 mg/l and 0.1 mg/l, respectively.

These projects will generate several avoided costs: avoided imported water costs, avoided O&M and treatment costs for existing groundwater, avoided costs for upgrading the Point Loma WWTP, and avoided costs associated with upgrading the Santee WRF. Without this project, imported water would be necessary to supply Padre Dam and HWD's customers. The present value benefit of using recycled water from Santee WRF in lieu of imported supplies is $33.8 million. The portion of this benefit attributed to the Santee WRF Expansion Project is $14.5 million ($33.8 million * 42.8%).

Improving groundwater quality also provides benefits in the form of avoided O&M costs for wells and avoided treatment costs. The present value benefit of avoiding these costs is $0.4 million, or $0.17 for the Santee WRF Expansion Project.

The project will reduce 2.4 percent of the loading to Point Loma WWTP, reducing the projected costs associated with upgrading that facility. The present value of this avoided cost is approximately $8.5 million. The portion attributed to this project is approximately $3.6 million. In addition, if this project were not implemented, Padre Dam MWD would need to implement a $3.3 million treatment upgrade at the Santee WRF which could be avoided with this project. The present value of this benefit is approximately $7.1 million, $3.0 million of which is attributed to this project.

In summary, the monetizable water supply and water quality benefits alone do not outweigh the costs. However, when considered along with the monetizable, non-water supply or water quality benefits expected to be generated by the project ($28.5 million in high quality sand, refer to attachment 9) and improved water supply reliability (as much as $10.8 million for the combined project), the benefits of the projects outweigh the costs.

These projects also generate significant additional qualitative water supply and water quality benefits, such as increased potable water supply. A summary of the qualitative benefits is provided in the following table.

Table 4.5: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Water Supply Benefits	
Increased local potable groundwater supply	+
Reliability of local water supply	++

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. Such issues are listed in the following table.

Table 4.6: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided imported water costs	+	The avoided cost estimate for offset water imports is based on projected increases in the cost of delivery MWD-supplied waters from the SWP and Colorado River. Recent and future climatic conditions (e.g., drought, decreased snow pack,

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
		climate change) and regulatory/ legal issues (e.g., federal Court rulings reducing SWP extractions from the Bay-Delta) combine to make it more likely than not that the future availability of MWD-provided imported waters will be increasingly constrained, and that costs will escalate at rates higher than experienced in the recent past. The projections also are driven by "normal year" expectations, whereas dry year conditions will add additional cost pressures (and may move some of the imported water to higher cost Tier 2 levels). On net, the projected benefits due to reducing the local demands for imported waters are probably understated in this analysis.
Improved water supply reliability	++	The monetized value of added reliability is not included in the benefit-cost comparison. If we had added the present value benefit of improved water supply reliability in the overall benefit-cost analysis, it would increase net benefits. This value could be an over or underestimation of the actual value San Diego residential water customers place on improved reliability. The values used to calculate this benefit were conservative (based on the lowest end of the empirical range found in the literature). The value of reliability to commercial, institutional, and industrial (CII) customers was not included in the illustrative empirical analysis.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #5: Recycled Water Retrofit Assistance

The Recycled Water Retrofit Assistance Program will provide direct financial assistance to homeowners' associations, public agencies, and other customer types to facilitate the conversion from potable to recycled water (RW) for landscape irrigation and other uses. The project will reimburse all, or a portion of the reasonable costs incurred by customers for retrofit work reviewed and approved by member agencies. The project will target approximately 40 publicly-owned sites throughout the San Diego County Water Authority (SDCWA) service area which will allow approximately 2,000 AFY of additional recycled water to be used. The SDCWA's ultimate goal is to promote the development and use of recycled water (RW) capable of supplying 5% of the region's water demand by 2011.

Customer on-site retrofits can be a barrier to customer use of RW. The costs of an average retrofit can vary widely from $10,000 to $100,000 per site. Some potential RW customers may find the initial retrofit

costs too prohibitive to make the initial investment worthwhile. Customer financial barriers preventing retrofit of sites can effectively prohibit the delivery of RW. Although 16 of the SDCWA's 24 member agencies are currently involved in some level of water recycling and have mandatory use ordinances, the issue still remains that if potential customers are unable to tie in to a recycled water system due to cost considerations, the production and distribution costs associated with recycled water will be wasted.

At least eight of the SDCWA's member agencies have expressed interest in participating in this Project, and over 50 willing customers have been identified for the program. It is estimated that approximately 40 individual sites located throughout San Diego County will be retrofitted. These sites consist of parks, residential areas, homeowner's associations, highways, medians, and a power plant. Participants would include cities, school districts, Caltrans, botanical gardens, University of San Diego and golf courses. The majority of these customers would not implement retrofits without funding from the proposed retrofit assistance program.

Grant amounts will be established as $2,500 per irrigated acre, not to exceed $50,000 per retrofit site (i.e. maximum of 20 irrigated acres per site). Customers will be required to provide at least 25% in matching funds per retrofit site. Member agencies will be required to provide at least 25% in matching funds per retrofit site and may elect to cover the customer's portion of the project costs.

The benefits associated with the retrofit assistance program are presented in the following tables, which identify the assessment level of each benefit (e.g., whether the benefit can be monetized or is described quantitatively or qualitatively). Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-6.

Table 5.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Avoided imported water costs	Monetized	Local, Regional
Improved water supply reliability	Qualitative	Local, Regional
Water Quality		
Avoided introduction of salts to the basin	Quantitative	Local, Regional
Other Benefits (described in Attachment 9)		
Avoided fertilizer costs	Qualitative	Local, Regional
Reduced stress on Bay-Delta	Qualitative	Statewide
Avoided greenhouse gas emissions	Qualitative	Statewide

Table 5.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$1.39 M
Monetizable Benefits	
Avoided cost of additional imports	$16.1 M
Total Monetized Benefits	$16.1 M

	Qualitative indicator*
Qualitative Benefits	
Improved water supply reliability	++
Avoided introduction of salts to the basin	++
Avoided fertilizer costs	+
Reduced stress on Bay-Delta	+
Avoided greenhouse gas emissions	++

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The proposed program will provide direct financial assistance for the retrofits needed to convert from potable water use to recycled water use for landscape irrigation. There are no specific capital or operations and maintenance costs associated with the program. The cost of the program is simply the amount of funding that will be available for the various retrofit applications. The total budget for the retrofit program is $1.6 million (which includes $400,000 of monetary contributions from member agencies and $400,000 from participating customers). Approximately 20% of the funds will be distributed in 2008, 70% in 2009 and the remaining 10% in 2010. Assuming a 6% real discount rate, the present value (in 2006 US$) of the cost of the program is estimated to be $1.39 million. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-6.

The "Without Project" Baseline

Without the proposed retrofit assistance program, some customers would continue to use potable water for landscape irrigation and the remaining portion would find other sources of funds to pay for the retrofits necessary for RW use. It is not possible to determine the exact number of customers that would implement retrofits without this program, although preliminary assessments indicate that the "majority" would not pay for retrofits. Therefore, as a conservative estimate, we assume that 50% (as opposed to the majority) would continue to use potable water and the remaining 50% would install retrofits. Accordingly, without the proposed program, customers will continue to rely on approximately 1,000 AFY of potable water for landscape irrigation instead of replacing that potable water with RW (the other 1000 AFY is assumed to be used by the 50% of customers who would retrofit regardless of the cost share). The SDCWA would supply potable water imported from the SWP and the CRA. Approximately 1,000 AFY of RW will be discharged to the ocean that would have been beneficially reused if the program were implemented.

Water Supply and Water Quality Benefits

This project will create both water supply and water quality benefits in the San Diego Region. The three key water supply benefits are avoided imported water costs, avoided power costs to deliver water, and improved water supply reliability. The key water quality benefit is avoided introduction of salts to the basin. These benefits are described in more detail in the following sections. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-6.

Water Supply Benefits

<u>Avoided cost of imported water</u>

By providing the funding to convert from potable water to RW for landscape irrigation, the proposed program would offset imported water demand by approximately 1,000 AFY as compared to the without project baseline. The SDCWA supplies imported water (from SWP and CRA) from MWD to its member agencies. The rate for imported water will be approximately $668/AF in 2011, increasing in future years. The proposed program would avoid imported water purchases of approximately $134,000 per year in

2008. Assuming a 6% real discount rate, the present value (in 2006 US$) of total avoided purchases of imported water over the 50-year project life is estimated to be $16.1 million.

Improved water supply reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed project will provide a local water source that will help the San Diego Region sustain water supplies through drought periods or import supply reductions. Annual demand in the Water Authority's service area is approximately 715,450 AF.[14] The contribution of the roughly 1,000 AFY added by this project toward 100% reliability can be characterized by the relative size of a potential 20% shortfall in regional supply relative to projected demands. A 20% supply shortfall would be roughly 160,000 AF (based on a projected total supply need between years 2015 and 2020 of 800,000 AF). Expanding RW use by 1,000 AFY would offset about 0.6% of such a shortfall (1000/160,000).

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies do indicate that residential and industrial (i.e. urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $88 to $461 per household (updated to 2006 dollars) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought; see Appendix 8-1 for a full discussion of reliability and values).

The challenge for use of these values to determine a value of the project is recognizing how to reasonably interpret these survey-based household monetary values The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas the proposed project enhances overall reliability, but does not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For this analysis, we adjust the lower bound of the literature values downward from $88 per household per year to $0.55 per household[15] per year to adjust for 0.6% increase in reliability associated with the relatively small amount of new water supply relative to total demands. When multiplied by the approximately 704,000 households[16] in the SDCWA service area, the potential benefit from increased reliability is $387,000 per year. Assuming a 6% discount rate, the present value of improved reliability over the 50-year project life is $5.8 million.

Due to uncertainties in applying values from the literature to the proposed program, we have not included this as a monetized benefit for this project. Instead, this value is provided here to give an idea of the possible magnitude associated with this benefit.

Water Quality Benefits

Avoided Introduction of Salts to the Basin

By enabling customers to use recycled water for landscape irrigation in lieu of imported water, this project avoids the introduction of additional salts (i.e. total dissolved solids) to the basin. According to the Metropolitan Water District's 2005 Urban Water Management Plan, average TDS concentration in SWP water delivered through the East Brach is approximately 250 mg/l. TDS concentrations in CRA water are

[14] source: Table 8-1, SDCWA UWMP 2005

[15] The contribution of the roughly 1,000 AFY added by this project toward 100% reliability can be characterized by the relative size of a potential 20% shortfall in regional supply relative to projected demands. A 20% supply shortfall would be roughly 160,000 AF (based on a projected total supply need between years 2015 and 2020 of 800,000 AF). Expanding RW use by 1,000 AFY would offset about 0.6% of such a shortfall (1000/160,000), implying an approximate value per household of 0.6% of $88 per year (lower bound), which equals about $0.55 per household annually.

[16] Household estimate for all of SDCWA region.

higher, averaging about 650 mg/l. Approximately 40% of SDCWA's imported water is SWP water and 54% is CRA water. Therefore, one AF of imported water contains, on average, 1332 lbs of salt[17]. By providing RW to the customers described above, approximately half of whom would not implement retrofits without the assistance program, implementation of the proposed program would offset demand for imported water in San Diego by approximately 1,000 AFY. Therefore, this project would avoid introducing over 600 metric tons of salt to the basin per year. Over the 50-year project life, that equates to over 30,000 tons of salts.

Distribution of Project Benefits, and Identification of Beneficiaries

The proposed project would lead to benefits realized by the member agencies with long-term purchase agreements (local), throughout San Diego County (regional), as well as benefits realized statewide. The following table presents a summary of project beneficiaries.

Table 5.3: Project Beneficiaries Summary

Local	Regional	Statewide
Proposed RW customers, including: cities, school districts, homeowner's associations, a power plant, Caltrans, botanical gardens, University of San Diego and golf courses.	SDCWA, MWD, and their customers	Other water agencies that depend on MWD water for their local supplies. Californians interested in the preservation of the Delta smelt and the aquatic habitat of the Bay-Delta. Californians concerned with reducing the State's total GHG emissions.

Project Benefits Timeline Description

Approximately 20% of the funding for retrofits will be distributed in 2008, 70% will be distributed in 2009, and the remaining 10% will be distributed in 2010. A portion of the benefits resulting from the assistance program (avoided imported water costs, improved water supply reliability, and avoided introduction of salts to the basin) would begin to accrue in 2009 and the full extent of the benefits would begin to accrue in 2011 (once all retrofits are complete). Benefits are expected to continue for 50 years (the assumed project life).

Potential Adverse Effects from the Project

Any potential short-term impacts associated with the assistance program will be mitigated. No long-term adverse effects are expected as a result of the proposed project.

Summary of Findings, Tables

The proposed project will generate both water quality and water supply benefits. Although the key water quality benefit, avoided introduction of salts to the basin, could not be monetized, a quantitative analysis was provided, which is summarized again below. Monetary estimates were included for the water supply benefits to provide a relative sense of the potential magnitude of each benefit; these, too, are described in more detail below. The value of the avoided cost of imported water is the only benefit that we include as a monetized benefit to be compared against the cost of the project. The present value of this benefit alone is over $14 million greater than the present value of the cost of the project. By not importing an average of 1,000 AFY, costs associated with power to deliver imported water are avoided. The present value of the avoided cost of power for delivering imported water is approximately $1.5 M over the life of the project.

[17] 1AF = 1233482 liters; 250 mg/l = 308370460 mg/AF and 650 mg/l = 801763196 mg/AF; 1mg = 2.2 x 10^{-6} lbs; therefore, if 46% of supply has concentration of 250 mg/l and 54% has a concentration of 650 mg/l, then, in terms of lbs per AF, the concentration of salts is approximately 1332 lbs/AF.

Replacing imported water with locally produced RW avoids introducing additional salts to the basin. By offsetting SWP and CRA water imports by 1,000 AFY, the proposed project avoids the introduction of over 600 metric tons of salt to the basin each year (over 30,000 tons over 50 years).

Although the estimated value of improved water supply reliability was not included as monetized benefit, the estimated value of this benefit was calculated. According to the lower bound of the values found in the literature ($88 per household), the number of households in SDCWA service area (approximately 704,000), and the portion of potential water supply shortfall avoided by the provision of locally produced RW (0.6%), the estimated annual value of improved water supply reliability is $387,000. The potential value of this benefit, over the 50-year project life (in present value terms) is approximately $5.7 million.

The present value of avoided imported water purchases is $16.1 million (in 2006 $). By offsetting 1,000 AF of imported water per year, the proposed project avoids annual imported water purchases of $133,600, beginning in 2008. Over the 50-year life of the project, the present value of this benefit totals $16.1 million. This benefit is approximately $14.8 million greater than present value of the cost of the proposed project ($1.35 million).

In summary, the benefits associated with this project outweigh the costs. Project beneficiaries are summarized in the following table.

Table 5.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Improved water supply reliability	+
Avoided introduction of additional salts to basin	+

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. Such issues are listed in the following table.

Table 5.5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Improved water supply reliability	1) ++ 2) + 3) + 4) U	1) The benefit of improved water supply reliability as a result of the project was omitted from the monetary estimates; had it been included, the total monetized net benefits would be higher. 2) The estimate is based on the number of households in the SDCWA service; the estimate does not account for the fact that the number of households will increase over the project life. 3) Reliability values for nonresidential customers was not included. 4) The estimate is also based on the percent of potential water supply shortfall which the project would offset, assuming that the benchmark shortfall would be approximately 20% of total supply projected for 2015 to 2020. If the estimate were based on a different future water supply projection, or used a different percentage of total supply for a potential shortfall, the value of

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
		improved reliability could be correspondingly higher or lower.
Avoided imported water costs	+	The avoided cost estimate for offset water imports is based on projected increases in the cost of delivery MWD-supplied waters from the SWP and Colorado River. Recent and future climatic conditions (e.g., drought, decreased snow pack, climate change) and regulatory/ legal issues (e.g., federal Court rulings reducing SWP extractions from the Bay-Delta) combine to make it more likely than not that the future availability of MWD-provided imported waters will be increasingly constrained, and that costs will escalate at rates higher than experienced in the recent past. The projections also are driven by "normal year" expectations, whereas dry year conditions will add additional cost pressures (and may move some of the imported water to higher cost Tier 2 levels). On net, the projected benefits due to reducing the local demands for imported waters are probably understated in this analysis.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #6: City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse / Reservoir Augmentation Project

The City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse / Reservoir Augmentation (IPR / RA) Project has three parts. Part 1 will install 18,000 feet of new recycled water (RW) pipe to distribute 1,500 acre-feet per year (AFY) of RW to irrigate new developments (Pacific Highlands Ranch and Torrey Highlands), community open spaces, medians, slopes, and the SR-56 freeway. Part 2 will extend the existing RW distribution system to selected City of San Diego parklands and retrofit the irrigation systems at these parklands to use recycle water, creating an additional 209 AFY demand for recycled water. In total, the retrofits and distribution system expansions will make possible the beneficial use of approximately 1900 AFY of RW in the City of San Diego. Part 3 of the project will project will implement Phase 2 of a three-phase IPR / RA program that – on completion of Phase 3 - will create 12,000 acre-feet per year (AFY) of new potable water supply for the City of San Diego (City) from tertiary treated wastewater. Phase 2 of the project, which will be completed as part of this project, will include building, operating, and testing a 0.3 million gallons per day (MGD) demonstration-scale advanced water treatment plant (D-AWT) at the North City Water Reclamation Plant (NCWRP); conducting a limnology study of San Vicente Reservoir (Reservoir) to assure adequate hydraulic characteristics; and defining the regulatory requirements for IPR/RA.

The City of San Diego (City) treats its wastewater at the Point Loma WWTP, which provides advanced primary treatment before disposal in an ocean outfall. As part of a waiver from the federal Clean Water Act (CWA) which, since 1972, has required wastewater plants to provide a minimum of secondary treatment, the City committed to implement a water reclamation program that would create a system capacity of 45 million gallons per day (MGD) by 2010. With assistance of a grant from the U.S.

Environmental Protection Agency (EPA), the City constructed the 30 MGD[18] North City Water Reclamation Plant (NCWRP). As a condition of the grant, the City committed to beneficially reuse 50% of the flows treated at the NCWRP by December 2010.

In 2005, NCWRP inflows were at approximately 75% of plant capacity (22.5 MGD). Based on anticipated flows, the City established a reuse goal of 12 MGD by the end of 2010 to fulfill the EPA grant goals. As of 2005, approximately 6 MGD of recycled water is beneficially reused.

By creating demand for and distributing RW, the proposed project would move the City substantially toward the goal of beneficially reusing 50% of the flows treated at NCWRP. In addition, using recycled water reduces imported water demand, increases local water supply, and results in less wastewater to be treated and the discharged into the ocean.

This three-part project will implement portions of Phase I and Phase II of the City's three-phase Recycled Water Master Plan. Part 1 of this project, the RW Expansion, would complete Phase II (Phase II is already underway, with more than 16,000 feet of pipeline already in the ground). Part 2 of the proposed project, the Parklands Retrofit, will implement the on-site infrastructure portion of Phase I (the off-site construction of Phase I is already complete). Phase III, which cannot move forward until Phases I and II are complete, is still in the planning phase.

The benefits associated with the project are presented in the following tables, which identify the assessment level of each benefit (e.g., whether the benefit can be monetized or is described quantitatively or qualitatively). For those benefits best described qualitatively, a summary is provided, along with an overview of the monetized benefits and costs of the program. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-7.

Table 6.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Avoided imported water costs	Monetized	Local, Regional
Improved water supply reliability	Monetized	Local, Regional
Water Quality		
Avoided discharges from Point Loma	Quantitative	Local, Regional
Avoided introduction of additional salts to basin	Quantitative	Local, Regional
Improved potable water quality	Qualitative	Local, Regional
Other Benefits (described in Attachment 9)		
Avoided fertilizer costs	Monetized	Local, Regional
Increased likelihood of meeting EPA requirement to beneficially reuse 50% of flows from NCWRP by 2010	Qualitative	Local, Regional
Reduced stress on Bay-Delta	Qualitative	Statewide
Avoided greenhouse gas emissions	Qualitative	Statewide
Improved Dry Year Landscape Appearance	Monetized	Local, Regional

[18] The City fulfilled the 45 MGD treatment capacity requirement in 2002 when the 15 MGD SBWRP was completed (source: 2005 Master Plan).

Table 6.2: Benefits Summary

	Present Value ($2006)
Costs – Total Capital and O&M	$11.3 M
Monetizable Benefits	
Water Supply Benefits	$28.7 M
Water Quality Benefits	Not monetized
Total Benefits	**$28.7 M**
	Qualitative indicator*
Qualitative Benefits	
Avoided fertilizer costs	+
Increased likelihood of meeting EPA requirement to beneficially reuse 50% of flows from NCWRP by 2010	+
Reduced stress on Bay-Delta	+
Avoided greenhouse gas emissions	+
Improved Dry Year Landscape Appearance	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The main capital expenditures for the project include 18,000 feet of new pipe, a new transmission main, retrofits at parklands, and a demonstration-level advanced water treatment. Construction is expected begin in 2009 and be completed by mid-2011. It is assumed that approximately ¼ of the capital costs would be incurred in 2009, ½ would be incurred in 2010, and the remaining ¼ would be incurred in 2011. Expected capital costs total $13.5 million. Assuming a 6% real discount rate and a 50-yr project life, the present value (in 2006 US$) of capital costs is approximately be $11.3 million.

O&M costs will be incurred annually beginning in 2009. During the first two years of construction, projected O&M costs are $25,000 per year ($5,000 for administrative costs, $5,000 for maintenance, and $15,000 for operations). Beginning in 2011 (when RW delivery begins) through the end of the project life, annual O&M costs are projected to increase to $43,000 ($8,000 for administrative costs, $10,000 for maintenance, and $25,000 for operations). Assuming a 6% real discount rate, the present value (in 2006 US$) of total O&M over the 50-year project life is estimated to be $0.6 million.

The present value of the total cost of the project, including capital and O&M, is estimated to be $11.2 million. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-7.

The "Without Project" Baseline

Without the proposed project, imported water supplied by the Water Authority would be used to irrigate the community open spaces, medians, slopes, and parklands that would have utilized RW as part of the project.

In addition, without the project, approximately 1900 AFY (1.7 MGD) of water treated at NCWRP would not be put to beneficial use. Instead, that water would go to Point Loma and be discharged to the ocean. This volume of wastewater accounts for approximately 28%[19] of the City of San Diego's current "shortfall" towards meeting the EPA goal of putting 50% of flows into NCWRP to beneficial use.

Without the demonstration advanced water treatment plant, the City would not be able to proceed with full-scale indirect potable reuse, which will ultimately provide 12,000 AFY of drought proof potable supplies to offset imported water.

Water Supply and Water Quality Benefits

This project will create both water supply and water quality benefits in the San Diego region. The key water supply benefits are avoided imported water costs and improved water supply reliability. The key water quality benefits are avoided discharges from Point Loma and avoided introduction of salts to the basin. These benefits are described in the following sections. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-7.

Water supply benefits

Avoided imported water costs

By providing the distribution system and retrofits necessary to use replace potable water with RW for landscape irrigation, the proposed project would offset potable water use by 1904 AFY. The Water Authority supplies potable water to the City of San Diego. It is assumed that the RW would offset imported water by 1904 AFY, beginning in December, 2010.[20]

In addition to the 1904 AFY of potable water offset by Parts 1 and 2 of the project, the full-scale IPR / RA will generate 12,000 AFY of potable supply on completion. Because the timing and cost of Phase 3 are uncertain, this benefit has not been monetized.

The proposed project (excluding future yield from the full-scale IPR / RA project) would avoid imported water purchases of approximately $1.5 million per year in 2011. Assuming a 6% real discount rate and escalating imported water costs, the present value (in 2006 US$) of total avoided purchases of imported water over the 50-year project life is estimated to be $28.8 million.

Improved Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed project will provide a local water source that will help the City of San Diego sustain water supplies through drought periods or imported supply reductions. Assuming a 20% cutback scenario, the additional 1,904 AFY water made available by the project would reduce the shortfall by approximately 4% (1904 AF out of 0.2*220,000 AF).[21] This number would significantly increase with consideration of the 12,000 AFY of supply projected from the full-scale IPR / RA project; however, because the timing and cost of Phase 3 of the project are uncertain, this benefit cannot be monetized at this time.

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies do indicate that residential and industrial (i.e. urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual

[19] The City established a reuse goal of 12 MGD by the end of 2010 to fulfill the EPA grant goals. As of 2005, approximately 6 MGD of recycled water is beneficially reused, so the existing shortfall is 6 MGD (or 6720 AFY). This project will beneficially reuse 1,9000 AFY, thereby contributing to 28% (1,9000/6720) of the City's reuse goal.

[20] It is assumed that SDCWA would not reduce use of local groundwater, given the preference to use local over imported supplies, especially given the cost difference. The average cost to pump and treat groundwater is $150/AF, compared to nearly $600/AF to obtain, treat, and deliver MWD water.

[21] City of San Diego's imported water demand 2010 projection is 197,320 AF; imported water accounts for 90% of total supply, so demand in 2010 is approximately 220,000 AF (source: SDCWA UWMP 2005).

value of reliability ranges from $88 to $461 per household (updated to 2006 dollars) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought; see Appendix 8-22 for a full discussion of reliability and values).

The challenge for use of these values to determine a value of the project is recognizing how to reasonably interpret these survey-based household monetary values The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas the proposed project enhances overall reliability, but does not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For the proposed project, we adjust the lower bound of the literature values downward from $88 per household per year to approximately $3.80 per household per year to adjust for the partial increase in reliability associated with the relatively small amount of new water supply relative to total demands.[22] When multiplied by the 469,689 households[23] in the City of San Diego, the potential benefit from increased reliability is approximately $1.8 M per year. Assuming a 6% discount rate, the present value of improved reliability over the 50-year project life is over $25 million.

Due to uncertainties in applying values from the literature to this situation, we have not included this as a monetized benefit for this project. Instead, this value is provided here to give an idea of the possible magnitude associated with this benefit.

Water Quality Benefits

Avoided Discharges from Point Loma

The proposed project enables 1.7 MGD of RW to be put to beneficial reuse, and therefore avoids secondary treated wastewater discharges to the ocean from Point Loma of 1.7 MGD.

Avoided Introduction of Additional Salts to the Region

By serving municipal and industrial (M&I) customers recycled water in lieu of imported water, this project avoids the introduction of additional salts (i.e. total dissolved solids) to the basin. According to MWD's 2005 Urban Water Management Plan, the average TDS concentration of SWP water delivered through the East Brach is approximately 250 mg/l. TDS concentrations in CRA water are higher, approximately 650 mg/l. Approximately 40% of SDCWA's imported water is SWP water and 60% is CRA water. Therefore, one AF of imported water contains, on average, 1332 lbs of salt[24]. By providing RW to the existing and future customers described above, the proposed project would offset demand for imported water in San Diego by approximately 1904 AFY. Therefore, this project would avoid introducing over 1,150 metric tons of salt to the basin per year, and over 57,500 metric tons of salts over the 50-year life of the project.

Improved Potable Water Quality

With completion of Phase 3 of the IPR / RA project, potable water quality delivered to customers will improve. Water produced in the advanced treatment process will be approximately 400 mg/L lower in TDS than current supplies. This reduction will assist the City with water reclamation efforts and groundwater management efforts by reducing the need for expensive demineralization processes, and benefits the City's customers by extending the life of water heaters and other household fixtures.

[22] The contribution of 1,900 AFY by this project toward 100% reliability can be characterized relative the size of a potential 20% shortfall in supply. A 20% supply shortfall would be about 44,000 AF (based on a project total supply need of 220,000 AF by 2010). Adding 1900 AFY of RW would offset about 4.% of such a shortfall (1715/44,000), implying an approximate value per household of 4.% of $88 per year (lower bound), which equals about $3.80 per household annually.

[23] Household estimate for year 2000 from US Census (http://quickfacts.census.gov/qfd/states/06/0666000.html).

[24] 1AF = 1233482 liters; 250 mg/l = 308370460 mg/AF and 650 mg/l = 801763196 mg/AF; 1mg = 2.2 x 10-6 lbs; therefore, if 46% of supply has concentration of 250 mg/l and 54% has a concentration of 650 mg/l, then, in terms of lbs per AF, the concentration of salts is approximately 1332 lbs/AF.

Based on estimates in the 1999 Salinity Management Study (MWD, U.S. Bureau of Reclamation), this reduction in TDS could produce a monetized benefit of $200 / AF in savings. For a 12,000 AFY project, that translates to $2,400,000 per year. This benefit has not been included in this analysis due to uncertainty associated with the timing and cost of the Phase 3 project; however, this will be an important benefit from the Phase 2 project.

Distribution of project benefits, and identification of beneficiaries

The proposed project would lead to benefits realized in the City of San Diego (local), throughout San Diego County (regional), as well as benefits realized statewide. Table 4 presents a summary of project beneficiaries.

Table 6.3: Project Beneficiaries Summary

Local	Regional	State
Member agencies, Recreational Park Users, Homeowners, Commuters	SDCWA, MWD, Regional Beach Users, Point Loma Wastewater Treatment Facility (Avoided Capacity Expansions), other communities interested in implementing indirect potable reuse	Other water agencies that depend on MWD water for their local supplies; Californians interested in the preservation of the Delta smelt and the aquatic habitat of the Bay-Delta; Californians concerned with reducing the State's total GHG emissions; Bay-Delta Ecosystem, Visitors to Region, California Citizens Other communities interested in implementing indirect potable reuse

Project Benefits Timeline Description

All components of construction related to this project would be complete by 2011. Sufficient retrofits and distribution system expansion would be complete by December, 2010 to enable RW to be used at that time. Benefits resulting from this project (increased supply reliability, avoided imported water costs, avoided groundwater pumping costs, avoided introduction of additional salts to the basin, and avoided discharges from Point Loma) would all begin to accrue in 2011 and extend through the full 50-year project life.

Potential Adverse Effects from the Project

Any potential short-term impacts associated with the retrofits and/or construction of the recycled water distribution system will be mitigated. No long-term adverse effects are expected as a result of the proposed project.

Summary of Findings, Tables

The proposed project will generate both water quality and water supply benefits. Although the key water quality benefits could not be monetized, the benefit of avoided discharges at Point Loma was described qualitatively and a quantitative analysis of the avoided introduction of salts to the basin was provided. Both are summarized again below. Monetary estimates were included for water supply benefits to provide a relative sense of the potential magnitude of each benefit and are described in more detail below. The monetary benefits associated with full-scale implementation of the IPR / RA project were described above, but could not be monetized due to uncertainties associated with the timing and costs of Phase 3 of the project. The value of the avoided cost of imported water and the reduced costs associated with transporting imported water are the only benefits that we include as monetized benefits to be compared

against the cost of the project. The present value of these benefits alone are over $23 million greater than the present value of the cost of the project.

Replacing imported water with locally produced RW avoids introducing additional salts to the basin. As summarized above, by offsetting SWP and CRA water imports by 1,904 AFY, the proposed project avoids the introduction of over 1,150 metric tons of salt to the basin each year (over 57,000 tons over 50 years).

Although the estimated value of improved water supply reliability was not included as monetized benefit, the estimated monetary value of this benefit was calculated. According to the lower bound of the values found in the literature ($88 per household), the number of households in the City of San Diego (approximately 470,000), and the portion of potential water supply shortfall avoided by the provision of locally produced RW (0.1%), the estimated annual value of improved water supply reliability is $1.7 million. The potential value of this benefit, over the 50-year project life (in terms of present value) is approximately $25 million.

By offsetting 1,904 AF of imported water per year, the proposed project avoids annual imported water purchases of $1.5 million, beginning in 2011. Over the 50-year life of the project, the present value of this benefit totals $28.8 million. Similarly, by offsetting 1,904 AFY of imported water, $203,000 per year in power cots associated with transporting the imported supply are avoided, for a present value of $5.0 M over the life of the project. These benefits together are approximately $23 million greater than the present value of the cost of the proposed conveyance project ($8.1 million).

In summary, the benefits associated with this project outweigh the costs.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. Such issues are listed in the following table.

Table 6.4: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Improved water supply reliability	++	The monetized value of added reliability is not included in the benefit-cost comparison. If we had added the present value benefit of improved water supply reliability in the overall benefit-cost analysis, it would increase net benefits. This value could be an over or underestimation of the actual value San Diego residential water customers place on improved reliability. The values used to calculate this benefit were conservative (based on the lowest end of the empirical range found in the literature). The value of reliability to commercial, institutional, and industrial (CII) customers was not included in the illustrative empirical analysis.
Avoided imported water costs	++	The avoided cost estimate for offset water imports is based on projected increases in the cost of delivery MWD-supplied waters from the SWP and Colorado River. Recent and future climatic conditions (e.g., drought, decreased snow pack, climate change) and regulatory/ legal issues (e.g.,

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
		federal Court rulings reducing SWP extractions from the Bay-Delta) combine to make it more likely than not that the future availability of MWD-provided imported waters will be increasingly constrained, and that costs will escalate at rates higher than experienced in the recent past. The projections also are driven by "normal year" expectations, whereas dry year conditions will add additional cost pressures (and may move some of the imported water to higher cost Tier 2 levels). On net, the projected benefits due to reducing the local demands for imported waters are probably understated in this analysis.
IPR / RA Project Benefits	+	Benefits associated with the IPR / RA project could not be monetized due to uncertainty associated with the cost and timing of Phase 3 of the project. However, if these benefits could be monetized, the total benefit of the project would increase significantly.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

LOCAL SUPPLY PROTECTION AND DEVELOPMENT PROGRAM

Work Item #7: San Vicente Reservoir Source Water Protection through Watershed Property Acquisition and Restoration

This project will acquire and restore lands immediately around San Vicente Reservoir and some lands more distant, but still within the San Vicente Reservoir for the purposes of source water protection, pollution prevention, habitat preservation, and restoration in the San Vicente Watershed. Through the San Vicente Dam Raise project, the dam will be raised at least 54 feet and as much as 117 feet. This will reduce the amount of publicly-owned land surrounding the reservoir that acts as a source water protection buffer. In compliance with guidelines of the California Department of Health, the San Diego Water Department has established a 1000 foot source water protection buffer from the high waterline of the reservoir.

One component of this project is development of an acquisition plan for the watershed. This plan would target two types of properties: (1) properties necessary to create at least a 1000 foot buffer around the enlarged reservoir high water line and (2) "acquisitions of opportunity" elsewhere in the watershed guided by a source water protection plan. Project elements would include a survey of the affected areas to identify areas where improvements would lead to improved water quality and implementation of appropriate measures to alleviate water pollution issues. Other project activities would include development of appropriate management directives, control of invasive species, installation of fencing as needed to preclude unauthorized access, the establishment of buffers to preclude impacts associated with surrounding agricultural and urban land uses and identification of areas where public access and recreational opportunities could be incorporated. Acquisition of these areas would also provide for preservation in perpetuity of biological resources of high value.

The project would provide the following benefits:

(1) Ownership and management by the Water Department of lands intended to ensure the safety and reliability of the drinking water supply;
(2) Acquisition and protection of parcels of habitats contiguous to other areas that have been acquired for conservation and limited recreation opportunities. The proposed project would act as part of a mosaic within this portion of the watershed that will allow for the conservation of important regional wildlife habitat providing for linkages and wildlife movement corridors in perpetuity;
(3) Maintenance and improvement of the quality of source drinking water. Improved water quality should lead to reducing costs of treatment to achieve potable water;
(4) Establishment and management of critical buffers for source water quality protection that serves as part of the regional Emergency Storage Project;
(5) Minimization of the introduction of pollutants into water supply reservoirs and their tributaries;
(6) Reduction of the potential of pollutants into the water supply and other water bodies by targeting illegal dumping and other unauthorized activity which has negative consequences for water quality purposes (focus would be on source controls);
(7) Exotic species mapping, removal and control;
(8) Control of activities associated with agricultural land uses (such as cattle grazing) which hinder water quality, the drinking water supply and habitat conservation efforts;
(9) Increased participation by varied stakeholders in regional efforts aimed at improved water quality and conservation planning;
(10) Imposition and enforcement of stricter controls to minimize adverse effects to water quality and conservation planning;
(11) Further implementation of specific actions and objectives consistent with the MSCP, which reflects priorities and goals established at the national, state and local levels.

The water supply and water quality benefits associated with this project are summarized in the following tables. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-8.

Table 7.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Supports San Diego Emergency Storage Project	Qualitative	Local, Regional
Water Quality		
Prevent NPS pollution	Qualitative	Local, Regional
Prevent impervious surfaces	Qualitative	Local, Regional
Other Benefits (described in Attachment 9)		
Supports San Diego Emergency Storage Project	Qualitative	Local, Regional
Prevent NPS pollution	Qualitative	Local, Regional
Prevent increase in impervious surfaces	Qualitative	Local, Regional
Preserves land for habitat	Qualitative	Local
Ecosystem restoration enabled	Qualitative	Local
Provides passive recreation opportunity	Qualitative	Local, Regional
Protection of special status species	Qualitative	Local, Regional, State

Table 7.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$1.04 M
Monetizable Benefits	None readily monetizable
Qualitative Benefits	**Qualitative indicator***
Supports San Diego Emergency Storage Project	+
Prevent NPS pollution	+
Prevent impervious surfaces	+
Preserves land for habitat	+
Ecosystem restoration enabled	+
Provides passive recreation opportunity	+
Protection of special status species	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Because this is a land acquisition and restoration project, costs are incurred only during years 2008, 2009, and 2010. These costs have been distributed equally over the timeframe for each activity. The present value total cost for this project is $1,040,693 in 2006 dollars. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-8.

The "Without Project" Baseline

The City of San Diego Water Department owns and manages approximately 2,600 acres within the San Vicente Reservoir watershed for the purpose of source water protection. Currently a buffer exists around the reservoir for purposes of source water protection. Through implementation of the San Vicente Dam Raise Project, this buffer will be substantially reduced. San Vicente Reservoir currently experiences seasonal problems with excessive algal growth and associated low dissolved oxygen conditions caused by excessive nutrients. Algal blooms produce taste and odor problems that require special treatment and sometimes force Water Department operators to abandon San Vicente Reservoir as a water source. These algal blooms also contribute to excessive total organic carbon levels. Total dissolved solids are also of concern because of water imported from the SWP and CRA.

Water Supply and Water Quality Benefits

Water Supply and water quality benefits provided by the project are presented below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-8.

Water Supply Benefits

<u>Supports San Diego Emergency Storage Project</u>

This project supports the Water Authority's Emergency Storage Project, which include the enlargement of San Vicente reservoir (known as the San Vicente Dam Raise Project) and the San Vicente Pipeline Project which will connect San Vicente Reservoir to the regional aqueduct system. The San Vicente Pipeline is under construction and anticipated to be operational in 2008. The San Vicente Dam Raise is currently being designed and is anticipated to be complete by 2012. Assuming the dam is raised 54 feet, it will provide an additional 52,000 acre feet of additional storage capacity. If it is raised 117 feet, it will provide as much as 150,000 acre feet of additional storage capacity. This project will ensure an adequate buffer is in place to provide water quality protection before and after these projects have been implemented.

Water quality benefits

<u>Prevent NPS pollution</u>

San Vicente Reservoir is listed as water quality impaired on the 2006 303(d) list. Water from this reservoir is also transferred to Murray and El Capitan Reservoirs, which are also 303(d) listed for color, manganese, pH (high), and sulfates. The greatest management challenges are nutrients, total organic carbon, and total dissolved solids. Nutrients, nitrogen and phosphorous, in particular, cause seasonal algal blooms that reduce the dissolved oxygen in the reservoir, cause taste and odor problems that exceed the City of San Diego's goals, and increase total organic carbon levels (which act as precursors to disinfection by-products, found to have adverse human health effects at low levels). These pollutants are a result of urban runoff, recreational boating, and concentrated animal facilities. Preserving more land from development and restoring fire-damaged lands will help prevent further water quality degradation as a result of general disturbance, development or agricultural use of the land.

<u>Prevent development of impervious surfaces</u>

Preventing the development of these parcels will prevent large impervious surfaces from being built on the land. This ensures continued natural filtration mechanisms that help to purify water. Preventing the development of impervious surfaces maintains a more natural hydrologic regime of subsurface runoff and prevents an increase in Horton overland flow (surface runoff) that reaches the stream channel very

quickly, often carrying constituents of concern from developed areas and increasing consequent erosion and sedimentation (as well as increasing flooding and habitat damage).

Distribution of Project Benefits, and Identification of Beneficiaries

Water from San Vicente reservoir is treated at the Alvarado Water Treatment Plant and then distributed to customers in the San Dieguito, Penasquitos, San Diego, Pueblo, Sweetwater, Otay, and Tijuana hydrologic units. Water customers in all of these hydrologic units will receive the water quality benefits of an increased source water protection buffer and restoration of fire-damaged lads adjacent to the reservoir. Ecological benefits are more local in nature, while recreational benefits accrue to all recreational users of San Vicente Reservoir throughout the region. Species protection will benefit many individuals and organizations holding these values throughout the state as well as the State of California itself. The following table summarizes beneficiaries of this project.

Table 7.3: Project Beneficiaries Summary

Local	Regional	Statewide
Nearby residents, local recreational users of the Reservoir, and sensitive local plant and animal species	Customers in the San Dieguito, Penasquitos, San Diego, Pueblo, Sweetwater, Otay, and Tijuana hydrologic units. Recreational users of San Vicente Reservoir throughout the region	Individuals and organizations holding values for land and wildlife preservation and reduced threats to impaired waters.

Project Benefits Timeline Description

This project will complete an acquisition plan by 2008, appraisal of the properties and negotiations with the landowners throughout 2009, and acquisition and restoration of the properties in 2010. All benefits would start accruing upon acquisition in 2010, except for possible ecosystem restoration and passive recreation, which would accrue upon completion of land management planning or other post-acquisition management activities.

Potential Adverse Effects from the Project

No adverse effects are anticipated as a result of acquiring and restoring these parcels of land.

Summary of Findings, Tables

The water quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost.

Table 7.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Supports San Diego Emergency Storage Project	+
Prevent NPS pollution	+
Prevent impervious surfaces	+

Work Item #8: El Capitan Reservoir Watershed Acquisition and Restoration Program

This project proposes the acquisition and restoration of several parcels of land. There are two primary targeted properties – one property consists of two parcels totaling 126 acres and the second property consists of three 40 acre parcels. These primary targeted properties total 246 acres. This project has also identified two additional properties as back up acquisitions if problems arise with either of the primary targeted acquisitions. All of these acquisitions and subsequent restoration efforts provide for source water protection, pollution prevention, and habitat preservation in the El Capitan reservoir watershed. One property is the last parcel at the reservoir high water mark not in public ownership. The other properties are near the reservoir and are private inholdings within the Cleveland National Forest. At 112,000 acre feet of storage, El Capitan Reservoir is the largest capacity reservoir in San Diego County.

According to the San Diego River Watershed Management Plan, the City of San Diego Water Department "has concluded that diffuse NPS [pollution] from residential and commercial developments are the most significant sources of [constituents of concern] in the management area" (2005: 40). Furthermore, the El Capitan Management Area and the Upper San Diego River specifically has been identified as a critical wildlife corridor and an area of unique biological value. The acquisition of these properties will complete a public land buffer around the reservoir to enable an increase in reservoir storage capacity, prevent further degradation of the water quality in the Upper San Diego River and El Capitan Reservoir, preserve land for habitat, ensure recreational access, protect species, and preserve the continuity of public lands in the area.

Project benefits are summarized in the following tables. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-9.

Table 8.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Enable future increase in storage capacity	Qualitative	Local, Regional
Other Benefits (described in Attachment 9)		
Prevents increase in impervious surfaces		
Preserves land for habitat	Physical quantification	Local
Ecosystem restoration enabled	Qualitative	Local
Provides passive recreation opportunity	Physical quantification	Local, Regional
Protection of special status species	Qualitative	Local, Regional, State
Provides connectivity with protected lands	Qualitative	Local

Table 8.2: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$1.06 M
Monetizable Benefits	None readily monetizable
	Qualitative indicator*

Qualitative Benefits	
Enable future emergency storage	+
Prevents increase in impervious surfaces	+
Preserves land for habitat	+
Ecosystem restoration enabled	+
Provides passive recreation opportunity	+
Protection of special status species	+
Provides connectivity with protected lands	++

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to any quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Costs for this land acquisition and restoration project will be incurred during years 2008 and 2009. The present value total cost for this project is $1,061,048 in 2006 dollars. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-9.

The "Without Project" Baseline

The parcels targeted for acquisition and restoration are buildable lots in close proximity to El Capitan Reservoir, one of which lies at the reservoir's high water line. Other properties lie nearby within the Cleveland National Forest, and the U.S. Forest Service would be required to allow for the construction of access roads to serve the properties, magnifying the development footprint of these parcels.

The City of San Diego Water Department "has concluded that diffuse NPS [pollution] from residential and commercial developments are the most significant sources of [constituents of concern] in the management area" (2005: 40). In 2003 the Cedar Fire burned this entire management area, and water quality issues associated with sediment loading and nutrient cycling will persist for many years. Furthermore, El Capitan Reservoir was listed in 2006 as a 303(d) impaired water body for manganese, pH and color. Any further development in the area will worsen the impacts to this water body.

Water Supply and Water Quality Benefits

Water supply and water quality benefits of the project are presented below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-9.

Water supply benefits

<u>Enable Future Increase in Storage Capacity</u>

By acquiring and restoring the last parcel of land at the reservoir high water mark in private ownership, this project opens the possibility of raising the dam to increase the storage capacity of this reservoir.

Water Quality Benefits

<u>Prevent NPS pollution</u>

El Capitan reservoir is a 303(d) listed water body for manganese, pH and color. Preventing further development of the area will prevent further construction and residential runoff that may adversely affect the water quality of El Capitan reservoir and the San Diego River watershed.

Downstream, the mouth of the San Diego River discharges into the Pacific Ocean at the community of Ocean Beach. Beach postings and closures from elevated levels of coliform bacteria more than doubled between 1996 and 1999 due to urban runoff and sewage spills. Discharge from the San Diego River

outlet may also influence water quality in other nearby coastal areas, including Sunset Cliffs, Pacific Beach, and Mission Beach.

Prevent development of impervious surfaces

Preventing the development of these parcels will prevent large impervious surfaces from being built on the land. This ensures continued natural filtration mechanisms that help to purify water. Preventing the development of impervious surfaces maintains a more natural hydrologic regime of subsurface runoff and prevents an increase in Horton overland flow (surface runoff) that reaches the stream channel very quickly, often carrying constituents of concern from developed areas and increasing consequent erosion and sedimentation (as well as increasing flooding and habitat damage). Because the U.S. Forest Service would be required to allow the construction of roads to reach the two inholding parcels within the Cleveland National Forest, the footprint of impervious surfaces associated with these parcels could significantly exceed the size of the home, driveway, and other structures.

Distribution of Project Benefits, and Identification of Beneficiaries

These acquisitions and restoration efforts were proposed by a community-based organization. If successful, these projects would leverage private funds for a greater public good and empower the community to participate in decisions which impact the future of their community. The State of California's San Diego River Conservancy 5 year Strategic and Infrastructure Plan and the San Diego River Coalition Work Plan recommend acquisition of these properties. These acquisitions are also consistent with the goals and objectives of the San Diego River Watershed Management Plan. Because El Capitan Reservoir is San Diego County's largest reservoir and it serves customers throughout the Region. Project beneficiaries are summarized in the following table.

Table 8.3: Project Beneficiaries Summary

Local	Regional	Statewide
Communities, habitats, and species of concern within the watershed	Recreational users of El Capitan reservoir and the Cleveland National Forest , ocean communities of Ocean Beach, Sunset Cliffs, Pacific Beach, and Mission Beach Potable water customers throughout the Region	Visitors to the Reservoir

Project Benefits Timeline Description

This project will complete the appraisal of the properties by 2008 and acquisition by 2009, with restoration to follow. All benefits would start accruing upon acquisition in 2009, except for ecosystem restoration and passive recreation, which would accrue upon completion of land management planning and other post-acquisition management activities.

Potential Adverse Effects from the Project

No adverse effects are anticipated as a result of acquiring and restoring these parcels of land.

Summary of Findings, Tables

The water supply and water quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. The following table summarizes the qualitative benefits that will be generated by the project.

Table 8.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Enable future increase in storage capacity	+
Prevent NPS pollution	+
Prevent development of impervious surfaces	+

Work Item #9: Northern San Diego County Invasive Non-Native Species Control Program

The Northern San Diego County Invasive Non-Native Species Control Program will eradicate 505 acres of targeted invasive non-native plant species throughout Northern San Diego County. More specifically, it would target five invasive species: giant reed (*Arundo donax)*, pampas grass (*Cortaderia selloana*), Tamarisk, Perennial pepperweed *(Lepidium latifolium)* and eucalyptus. It would protect and enhance habitat in the San Juan, Santa Margarita, San Luis Rey, Carlsbad and San Dieguito hydrologic units; conserve water resources by increasing available groundwater; protect water delivery and storage systems by reducing flood risk and damage; improve water quality by reducing erosion through minimizing bank failures and normalizing sediment discharge processes; and reduce fire risk.

This project would treat 505 acres of high impact invasive non-native plants: 110 acres of *Arundo*, 40 acres of pampas grass, 15 acres of eucalyptus, 225 acres of pepperweed, and 120 acres of tamarisk. Total water savings from the project would be approximately 960 AFY. Control of invasive species and native re-vegetation of riparian habitat would also benefit many federally endangered species in the area, such as least Bells' vireo, southwestern willow flycatcher, arroyo toad, California Least Tern, and the California Light-footed clapper rail in addition to other listed species.

The proposed Invasive Non-Native Species Control Project will result in water supply, water quality, and other benefits that are summarized in the following tables. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-10.

Table 9.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits		
Increased water supply availability	Physical quantification	Local, Regional
Water Quality Benefits		
Decreased Salinity		
Other Benefits (described in Attachment 9)		
Improved Habitat Benefit for Threatened and Endangered Species	Qualitative	Local, Regional
Improved Flood Protection and Erosion Mitigation	Qualitative	Local, Regional
Increased Fire Hazard Mitigation	Qualitative	Local, Regional
Recreation and Public Access Benefits	Qualitative	Local, Regional

Table 9.2: Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$2.5 M
Monetizable Benefits	None readily monetizable
	Qualitative indicator*
Qualitative Benefits	
Increased water supply availability	++
Decreased salinity	+
Improved Habitat Benefit for Threatened and Endangered Species	+
Improved Flood Protection and Erosion Mitigation	++
Increased Fire Hazard Mitigation	++
Recreation and Public Access Benefits	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Present value Invasive Non-Native Species Control Program costs total approximately $2,478,441. The overall planning and removal work will be accomplished from June 2008 through June 2011. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-10.

The "Without Project" Baseline

Without the Invasive Non-Native Species Control Program, arundo, tamarisk, and the other invasive species would continue to spread, covering a greater percentage of the four impacted watersheds and exacerbating the following negative impacts.

- **Water Quality:** Reduction in the shading of surface water, thereby resulting in reduction of bank-edge river habitat, higher water temperature, lower dissolved-oxygen content, elevated pH, and conversion of ammonia to toxic unionized ammonia.
- **Water Supply:** Loss of surface and groundwater through heavy water consumption and rapid transpiration.
- **Flooding:** Obstruction of flood flows with associated damage to public facilities, including bridges and culverts, and to private property such as farmland.
- **Erosion:** Increased erosion of streambanks, associated damage to habitats and farmlands due to channel obstructions, and decreased bank stability associated with shallow-rooted arundo.
- **Fire Hazards:** Substantially increased danger of wildfire occurrences, intensity, and frequency, and a decreased role as a firebreak or buffer of riparian areas infested with arundo.
- **Native Habitats:** Displacement of critical riparian habitat through monopolization of soil moisture by dense monocultures of arundo and tamarisk.
- **Native Wildlife:** Reduction in diversity and abundance of riparian-dependent wildlife due to decreased habitat quality, loss of food and cover, and increased water temperatures.
- **Threatened and Endangered Species:** Substantial reduction in suitable habitat available for state and federally listed species, such as the least Bell's vireo.

Water Supply and Water Quality Benefits

The Invasive Non-Native Species Control Program will generate the following water quality and water supply benefits for the regions watersheds. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-10.

Water Supply Benefits

Increased water supply availability

Arundo and tamarisk use much larger amounts of groundwater and surface water than native species. Removing these species will leave more water in the area by increasing stream flows.

Tamarisk consumes approximately 3.95 AFY per acre and arundo consumes 5.62 to 20.71 AFY per acre, depending on climatic conditions and water availability. Assuming this project will treat 110 acres of arundo and 120 acres of tamarisk, and using the mid-point of the range for arundo water consumption (13.2 AFY/acre), the Invasive Non-Native Species Control Program will save an estimated 1,972 AFY. This saving is the sum of 1,498 AFY from arundo removal and 474 AFY from tamarisk removal. Over the expected life of this Project (50 years), this sums to 74,900 AF from arundo removal and 23,700 AF from tamarisk removal, for a total of 98,600 AF.

Water Quality Benefits

Decreased Salinity

Tamarisk deposits concentrate salt from its leaves to the soil. This salt originates from the soil and from deeper aquifers, as its taproot can bring up water from 100 feet deep. When these leaves drop, increased soil salinity and salts are deposited into adjacent creeks due to salt transport during runoff. Native plant species are further impacted because they generally cannot tolerate tamarisk's contribution to soil salinity, while arundo can.

Distribution of project benefits, and identification of beneficiaries

Table 4 summarizes Invasive Non-Native Species Control Program beneficiaries. The Invasive Non-Native Species Control Program will benefit the immediate area where it is implemented and downstream users in the four effected watersheds benefiting from increased water supply and higher water quality.

Table 9.3: Project Beneficiaries

Local	Regional	Statewide
Local Habitat and Species, Steelhead, Residents and businesses and cities located in the Santa Margarita, San Luis Rey, Carlsbad and San Dieguito HUs,	Recreational Users of the Santa Margarita, San Luis Rey, Carlsbad and San Dieguito River Hydrologic Units (HUs), San Diego County, Caltrans, downstream users	Recreational Users of the Santa Margarita, San Luis Rey, Carlsbad and San Dieguito River Hydrologic Units (HUs), Citizens of California, Office of Emergency Services

Project Benefits Timeline Description

The Invasive Non-Native Species Control Program would provide benefits in excess of the 50-year project lifetime (2008-2057).

Potential Adverse Effects from the Project

The Invasive Non-Native Species Control Program may have short-term negative impacts during removal work, but steps will be taken to avoid long-term disturbance to habitat and native species living in the area.

Summary of Findings, Tables

Water savings from arundo and tamarisk removal have been physically quantified. The values in this table only include anticipated benefits from the Invasive Non-Native Species Control Program implementation, which will generate 1,452 AFY of water savings from arundo removal (13.2 AFY/acre × 110 acres) and 474 AFY from tamarisk removal (3.95 AFY/acre × 120 acre).

The following table presents the qualitative benefits from the Invasive Non-Native Species Control Program. Removal of tamarisk and arundo will increase water supply availability, and removal of tamarisk will eliminate the additional soil salinity and concentrations of salts in creeks from tamarisk leaves during runoff events.

Table 9.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Increased water supply availability	++
Decreased salinity	+

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainty is associated with the range of estimates in the literature for water consumption per year of arundo. This issue is discussed in the following table.

Table 9.5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Increased Water Availability	U	The estimate of avoided water losses due to removal of arundo and tamarisk are based on the available literature. The estimated consumption per acre for arundo in particular shows wide variability in the literature – from 5.62 to 20.71 AFY. It is assumed here that the midpoint of that range is applicable. Also the estimates of the current amount of acres covered by arundo in the watershed is a reasonable estimate, but is not based on comprehensive visual evidence (such as aerial photos).

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #10: Santa Margarita Conjunctive Use

The proposed Santa Margarita Conjunctive Use Project provides for enhanced recharge and recovery from the groundwater basin on Camp Pendleton to provide a water supply for both Camp Pendleton and Fallbrook as resolution of the long-standing water rights disputes between the United States and Fallbrook. The project will also include a seawater intrusion barrier using recycled water and a distribution system able to deliver water both to Fallbrook Public Utility District and the SDCWA aqueduct system, thereby allowing the transfer of excess water to all SDCWA member agencies. By treating the water with membranes, the TDS of the lower basin will, over time, be reduced as lower TDS water is applied at the surface and migrates to the groundwater supply.

The proposed project will preserve the entire Santa Margarita River, while at the same time, provide for approximately 6,800 AFY of new local supply from the Santa Margarita River by conjunctively managing the groundwater basins on Camp Pendleton. Approximately 1,383 acres of sensitive habitat will be preserved along the river as a result of this project.

A listing of benefits, along with the type of assessment performed in this analysis and the identified beneficiaries is presented in the following table. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-11.

Table 10.1: Summary of Benefits

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Avoided Use of Imported Water	Monetized	Local, Regional and State
Improved Water Supply Reliability	Qualitative	Local and Regional
Water Quality		
Reduced import of salts (TDS) into the region	Quantitative	Local and Regional
Other Benefits (addressed in Attachment 9)		
Reduction in Greenhouse Gas Emissions	Quantitative	Local, Regional and State
Riparian Habitat Preservation	Qualitative	Local and Regional
Santa Margarita River Recreation and Public Access	Qualitative	Local, Regional and State
Bay-Delta Habitat Protection	Qualitative	Local, Regional and State

Table 10.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$182.0 M
Monetizable Benefits	
Water Supply Benefits	$98.7 M
Water Quality Benefits	$14.5 M
Total Benefits	$113.2 M
	Qualitative indicator*
Qualitative Benefits	
Improved water supply reliability	++
Reduction in Greenhouse Gas Emissions	+
Riparian Habitat Preservation	+
Santa Margarita River Recreation and Public Access	+
Bay-Delta Habitat Protection	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Capital costs for the proposed project will total $191,415,274 (including $13,830,000 for Open Space Management Zone land acquisition, which was excluded from Table 8 because it was acquired prior to March 2007). Major capital items included will be a new collapsible diversion weir and 46 acres of new recharge ponds; construction of up to five new wells, with a monitoring, and collection system; advanced water treatment involving construction of membrane filtration, disinfection, and brine disposal facilities at the Rattlesnake Canyon site on Camp Pendleton, adequate to treat 20 million gallons per day; and construction of a distribution system connecting to Camp Pendleton and Fallbrook that includes two pump stations and approximately nine miles of transmission pipeline. Construction is expected to last 3 years – from April 2010 to 2012. Operations and maintenance costs for the project are expected to total $3,250,000 per year, which includes O&M for the pipelines, pumping plants, water treatment operations. The total present value of the capital and O&M costs for the project are expected to be $182,011,788. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-11.

The "Without Project" Baseline

Without the project, the Fallbrook Public Utility District would continue purchasing imported water from the Metropolitan Water District of Southern California. Fallbrook PUD does not currently extract surface or ground water from the Santa Margarita River. FPUD purchases approximately 10,500 acre-feet of water from the SDCWA per year. The District provides imported water and sewer service to 35,000 residents living on 28,000 acres in Fallbrook. Approximately one half of Fallbrook PUD water use is agricultural, while the other half consists of domestic and commercial uses. Most of the farmers at Fallbrook PUD have been purchasing water at a discounted, interruptible rate, making them first to be shorted water in the event of water rationing from MWD and SDCWA. Shortages of at least 30% have been implemented starting January 1, 2008 in response to water shortage conditions for MWD as a result of 8 years of

drought on the Colorado River and court-ordered pumping reductions for the State Water Project in order to protect Delta Smelt in the San Francisco Bay-Delta.

Water Supply and Water Quality Benefits

The project will enable water supply and water quality benefits including avoided cost of imported water purchases, avoided reservoir construction and operation costs, improved water supply reliability for the entire SDCWA service area and for the Fallbrook PUD, and reduced import of total dissolved solids into the basin. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-11.

Water Supply Benefits

Avoided imported water purchases

By providing local supply to offset imported supplies, the proposed project would offset potable water use by 6,800 AFY. It is assumed that the local supply would offset imported water by beginning in 2013. The proposed project would avoid imported water purchases of approximately $6.0 M million per year in 2013. Assuming a 6% real discount rate and escalating imported water costs, the present value (in 2006 US$) of total avoided purchases of imported water over the 50-year project life is estimated to be $98.7 million.

Improved Water Supply Reliability for the SDCWA Service Area

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed project will improve water supply reliability for SDCWA in two ways. First, the project will avoid imported water purchases and replace them with a local source. This means that more of the water used in the SDCWA service area will be local water. Second, the project will be physically interconnected with the SDCWA distribution system. The pipeline installed will provide Camp Pendleton with a connection to the regional water delivery system in case of emergency. These facilities will allow for the transfer of treated water from the project to the SDCWA aqueduct system providing a new local supply to the entire region. The contribution of the roughly 6,500 AFY added by this project toward 100% reliability can be characterized by the relative size of a potential 20% shortfall in regional supply relative to projected demands. A 20% supply shortfall would be roughly 160,000 AF (based on a projected total supply need between years 2015 and 2020 of 800,000 AF). Expanding local supply use by 6,500 AFY would offset about 4.3% of such a shortfall (6,800/160,000).

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies do indicate that residential and industrial (i.e. urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $88 to $461 per household (updated to 2006 dollars) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought; see Appendix 8-22 for a full discussion of reliability and values).

The challenge for use of these values to determine a value of the project is recognizing how to reasonably interpret these survey-based household monetary values The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas the proposed project enhances overall reliability, but does not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this “whole versus part” problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For this analysis, we adjust the lower bound of the literature values downward from $88 per household per year to $3.74 per household per year to adjust for the partial increase in reliability associated with the relatively small amount of new water supply relative to total demands[25]. When multiplied by the

[25] The contribution of the roughly 6,500 AFY added by this project toward 100% reliability can be characterized by the relative size of a potential 20% shortfall in *regional* supply relative to projected demands. A 20% supply shortfall would be roughly 160,000 AF

approximately 704,000 households[26] in the SDCWA service area, the potential benefit from increased reliability is $2.6 million per year. Assuming a 6% discount rate, the present value of improved reliability over the 50-year project life is $29.3 million.

Due to uncertainties in applying values from the literature to the proposed project, we have not included this as a monetized benefit for this project. Instead, this value is provided here to give an idea of the possible magnitude associated with this benefit.

Improved Water Supply Reliability for Agricultural Use at Fallbrook PUD

Use of water from the Santa Margarita River through aquifer storage and recovery would increase the reliability of local supplies for Fallbrook PUD. The District currently does not use any water from the Santa Margarita River, and is completely dependent in imported supplies from SDCWA. Increased water supply reliability for agricultural users in Fallbrook PUD is a very real example of potential for increased water supply reliability as a result of the proposed project.

Approximately one half of Fallbrook PUD water use is agricultural, while the other half consists of domestic and commercial uses. Most of the farmers at Fallbrook PUD have been purchasing water at a discounted, interruptible rate, making them first to be shorted water in the event of water rationing from MWD and SDCWA. Shortages of at least 30% have been implemented starting January 1, 2008 in response to water shortage conditions for MWD as a result of 8 years of drought on the Colorado River and court-ordered pumping reductions for the State Water Project in order to protect Delta Smelt. Agricultural users on the interruptible rate will have deliveries cut back before any reductions in use are ordered for agricultural users paying the full rate or for municipal or industrial customers.

Agricultural production in Fallbrook PUD consists of high value and often high water use crops, including avocadoes. FPUD's service area accounts for approx 15% of San Diego's agricultural production, estimated at $1.5 billion annually. Because almost all agricultural users in Fallbrook PUD are enrolled in the interruptible rate program, an estimated 30% delivery reduction presumably will impact approximately the same percentage of agricultural production. This is estimated to result in an annual loss of $67 million if the 30% supply reduction lasts throughout the growing season.

This value is presented to indicate the likely order of magnitude of this reliability benefit to FPUD agricultural users. However there are at least two reasons why this estimate should not be included in the benefit tables. First, FPUD farmers receive a subsidy from SDCWA and MWD, and these losses may not exist if farmers were not enrolled in the interruptible delivery program. The likelihood of shortage for these farmers if they were not enrolled in the interruptible rate program depends on the ability of other interruptible rate users to make cutback sufficient to meet MWD's water use reduction target. If this target is not met, then users paying the full rate for their water would be asked to incur supply delivery reductions as well. Second, the likelihood of shortages similar to the magnitude of the current shortage is unclear. Past analyses of reliability for delivery of water from MWD to SDCWA, such as SDCWA's 2005 Urban Water Management Plan, have concluded that the likelihood of potential interruptions in delivery from MWD is extremely low. Metropolitan stated that it can maintain 100% reliability in meeting direct consumptive demand under the conditions that represent normal, single-dry, and multiple-dry years through 2030 (SDCWA UWMP 2005).

Improved Water Supply Reliability for Municipal and Industrial Use at Fallbrook PUD

Domestic and commercial use at Fallbrook PUD will also gain water supply reliability as a result of the proposed project. Assuming that half of the current FPUD deliveries are for non-agricultural purposes,

(based on a projected total supply need between years 2015 and 2020 of 800,000 AF). Expanding local supply use by 6,500 AFY would offset about 4% of such a shortfall (6,500/160,000), implying an approximate value per household of 4% of $88 per year (lower bound), which equals about $3.58 per household annually.

[26] Household estimate for all of SDCWA region

and that half of the project yield would be for non-agricultural purposes, a 3,250 AF increase in local annual supplies represents approximately 62% percent of water used to meet non-agricultural demand (5,250 AF). Underground storage associated with the proposed conjunctive use project means the new local source would likely achieve close to 100% reliability. This means that 62% of non-agricultural supply would become 100% reliable while the other 38% of supplies would have the reliability of MWD deliveries through SDCWA. Due to a lack of an estimate of the water supply reliability of imported water from MWD and SDCWA, an estimate of the value of increased reliability for non-agricultural uses at FPUD cannot be made. However, it is clear that there is a significant water supply reliability benefit for non-agricultural FPUD water users.

Water Quality Benefits

Reduced Import of Salts into the Region

The proposed project would avoid import of total dissolved solids (commonly referred to as salts or salinity) into the region. Control of TDS concentrations in local water bodies is a goal of the basin plan for the region. Target concentrations for ground water in the area range from 500 mg/l to 750 mg/l. The recommended secondary drinking water standard for total dissolved solids is 500 mg/l with an upper limit of 1000 mg/l due to taste considerations. Concentrations above 500 mg/l can have significant impact on municipal and agricultural values, by lowering the useful lifetime of water-using devices, and by lowering the yield of salt-sensitive crops.

Water delivered from MWD typically is a blend of about 60% Colorado River water and 40% State Water Project water. Colorado River water has a salinity of around 650 mg/l, while the typical TDS value for SWP water is 250 mg/l. Combined, delivered water has a TDS value of around 490 mg/l. By avoiding import of 6,800 AF per year of imported water into the San Diego region, import of approximately 4,100 tons of salts per year will be avoided. Over the lifetime of the project, a total of 205,500 tons of salts will not be imported into the Region.

This benefit will be particularly important for downstream users. Without the project, imported water is used in Fallbrook PUD and salts are returned to the Santa Margarita River through return flows and runoff. This source of additional salts in the basin is removed by this project. For users in the Fallbrook PUD, it is unclear whether the concentration of TDS in delivered water with the project will be lower or higher than with MWD as the water source. The concentration of TDS in the Santa Margarita River ranged from 274 mg/l to 866 mg/l in 2006. Whether the project will result in lower or higher TDS concentrations for Fallbrook PUD will the salinity in the Santa Margarita River over the course of the year, upstream activities on the Santa Margarita River, and the mix of water sources throughout the year for deliveries from MWD.

Reduced TDS in Water Delivered to FPUD and Camp Pendleton

The treated local Santa Margarita River water to be served to FPUD and Camp Pendleton customers has a lower TDS concentration than does the water currently being served. The proposed project will provide a total of 14,100 AFY of water to FPUD and Camp Pendleton. While 6,800 AFY of this water will be new yield, the remaining 7,300 AFY will replace the currently consumed water mix of groundwater, Santa Margarita River water and imported water. This current supply mix has a TDS concentration ranging from 1,100 to 1,200 mg/l. The proposed project will provide treated Santa Margarita River water with a TDS concentration averaging 425 mg/l.

Although TDS is not considered to be a health issue, it is of concern for several reasons. Some level of TDS is desirable in drinking water and gives it a pleasant taste, but as levels increase beyond 500 mg/l many people complain about the taste. For this reason, US EPA has set a secondary (aesthetic) drinking water standard for TDS of 500 mg/l.

Experience in California communities and others shows that as TDS increases, people take action to avoid unpleasant effects, such as buying bottled water (Raucher et al. 2004, Bruvold, 1990; Woodard et

al. 1993). They may buy water softeners to reduce the effects of hardness[27], which are generally not related to taste. Those factors are scale formation and reduced cleaning efficiency of soaps.
Saline water supplies can corrode and shorten useful lives of water-using appliances such as water heaters, water faucets, dishwashers, clothes washers, evaporative coolers, and garbage disposals. The useful lives of these appliances and fixtures shorten as TDS levels increase (Lohman, 1988; Tihansky, 1974; Ragan, Makela and Young, 1993; Metropolitan Water District of Southern California, 1973). High salinity also can cause deterioration of water pipes over time. Damage can result from increased corrosion of metals that come in contact with the water and from scaling of contacted surfaces. Pipe damage from salinity occurs mostly in steel or iron pipes. Damage can occur both in water mains and in domestic piping (d'Arge and Eubanks, 1978; Lohman, 1988).

A study by Bookman-Edmonston Engineering for MWD and the U.S. Bureau of Reclamation (USBR) pulls together all the literature on effects from a reduction in TDS of water delivered by Metropolitan to households in its service area (Bookman-Edmonston, 1999). The study estimated a $35 million reduction in household costs from a 100 mg/l reduction TDS levels. This means the value per household per mg/l reduction in TDS levels per year is $0.0721 (updated to 2006 dollars). This value can be used to estimate the benefit of a reduction in TDS on FPUD and Camp Pendleton households. FPUD currently serves 35,000 persons. Camp Pendleton has more than 40,000 active-duty personnel and 25,000 reservists that visit the facilities each year. Applying an estimate of persons per household from FPUD (2000 Census – value is 3.0 persons per household) to both the FPUD and Camp Pendleton populations gives 25,000 households. When multiplied by the TDS concentration reduction anticipated from the proposed conjunctive use project and the value of $0.0721 per household per mg/l per year of TDS concentration reduction, this benefit is expected to about $1.3 million annually, or $14.5 million in present value 2006 dollars over the life of the project.

Distribution of project benefits, and identification of beneficiaries

The following table summarizes the beneficiaries of this project.

Table 10.3: Project Beneficiaries Summary

Local	Regional	Statewide
FPUD and Camp Pendleton water users, residents, recreation users	SDCWA, MWD, and their customers	Other water agencies that depend on MWD water for their local supplies. Californians interested in the preservation of the Delta smelt and the aquatic habitat of the Bay-Delta. Californians concerned with reducing the State's total GHG emissions.

Project Benefits Timeline Description

Benefits of the project are expected to accrue throughout the 50-year lifespan of the project. Benefits associated with habitat and recreation are expected to remain beyond the end of the project.

[27] The constituents of hardness are a subset of those that comprise TDS. TDS commonly includes elements such as sodium, calcium, magnesium, chloride, sulfate, and bicarbonate that are combined with forms of sulfur and carbon with oxygen. Thus, TDS includes all the dissolved constituents of other minerals such as table salt (NaCl), gypsum (CaSO4*2H20) and calcium carbonate (CaCO3). Hardness refers to concentrations of calcium and magnesium ions, but is usually reported as mg/l of CaCO3.

Potential Adverse Effects from the Project

Impacts are expected to occur to several acres of upland (e.g. coastal sage scrub) habitat, and temporary impacts will occur to wetland-riparian habitat within the Santa Margarita RIver. The 1,383 acres of proposed mitigation will address all potential project impacts. Biological impacts and mitigation will be analyzed as part of the EIS-EIR. Wetland-riparian habitat impacts associated with the infiltration ponds, Lake O'Neill dredging, diversion canal and replacement of the diversion structure with a collapsible weir will be part of this analysis.

Reclamation anticipates that a 404(R) exclusion will occur under the Clean Water Act and federal agencies are not defined as an "entity" required to obtain a 1602 permit under CDFG code Section 1600. RWQCB 401 & NPDES permits will be obtained as required. Additional information on environmental mitigation can be found in Attachment 11.

Summary of Findings, Tables

The key water supply and water quality benefits associated with the proposed project are: avoided imported water purchases and improved water supply reliability. The present value benefit of the avoided imported water purchases is $98.7 million. Water supply reliability was estimated for three separate groups: the SDCWA service area, agricultural users in the FPUD service area, and municipal and industrial users in the FPUD and Camp Pendleton service areas. Water supply reliability for the SDCWA service area was monetized, with a total projected benefit of $29 million. This estimate was not included in the total monetized benefits due to uncertainties associated with the methodology.

The project has one monetized water quality benefit which results from the reduction in delivered TDS to FPUD and Camp Pendleton customers. The reduction in delivered TDS from 1150 to 450 mg/l will result in avoided household costs associated with high TDS supplies of $14.5 million over the life of the project.

This project will also produce a benefit related to a reduction in salt being imported to the Region. While this benefit cannot be readily monetized, it is estimated that the reduction in imported supplies of 6,800 AFY will result in a reduction in TDS imported to the Region of over 4,100 tons per year, for a total reduction in TDS of 205,000 tons over the life of the project.

In summary, the monetizable water supply and water quality benefits alone do not outweigh the costs without consideration of water supply reliability benefits. However, this project also generates additional qualitative benefits, such as increased potable water supply. A summary of the qualitative benefits is provided in the following table.

Table 10.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Water Supply Benefits	
Increased local potable groundwater supply	+
Reliability of local water supply	++

* Magnitude of effect on net benefits
\+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the calculation of improved water supply reliability. Such issues are listed in the following table.

Table 10.5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
All benefits	+	Benefits in this analysis were developed for Fallbrook PUD only (not Camp Pendleton) because it was assumed that the grant funded portion of the project would not actually benefit Camp Pendleton. If there are benefits to Camp Pendleton that result from the grant funded portion of the project, the net monetized benefits of this project would increase.
Avoided imported water costs	+	The avoided cost estimate for offset water imports is based on projected increases in the cost of delivery MWD-supplied waters from the SWP and Colorado River. Recent and future climatic conditions (e.g., drought, decreased snow pack, climate change) and regulatory/ legal issues (e.g., federal Court rulings reducing SWP extractions from the Bay-Delta) combine to make it more likely than not that the future availability of MWD-provided imported waters will be increasingly constrained, and that costs will escalate at rates higher than experienced in the recent past. The projections also are driven by "normal year" expectations, whereas dry year conditions will add additional cost pressures (and may move some of the imported water to higher cost Tier 2 levels). On net, the projected benefits due to reducing the local demands for imported waters are probably understated in this analysis.
Avoided reservoir construction and operation costs	U	Cost estimates for the project were based on costs for Diamond Valley and Los Vaqueros Reservoirs which range from $21 to $41 million in 2006 dollars. In this analysis, we assumed the mid-point for the cost of this project. Projected O&M costs were not available at the time of the analysis, so these costs were assumed to be $750,000 per year. If either the capital or O&M costs would actually be higher or lower, the value of the benefit of the avoided reservoir construction would be higher or lower.
Improved water supply reliability for the SDCWA service area	++	The benefit of improved water supply reliability as a result of the project was omitted from the monetary estimates; had it been included, the total monetized could be $28 million higher.
Improved water supply reliability for agricultural use at Fallbrook PUD	+	The value of this benefit was not included as a monetized benefit. In a given year, the value of this benefit was estimated to be as high as $67.5 million.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #11: Carlsbad Desalination Local Conveyance

The Carlsbad Desalination Project Local Conveyance project will provide conveyance for 56,000 acre-feet per year (AFY) of new water supply for the San Diego region. Local desalinated water will be conveyed from the proposed Carlsbad Desalination Facility, which will be located at the Encina Power Station in the City of Carlsbad. The distribution system will consist of approximately 14 miles of pipelines and associated pump stations to deliver water to San Diego County Water Authority (SDCWA) member agencies. This project includes conveyance infrastructure alone (excludes the desalination facility itself).

Desalination is a critical element of long-term water planning in the Region and throughout the state. The SDCWA Urban Water Management Plan identifies a need for 56,000 AFY of desalinated seawater (specifically from the Carlsbad Project) by 2011. The Metropolitan Water District of Southern California (MWD) Integrated Water Resources Plan identifies a need for 250,000 AFY of seawater desalination (which includes the 56,000 AFY from Carlsbad) by the year 2020. And, the California Department of Water Resources' 2006 Water Plan Update identifies the need for 500,000 AF of desalinated water by 2030.

Several regional water agencies, including: Carlsbad Municipal Water District, Valley Center Municipal Water District, Rincon del Diablo Municipal Water District and Sweetwater Authority, have entered into long-term water purchase agreements with Carlsbad desalination plant. Collectively, they represent nearly 70% of its capacity. Additional water agencies in the San Diego Region have expressed interest in the remaining water, but the long-term purchase agreements have not yet been signed.

The full benefit of the new water supply depends on the implementation of both the proposed conveyance project and the Carlsbad Desalination facility itself. Therefore, the overall benefits of the new water supply (i.e., the desalination facility and conveyance system combined) will be assessed here as a joint project, and benefits then will be apportioned to the conveyance project according to its relative share of the total cost.

The benefits associated with this project are presented in the following tables. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-12.

Table 11.1: Qualitative Benefits Summary – Water Supply and Water Quality

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Avoided imported water costs	Monetized	Local, Regional
Improved water supply reliability	Qualitative	Local, Regional
Water Quality		
Avoided introduction of salts to the basin	Quantitative	Local, Regional
Other Benefits (described in Attachment 9)		
Reduced stress on Bay-Delta	Qualitative	Statewide
Reduction of Greenhouse Gas Emissions	Qualitative	Statewide
Stewardship of Agua Hedionda Lagoon	Qualitative	Local, Regional
San Dieguito Wetland Restoration Plan	Qualitative	Local, Regional
Dedication of Land for Expansion of Hubbs SeaWorld	Qualitative	Local, Regional
Water Contact Recreation	Qualitative	Local, Regional
Ocean Front and Lagoon Front Property	Qualitative	Local, Regional

Bay – Delta Habitat Protection	Qualitative	Local, Regional, Statewide

Table 11.2: Benefit-Cost Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$92.3 M
Monetizable Benefits	
Water Supply Benefits	$165 M
Total Benefits	$165 M
	Qualitative indicator*
Qualitative Benefits	
Improved water supply reliability	++
Avoided introduction of salts to the basin	++
Reduced stress on Bay-Delta	+
Reduction of Greenhouse Gas Emissions	++
Stewardship of Agua Hedionda Lagoon	++
San Dieguito Wetland Restoration Plan	+
Dedication of Land for Expansion of Hubbs SeaWorld	+
Water Contact Recreation	+
Ocean Front and Lagoon Front Property	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Combined Carlsbad Desalination Facility and Conveyance Projects

The capital cost of the Carlsbad Desalination Facility itself is estimated to be $227.76 million. The joint capital cost of the facility and the conveyance system is estimated to be $307.76 million. Therefore, the relative share of the combined capital cost of the conveyance project is approximately 25%. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-12.

Conveyance Project Only

The main capital expenditures for the conveyance project include 14 miles of new pipe and associated pump station facilities. Construction is expected begin in 2008 and be completed in 2010. It is assumed that approximately 1/3 of the capital costs would be incurred in 2009 and the remaining 2/3 in 2010. Expected capital costs total $80 million. Assuming a 6% real discount rate and a 50-yr project life, the present value (in 2006 US$) of capital costs is approximately $64.9 million.

Operations and maintenance (O&M) costs will be incurred annually beginning in 2010. In 2010, projected O&M costs are $530,000 ($10,000 in administrative costs, $10,000 in replacement costs, $20,000 for

maintenance, $30,000 for operations, and $460,000 for electricity). Beginning in 2011, when desalinated water conveyance begins, annual O&M costs are projected to increase to $2.5 million ($30,000 in administrative costs, $120,000 in operations, and $180,000 in maintenance, $295,000 in replacement costs, and $1.875 million for electricity). Assuming a 6% real discount rate, the present value (in 2006 US$) of total O&M over the 30-year project life is estimated to be $27.7 million.

The present value of the total cost of the conveyance project, including capital and O&M, is estimated to be $92.4 million.

The "Without Project" Baseline

Without the proposed project, the conveyance system needed to deliver desalinated water produced at the proposed Carlsbad Desalination facility would not be constructed, and 56,000 AFY of new, local water supply would not be available to member agencies in the San Diego region. In addition, water supplies in San Diego County (supplied by SDCWA), the southern California Region (supplied by MWD), and the state as a whole would fall short of future demand beginning as early as 2011. Member agencies in long-term water purchase agreements with the Carlsbad Desalination Facility would need to acquire a total of 56,000 AFY of imported water (which may require acquiring new entitlements to imported water and/or purchasing Tier 2 imports through MWD) to meet demand.

Water Supply and Water Quality Benefits

This project will create both water supply and water quality benefits in the San Diego region. The two key water supply benefits are improved water supply reliability and avoided imported water costs. The two key water quality benefits are improved water quality at Agua Hedionda Lagoon and avoided introduction of salts to the basin. These benefits are described in more detail below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-12.

Water supply benefits

Avoided cost of imported water

By providing a new potable water supply, the proposed conveyance project and Carlsbad Facility Project would offset imported water demand by 56,000 AFY. The Water Authority supplies a combination of SWP and CRA imported water from MWD to its member agencies. The proposed projects would avoid imported water purchases of approximately $44 million per year beginning in 2011. Assuming a 6% real discount rate and escalating cost of imported water, the present value (in 2006 US$) of total avoided purchases of imported water over the 30-year project life is estimated to be $659 million.

As mentioned above, the proposed project, which would provide the conveyance system necessary to supply desalinated water from the Carlsbad Desalination Facility, constitutes approximately 25% of the combined capital costs of the facility and conveyance system. Therefore, approximately 25% of the benefit of avoided imported water purchases can be attributed to the conveyance project. The present value (in 2006 US$) of total avoided purchases of imported water attributed to the proposed conveyance project is $164.8 million.

Improved water supply reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed project will provide a local water source that will help the San Diego Region sustain water supplies through drought periods or import supply reductions.[28] The contribution of the roughly 56,000 AFY added by this project toward 100% reliability can be characterized relative to the magnitude of a potential 20% shortfall in supply. A 20% supply shortfall would be about 160,000 AF (based on a projected total supply need between the

[28] Estimated demand for 2010 for the agencies identified as future customers (see Appendix 8-22). Source: "users" are those identified in Table 1 on pg 5 of the Information Request Form; 2010 imported water demand is also from Table 1; Percent of total supply that is imported, source: 2005 member rate survey.

years 2015 and 2020 of 800,000). Producing and distributing 56,000 AFY would offset such a shortfall by 35%.[29]

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies do indicate that residential and industrial (i.e. urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual value of reliability ranges from $88 to $461 per household (updated to 2006 dollars) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought; see Appendix 8-22 for a full discussion of reliability and values).

The challenge for use of these values to determine a value of the project is recognizing how to reasonably interpret these survey-based household monetary values The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas the proposed project enhances overall reliability, but does not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For this analysis, we adjust the lower bound of the literature values downward from $88 per household per year to $30 per household per year to adjust for the partial increase in reliability and the relatively small amount of new water supply relative to total demands.[30] When multiplied by the approximately 704,000 households[31] in the service area of the member agencies that will be served with desalinated water from the proposed Carlsbad facility, the potential benefit from increased reliability is $21.7 million per year. Assuming a 6% discount rate, the present value of improved reliability over the 30-year Carlsbad Desalination Project life is over $236 million.

As mentioned above, the capital cost of the conveyance project constitutes approximately 25% of the total capital cost of both the conveyance project and the desalination facility itself. Therefore, approximately 25% of the benefit of improved water supply reliability can be attributed to the conveyance project. The present value of the portion of the improved reliability benefit attributed to the conveyance project is approximately $59.1 million.

Given the uncertainties associated with how to interpret the available empirical information regarding the value of water supply reliability (lower bound), combined with uncertainty about the possible reliability of the desalination facility to operate as envisioned, we have not included this as a monetized benefit for this project. Instead, this value is provided here to give an idea of the possible magnitude associated with this benefit.

Water Quality Benefits

<u>Avoided introduction of salts to the basin (lower TDS in drinking and recycled water)</u>

Salt concentrations, or TDS, of the desalinated water will be approximately 42% lower than salt concentrations of imported water. By providing the conveyance for 56,000 AFY of desalinated water, the proposed project will offset annual imported water demand by 56,000 AFY. The Water Authority purchases imported water from MWD. According to MWD's 2005 Urban Water Management Plan, average TDS concentration in SWP water delivered through the East Brach is approximately 250 mg/l. TDS concentrations in Colorado River Aqueduct (CRA) water are higher, approximately 650 mg/l. Approximately 40% of SDCWA's imported water is SWP water and 60% is CRA water. One AF of

[29] Estimated demand for 2010 for the SDCWA service area (2005 UWMP).
[30] The contribution of the roughly 56,000 AFY added by this project toward 100% reliability can be characterized relative the size of a potential 20% shortfall in supply. A 20% supply shortfall would be about 160,000 AF (based on a projected total supply need between the years 2015 and 2020 of 800,000). Producing and distributing 56,000 AFY would offset such a shortfall by 35%, implying an approximate value per household of $30.80 (35% of $88) per year.
[31] Household estimate for the 8 member agencies listed in Table 1 (pg 5 of information request form) as listed in the 2005 water rate survey.

imported water delivered to SDCWA contains, on average, 1,332 lbs of salt[32], and the desalinated water contains approximately 735 lbs of salt/AF. Therefore, by offsetting imported water demands by 56,000 AFY, the proposed project would avoid the introduction of nearly 134,000 metric tons of salt[33] into the basin each year. Over the 30-year life of the project, that equates to over 455,000 tons of salt.

Benefits of a lower salinity level in the desalinated water include: (1) providing a more palatable blend to customers (which is possible by blending the desalinated water with the higher TDS imported water) and (2) reducing the cost to produce recycled water (by generating wastewater with lower TDS).

Using a model developed by MWD and the US Bureau of Reclamation, it has been estimated that the value of providing a water supply with a TDS concentration 42% lower than that of imported water would be $157/AF. According to this estimate, by providing desalinated water to member agencies in the San Diego region, the proposed Carlsbad Desalination Facility and conveyance project will provide an annual benefit of avoided salt concentrations valued at $8.8 million (56,000 AF * $157/AF). Assuming a 6% real discount rate, the present value (in 2006 US$) of total value of avoided salts over the 30-year project life is estimated to be $96 million.

As mentioned above, the proposed project, which would provide the conveyance system necessary to supply desalinated water from the Carlsbad Desalination Facility, constitutes approximately 25% of the combined capital costs of the facility and conveyance system. Therefore, approximately 25% of the benefit of reduced TDS can be attributed to the conveyance project. The present value (in 2006 US$) of total avoided purchases of imported water attributed to the proposed conveyance project is $24 million.

At the time of this analysis, specific details regarding the application of MWD/USBR model are unavailable. As a result, this has not been included as a monetized benefit for the proposed conveyance project. Instead, the $19.3 million value is provided here to give an idea of the possible magnitude associated with this benefit.

Distribution of Project Benefits, and Identification of Beneficiaries

The proposed project would lead to benefits realized by the member agencies with long-term purchase agreements (local), throughout southern California (regional), as well as benefits realized statewide, as summarized below.

Table 11.3: Project Beneficiaries Summary

Local	Regional	Statewide
Member agencies purchasing the desalinated water, and their customers	SDCWA, MWD, and their customers	Other water agencies that depend on MWD water for their local supplies. Californians interested in the preservation of the Delta smelt and the aquatic habitat of the Bay-Delta. Californians concerned with reducing the State's total GHG emissions.

Project Benefits Timeline Description

Project construction is expected to be complete by 2011, at which time desalinated water from Carlsbad will be available for distribution. Benefits resulting from this project (increased supply reliability, avoided

[32] 1 AF = 1233482 liters; 250 mg/l = 308370460 mg/AF and 650 mg/l = 801763196 mg/AF; 1mg = 2.2 x 10-6 lbs; therefore, if 46% of supply has concentration of 250 mg/l and 54% has a concentration of 650 mg/l, then, in terms of lbs per AF, the concentration of salts is approximately 1267 lbs/AF.
[33] Each AF of desalinated water avoids 597 lbs of salt`

imported water costs, and avoided introduction of salts to the basin) would all begin to accrue in 2011 and extend through the full 30-year project life.

Potential Adverse Effects from the Project

Any potential short-term impacts associated with construction of the pipelines or pump stations will be mitigated. No long-term adverse effects are expected as a result of the proposed project.

Summary of Findings, Tables

The key water supply and water quality benefits associated with the proposed project are: avoided imported water costs, improved water supply reliability, and avoided introduction of salts to the basin (e.g., lower TDS drinking water and recycled water). Monetary estimates for all three benefits have been included in the analysis to provide a relative sense of the potential magnitude of each benefit and are described in more detail below. The value of the avoided cost of imported water and the avoided power costs associated with transporting imported water are the only benefits that have been included as monetized benefits for comparison against the cost of the project. The present value of these benefits alone is almost $89 million greater than the present value of the cost of the project.

Salinity levels of the desalinated water are lower than those of imported water. By offsetting SWP and CRA water imports by 56,000 AFY, the proposed Carlsbad Desalination Facility and conveyance projects avoid the introduction of over 34,000 metric tons of salt to the basin each year (over 1 million tons over 30 years). Since the proposed conveyance project represents approximately 25% of the combined capital cost of the conveyance project and the desalination facility itself, 25% of this benefit (approximately 254,000 metric tons of avoided salts introduced to the basin) is attributed to the proposed conveyance project. According to a model developed by MWD and the US Bureau of Reclamation, the value of the lower salinity level in the desalinated water (as compared to imported water) is $157/AF, or approximately $5.3 million per year for the 56,000 AFY of produced at the Carlsbad Desalination facility. The present value of this benefit, over the 30-year project life, is estimated to be $58 million, 25% of which ($15 million) is attributable to the proposed conveyance project.

Although the estimated values of improved water supply reliability and avoided introduction of salts to the basin were not included as monetized benefits, monetized estimates were developed for these two benefits. According to the lower bound of the values found in the literature ($88 per household), the number of households in the SDCWA service area (approximately 704,000), and the portion of potential water supply shortfall avoided by the provision of locally produced desalinated water (35%), the estimated annual value of improved water supply reliability is $21.7 million. The present value of this benefit, over the 30-year project life, is estimated to be $236.4 million. Since the proposed conveyance project represents approximately 25% of the combined capital cost of the conveyance project and the desalination facility itself, $59.1 million (25% of $236.4 million) is attributed to the proposed conveyance project.

In total, the potential value of these two benefits (reliability and reduced salt levels), which were not compared against the cost of the proposed project, is $74 million.

The present value of avoided imported water purchases is $164.8 million (in 2006 $). By offsetting 56,000 AF of imported water per year, the Carlsbad desalination facility project and the proposed conveyance system avoid annual imported water purchases of $44 million, beginning in 2011. Over the 30-year life of the desalination facility, the present value of this benefit totals $659 million. Since the proposed conveyance project represents approximately 25% of the combined capital cost of the conveyance project and the desalination facility itself, $164.8 million (25% of $659 million) is attributed to the proposed conveyance project. This benefit alone is nearly $78 million greater than present value of the cost of the proposed conveyance project ($92.1 million).

In summary, the benefits associated with this project far outweigh the costs.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases, summarized below.

Table 11.4: Omissions, Biases, and Uncertainties and Their Effect on the Project

Benefit or cost category	Likely impact on net benefits*	Comment
Improved water supply reliability	++	The monetized value of added reliability is not included in the benefit-cost comparison. If we had added the present value benefit of improved water supply reliability in the overall benefit-cost analysis, it would increase net benefits. This value could be an over or underestimation of the actual value San Diego residential water customers place on improved reliability. The values used to calculate this benefit were conservative (based on the lowest end of the empirical range found in the literature). The value of reliability to commercial, institutional, and industrial (CII) customers was not included in the illustrative empirical analysis.
Avoided introduction of salts to the basin (lower salinity levels)	++	The value of the lower salinity levels of desalinated water compared to imported water was omitted from the monetary estimates. Had it been included the total monetized would be higher.
Avoided imported water costs	++	The avoided cost estimate for offset water imports is based on projected increases in the cost of delivery MWD-supplied waters from the SWP and Colorado River. Recent and future climatic conditions (e.g., drought, decreased snow pack, climate change) and regulatory/ legal issues (e.g., federal Court rulings reducing SWP extractions from the Bay-Delta) combine to make it more likely than not that the future availability of MWD-provided imported waters will be increasingly constrained, and that costs will escalate at rates higher than experienced in the recent past. The projections also are driven by "normal year" expectations, whereas dry year conditions will add additional cost pressures (and may move some of the imported water to higher cost Tier 2 levels). On net, the projected benefits due to reducing the local demands for imported waters are probably understated in this analysis.
Water quality improvements to Agua Hedionda Lagoon	+	Agua Hedionda Lagoon, which is located at the proposed site for the Carlsbad Desalination Facility (the Encina Power Plant site), is comprised of several hundred acres marine wetlands. According to the 2006 CWA 303(d) List of Water Quality Limited Segments Requiring

Benefit or cost category	Likely impact on net benefits*	Comment
		TMDLs, 6.8 acres (approximately 2%) of the lagoon area is impacted by sedimentation. The proposed Carlsbad Desalination Facility project will assume responsibility for maintenance dredging and general stewardship of Agua Hedionda Lagoon after the Encina Power Plant is decommissioned. [34] .

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #12: San Diego Region Four Reservoir Intertie Project Conceptual Design

This project proposes the conceptual design of conveyance infrastructure that would interconnect the San Vicente, El Capitan, Loveland, and Murray Reservoirs (with a combined storage capacity of approximately 233,000 acre feet) to allow for efficient use of water supplies in the Region, increase the region's water supply reliability, allow the use of currently unusable 100,000 AF of existing storage, increase the ability to efficiently supply water at the lowest possible cost, take advantage of potential energy management opportunities, improve flood management, increase water volumes for recreational use, and reduce the environmental impacts of imported water. While this project proposes only a conceptual design, it is a necessary precursor to potential construction of the Intertie System. Therefore, this conceptual design is appropriately considered as the first phase of the Intertie Project.

Currently, the San Diego Region receives significant water allocations from the SWP and from the CRA. Continuously increasing upstream demand and regulatory actions promoting greater environmental preservation have reduced the amount of imported water available for consumptive use. The Four Reservoir Intertie System would effectively increase the supply of local water, thereby reducing the cost and environmental impact of imported water. In particular, underutilized El Capitan and Loveland Reservoirs, both of which have no connection to the imported water system, could be used to capture and store local as well as imported water, increasing the flexibility and reliability of water management for the San Diego Region. A 1993 U.S. Army Corps of Engineers Reconnaissance Study found that "the Four Reservoir Plan was determined to be the most cost-effective means of producing water in excess of 10,000 acre feet annually and best met other evaluation criteria."

The expected benefits from this project are summarized below. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-13.

Table 12.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Optimize existing storage capacity	Physical quantification	Local, Regional, State

[34] Although the exact change in sedimentation is unknown, continued maintenance dredging will reduce sedimentation. Furthermore, as noted in the San Diego Coastal Lagoons TMDL monitoring work-plan (June 18, 2007, McLaughlin et al), the Carlsbad Desalination project operations would have a beneficial impact on the sedimentation problem by ensuring the lagoon inlet remains open to the Pacific Ocean and tidal exchange is unobstructed.
It is assumed that funding to maintain the lagoon is not included in the cost of the proposed conveyance project and that this benefit should be attributed to the Desalination facility, itself. It has been omitted from the benefit analysis for the proposed conveyance project. If the proposed project somehow contributes to maintenance of the lagoon, then it would increase total benefits of the project

Increase ability to capture local water	Monetization	Local, Regional
Increase ability to store imported water	Monetization	Local, Regional, State
Increase water supply reliability/flexibility	Monetization	Local, Regional
Water Quality		
None	N/A	N/A
Other Benefits (described in Attachment 9)		
Energy management opportunity	Monetization	Local, Regional
Reduce environmental impacts of imports	Qualitative	Regional, State
Increase water volumes for recreation	Qualitative	Local, Regional
Improved flood management	Monetization	Local, Regional
Improve climate adaptation capacity	Qualitative	Local, Regional

Table 12.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$2.5 M
Monetizable Benefits	
Water Supply Benefits	$2.3 M
Other Benefits	$3.0 M
Total Monetizable Benefits	$5.3 M
	Qualitative indicator*
Qualitative Benefits	
Reduce environmental impacts of imports	+
Increase water volumes for water dependent recreation	+
Climate change adaptation capacity improved	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Because this project proposes a conceptual design, actual costs are incurred only during years 2008, 2009, and 2010. 100% of costs incurred are for the conceptual design, expected to commence by July 1, 2008 and conclude June 30, 2010. The present value total cost for this conceptual design is $2,540,000 in 2006 dollars.

Because the potential benefits of this study accrue only upon a positive result from the conceptual design and actual construction of the Intertie Project, the financial figures from the 1993 U.S. Army Corps of Engineers Study have been updated and used to determine total project costs. Assuming the project as described in the 1993 USACE study is constructed in 2012, with the corresponding operations and maintenance costs, the present value total cost for the project --including the conceptual design -- is $924,000,000 in 2006 dollars.

This conceptual design represents 0.27% of the present value total costs for the Intertie Project. Therefore, the benefits developed below are apportioned to the study at 0.27% of the estimated monetized benefits of the combined benefits of studying and completing the project. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-13.

The "Without Project" Baseline

Because Loveland Reservoir is not connected to the imported water system and El Capitan Reservoir faces pipeline capacity limitations for receiving imported water, existing storage capacity is underutilized. With a capacity of 26,000 acre feet, Loveland has filled from local runoff only a dozen times in the 58 years since its completion. With a capacity of nearly 113,000 acre feet, El Capitan has filled only four times since its construction in 1934. Construction of infrastructure to link these currently unconnected systems would provide approximately 100,000 acre feet of additional storage capacity every year without modifications to existing storage facilities.

The San Diego water storage system has had to forgo both local and imported water in the recent past. For example, when the City of San Diego's Lake Hodges spilled in winter 2005, San Diego lost 68,000 AF of water. A significant portion of that water could have been utilized locally if the Intertie Project was in place by allowing the transfer of water to other reservoirs. During spring 2006, more water was available from a combination of imported sources than could be stored in reservoirs for use during the summer. Due to the shortage of available storage, imported water was allowed to flow to the ocean that could otherwise have been stored for summer usage had the Intertie Project been in place.

Water Supply and Water Quality Benefits

The Intertie Project would increase the effective storage capacity of several San Diego reservoirs by enabling inter-system transfers of water to maximize available in-system storage. This would enable greater capture of local runoff, offsetting imported water on a 1:1 basis. And, it would also allow for greater springtime (and wet year) storage of imported water for use during the summer (or dry years) by improving connectivity between two reservoirs and the imported water system.

The total present value benefit of all monetizable water supply benefits (as developed below) is $835 million. Because this conceptual design represents 0.27% of total costs for the total Intertie Project, we attribute 0.27% of its benefits to the conceptual design, or $2.25 million in 2006 dollars. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-13.

Water supply benefits

<u>Increase effective storage capacity</u>

Because Loveland Reservoir is not connected to the imported water system and El Capitan Reservoir faces pipeline capacity limitations for receiving imported water, existing storage capacity is underutilized. With a capacity of 26,000 acre feet, Loveland has filled from local runoff only a dozen times in the 58 years since its completion. With a capacity of nearly 113,000 acre feet, El Capitan has filled only four times since its construction in 1934. The unused storage in these reservoirs, along with Murray and San Vicente Reservoirs, would provide on average 100,000 acre feet of additional storage capacity every year.

<u>Increase ability to capture local water</u>

Most of the easily recoverable and inexpensive water in San Diego County has been developed, and additional increments of water supply can be expected to cost significantly more than existing supplies (USACE 1993: vi). The San Diego water storage system has failed to capture local water in the recent past. For example, when the City of San Diego's Lake Hodges spilled in winter 2005, San Diego lost 68,000 acre feet of water. A significant portion of that water could have been utilized locally if the Intertie

Project was in place by allowing the transfer of water to other reservoirs. This lost local water could have offset imported water on a 1:1 basis. According to the 1993 USACE study, San Diego County imports 83 percent of its water from the Metropolitan Water District. This single event alone cost San Diegans almost $35.8 million in 2006 dollars, assuming a per acre foot price for raw imported water of $550. Connecting these four existing reservoirs will prevent future losses of local water, reduce costs associated with importing water, and increase the effective water supply to meet projected growth in demand.

Assuming that a Lake Hodges-type overspill event occurs once every ten years, yielding an annualized increase in local water capture of 6,800 acre feet, two distinct benefits are realized. First, every acre foot of water captured locally can displace an acre foot of imported water. A raw water cost of $550 /AF was used to develop an annualized benefit of $3,740,000. The present value total benefit over the lifetime of the project is $68.8 million. The second benefit is a subsidy provided by the MWD of $250 per acre foot for increasing the use of local water, so it can be used in-lieu of imported water. Again using the annualized 6,800 acre feet of additional captured local water, this yields an annualized benefit of $1,700,000. The present value total benefit over the lifetime of the project is $31.3 million.

Increased ability to store imported water

During spring 2006, more water was available from a combination of imported sources than could be stored in reservoirs for use during the summer. Due to the shortage of available storage, imported water was allowed to flow to the ocean that could otherwise have been stored for summer usage had the Intertie Project been in place. This project would enable the storage of imported water during the winter and spring when the demand and environmental impacts are lower. A surplus of water is often available from flood operations in the Bay-Delta region during the winter months. When there is not sufficient storage capacity for this water, it is released into the ocean instead of being dedicated to beneficial use. By storing off-peak water, this project would reduce peak summertime demand on the region's imported water system.

MWD has a subsidy for storing excess imported water in wet years, if the stored waters will be used in-lieu of imported water in dry years. This storage/in-lieu payment is $250 per acre foot. Assuming that half of all years are wet and half are dry, and that of the 100,000 acre feet of additional storage from the Intertie Project, only 10% of that, or 10,000 acre feet, will be available for use in this program, an annualized benefit of $1,250,000 is expected. The present value total benefit over the lifetime of the project is $23 million.

Increase water supply reliability/flexibility

Connecting the San Vicente, El Capitan, Loveland, and Murray Reservoirs would facilitate efficient use of the existing in-system storage, increase the region's water supply reliability, and increase the ability to efficiently use water at the lowest possible cost. Tying existing systems in to the imported water system would significantly aid in the management of water resources by enabling storage of imported water when it is plentiful during spring runoff. Essentially, connecting these reservoirs and the imported water system creates a more integrated, reliable and resilient system capable of compensating for variations in local year to year runoff, as well as providing a buffer for seasonal variation in imported water availability.

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. The proposed project will enable the storage of more water, which will help the San Diego region sustain water supplies through drought periods or imported supply reductions. The contribution of roughly 100,000 AFY added by this project toward 100% reliability can be characterized by the relative size of a potential 20% shortfall in regional supply relative to projected demands. A 20% supply shortfall would be roughly 160,000 AF (based on a projected total supply need between years 2015 and 2020 of 800,000 AF). Expanding water storage by 100,000 AFY would offset about 62.5% of such a shortfall (100,000/160,000).

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies indicate that residential and industrial (i.e. urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual

value of reliability ranges from $88 to $461 per household (updated to 2006 dollars) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought; see Appendix 8-22 for a full discussion of reliability and values).

The challenge for use of these values to determine a value of the Intertie Project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas the proposed project enhances overall reliability, but does not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For this analysis, we adjust the lower bound of the literature values downward from $88 per household per year to $55 per household[35] per year to adjust for the partial increase in reliability associated with the new water storage relative to total demands. When multiplied by the approximately 704,000 households in the SDCWA service area, the potential benefit from increased reliability is $38,720,000 per year. Assuming a 6% discount rate, the present value of improved reliability over the 50-year project life is $712 million.

Water quality benefits

This project has no water quality benefits

Distribution of Project Benefits, and Identification of Beneficiaries

The Intertie Project has the potential of benefiting approximately 1.5 million residents in San Diego County. Sweetwater Authority and the City of San Diego have the support of the following key water agencies in the San Diego region: MWD, the Water Authority, Helix Water District, Otay Water District, and Padre Dam Municipal Water District. Exploring the feasibility of an Intertie System has the endorsement of the California Department of Water Resources, is fully consistent with the California Water Plan and the Cal-Fed Bay Delta Plan, and compliments new strategies to increase surface storage throughout the state. The project also directly addresses the Cal-Fed Bay-Delta Program goal of expanding surface storage outside the Bay-Delta area.

Table 12.3: Project Beneficiaries Summary

Local	Regional	*Statewide*
Communities near each of the four reservoirs	Water agencies and some 1.5 million water consumers in San Diego County, recreational users of the reservoirs, downstream communities subject to flooding, consumers of peak demand electricity in the region	Other users of MWD imported water from the Bay-Delta and the Colorado River

Project Benefits Timeline Description

This project proposes a conceptual design to begin July 1, 2008 and conclude by June 30, 2010. This conceptual design would enable the construction of facilities for the realization of project benefits. However, no benefits will accrue directly from the conceptual design itself. It is standard practice to ascribe to a conceptual design such as this the fractional benefits of the entire project based on its

[35] The contribution of roughly 100,000 AFY added by this project toward 100% reliability can be characterized by the relative size of a potential 20% shortfall in regional supply relative to projected demands. A roughly 20% supply shortfall would be roughly 160,000 AF (based on a projected total supply need between years 2015 and 2020 of 800,000 AF). Expanding water storage by 100,000 AFY would offset about 62.5% of such a shortfall (100,000/160,000), implying an approximate value per household of 62.5% of $88 per year (lower bound), which equals about $55 per household annually.

fractional cost. As such, it is reasonable to conceive of the conceptual design as providing $5.29 million in total monetizable benefits upon completion in 2010, or 0.27% of estimated project benefits.

The project under investigation could be implemented in logical phases by developing a first link from San Vicente Reservoir to El Capitan Reservoir, and then additional links to Murray Reservoir and Loveland. In this way, underutilized storage capacity at El Capitan Reservoir could come online without completing the entire project. Phasing the project would defer many costs while still obtaining significant benefits. Additional, unscheduled phases may include a treatment plant at Loveland Reservoir, along with an energy component (pumped storage/energy recovery through hydrogeneration).

Potential Adverse Effects from the Project

The environmental impacts of the Intertie Project should be low since each reservoir to be linked has been in place since the 1940s or earlier, and their footprints will not increase as a result of the Intertie Project. The 1993 U.S. Army Corps of Engineers study found that the impacts of pipeline construction could be minimized by following existing streets and roads, utility easements, and by tunneling in some areas. The Intertie Project would not increase the importation of water, although it would shift the time of year that importation occurs to earlier in the spring, when water from snowmelt is more plentiful.

Summary of Findings, Tables

This project proposes a conceptual design for a project that could increase the effective storage capacity of four San Diego County reservoirs by more than 100,000 acre feet. The monetizable benefits of local water capture, imported water storage, and increased water supply reliability provide a present value total benefit of $835 million. Because the conceptual design represents only 0.27% of total projected project costs, only that fraction of the benefits should be ascribed to the conceptual design, or $2.25 million. The monetized benefits include stated preference values for complete water supply reliability, avoided water imports due to increased local water capture, a MWD subsidy for increased local water capture, and a MWD subsidy for storing imported water during times of excess.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases, summarized below.

Table 12.4: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
All costs and benefits	U	Cost estimates for an Intertie Project from a 1993 United States Army Corps of Engineers report were used in this analysis. It is uncertain if actual costs would be higher or lower. If the cost of the Intertie Project were different, the percent of total benefits apportioned to the conceptual design would be different, as well.
Increase ability to capture local water	U	The calculation of the monetized value of this benefit required several assumptions: (1) that the spill of 68,000 AF from Lake Hodges in 2005 is an event that is likely to occur once every 10 years; (2) that if that water had not been lost, it could have been used locally, and therefore offset imports from MWD of 68,000 AF; (3) On average, the Intertie Project is likely to avoid the loss of approximately 6,800 AF of water per year; (4) The future cost of raw, imported water from MWD is $550/AF; and (5) by avoiding losses of local water, the water savings related to the Intertie project would be eligible for the $250/AF subsidy from MWD. Combined, this set of assumptions led to a total monetized benefit of increased ability to capture local water. If the increased

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
		ability to capture local water is a more "event-based" benefit (i.e. something that truly only occurs once every 10 or 20 years), as opposed to a benefit that can be assessed annually (as was done for this analysis), then the benefit of avoided water imports might only occur once every 10 or 20 years. The avoided cost of importing water might be discounted more or less depending on the timing of the "event", which could increase or decrease the monetized value of the benefit. Furthermore, the actual volume of avoided water imports could be more or less than 68,000 AF per event. Changes to these assumptions would have an uncertain impact on the net monetized benefit.
Increase ability to store imported water	U	The calculation of the monetized value of this benefit required several assumptions: (1) of the project life, 50% of the years will be "wet" years and 50% will be dry years; (2) of the 100,000 AF of additional storage made available by the Intertie project, 10% (or, 10,000 AF) would be considered "storage of excess imported water", and therefore eligible for the storage /in-lieu payment of $250/AF. If the number of years that this project is eligible for that payment were higher or lower, and/or if the volume of water stored and then used in lieu of imported water were higher or lower, the monetized value of this benefit would be different. It is uncertain at this time whether the monetized benefit would be higher or lower.
Increase water supply reliability/flexibility	U	The monetized value of added reliability is not included in the benefit-cost comparison. If we had added the present value benefit of improved water supply reliability in the overall benefit-cost analysis, it would increase net benefits. This value could be an over or underestimation of the actual value San Diego residential water customers place on improved reliability. The values used to calculate this benefit were conservative (based on the lowest end of the empirical range found in the literature). The value of reliability to commercial, institutional, and industrial (CII) customers was not included in the illustrative empirical analysis.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #13: South San Diego County Water Supply Strategy

This project proposes to fund Phase 3 of the United States Geological Survey (USGS) San Diego Formation Implementation Study, a part of the South San Diego County Water Supply Strategy. The Strategy would provide an integrated, comprehensive and balanced approach by public water agencies to sustainably using the apparently vast groundwater resources of the San Diego Formation (SDF), a natural underground aquifer that lies deep below the central and south San Diego Bay area. Reliable assessments currently estimate that the SDF holds upward of 1,000,000 acre-feet of water. It currently produces about 4 MGD of desalinated brackish water and 2 MGD of potable well water within Sweetwater Authority's service area. This extensive local water resource has the potential to significantly supplement water supplies and reduce dependence on imported water. In this regard, carefully coordinated, high-quality scientific analyses of its potential are an important component of realizing larger, long-term water supply goals for the San Diego Region and Southern California.

The two primary objectives of the USGS Study are: (1) develop an integrated, comprehensive understanding of the geology and hydrology of the SDF; and (2) further understand how to expand use of the SDF for sustainable water extraction and potential in-lieu conjunctive use. Long-term studies of the SDF began in 2001, and completed component studies have provided important information regarding depth-dependent flow rate and water quality data. The information also includes water quality sampling, development of a Geographical Information System, presentation of data on a website, literature review, analysis of satellite imaging data, aquifer tests, and completion of three multi-depth monitoring wells. Funding is requested to assist with Phase 3 of the Implementation Study, from July 1, 2008 to June 30, 2012. This will include two additional multi-depth monitoring wells, water quality sampling, aquifer testing, a groundwater computer model, and a final report on the 10-year study. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-14.

Table 13.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Maximize sustainable use of SDF water	Physical quantification	Local, Regional
Reduce dependence on imported water	Qualitative	Local, Regional
Increased water supply reliability/flexibility	Qualitative	Local, Regional
Water Quality		
None	N/A	N/A
Other Benefits (described in Attachment 9)		
Bay-Delta Habitat Protection	Qualitative	Local, Regional, State

Table 13.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$1.08 M
Monetizable Benefits	No readily monetizable benefits
	Qualitative indicator*
Qualitative Benefits	
Reduce dependence on imported water	++
Increased water supply reliability/flexibility	++
Bay-Delta Habitat Protection	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Because this project funds Phase 3 of a study, costs are incurred only during years 2008 through 2012, with no ongoing operations and maintenance costs. The overall cost of the project was divided equally over the timeline of the study. 100% of costs incurred are for Phase 3 of the USGS Implementation Study. The present value total cost for this project is $1,079,524 in 2006 dollars. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-14.

The "Without Project" Baseline

The San Diego Formation (SDF) currently produces about 4 MGD of desalinated brackish water and 2 MGD of potable well water within the Sweetwater Authority's service area. The Reynolds Desalination Facility in the Sweetwater Valley is currently capable of producing 4.0 MGD of potable water from brackish groundwater obtained from the SDF that is treated by an advanced reverse osmosis process. The SDF is estimated to hold upwards of 1,000,000 acre feet of water, but further study is needed to determine how much of this water can be extracted on a sustainable basis.

Two Proposition 50-funded feasibility studies are integral to the overall South San Diego County Water Supply Strategy (the Strategy): a Regional Concentrate Conveyance Facility (Brine Line) and the Otay River Basin Brackish Groundwater Desalination Study. Increased use of the brackish SDF groundwater resource will require increased desalination capability, either in the form of the proposed Otay facility, expansion of the Reynolds Desalination Facility, or similar facilities developed in the City of San Diego. Although all aspects of the Strategy are integral to the success of this overall approach, the USGS Implementation Study is considered under this application as an isolated project. In other words, the benefits and costs of the Brine Line or additional desalination capabilities are not considered as fractional benefits or costs of the Phase 3 Study.

Water Supply and Water Quality Benefits

Water supply and water quality benefits of the project are described below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-14.

Water Supply Benefits

Maximize Sustainable Use of SDF water

Currently the San Diego Formation produces only about 4 million gallons per day (MGD) of desalinated brackish water and 2 MGD of potable well water within the Sweetwater Authority's service area. However, reliable assessments currently estimate that the SDF holds upward of 1,000,000 acre-feet of water. The opportunity to expand use of the SDF for sustainable water extraction and potential in-lieu conjunctive use is significant, but requires carefully coordinated, high-quality scientific analyses of its potential.

Reduce dependence on imported water

Local production of brackish groundwater will offset, gallon for gallon, imported water supply, reducing the Region's dependence on imported water.

Increase water supply reliability/flexibility

Increasing use of the SDF either as a new source or for conjunctive use would facilitate efficient use of local water, increase the region's water supply reliability, and increase the ability to efficiently use water at the lowest possible cost. Expanding local supply in a Region that imports on the order of 80% of its water reduces vulnerability to imported water supply disruptions. Using the SDF for conjunctive use would increase the effective storage capacity for water in the Region with similar salutary effects on supply reliability, especially when demand for imported water is highest in the summer months, by allowing recharge of the aquifer when water is plentiful during spring runoff. Essentially, expanded use of the SDF would create a more integrated and resilient water supply system capable of compensating for variations in local year-to-year runoff, as well as providing a buffer for seasonal variations in imported water availability. Furthermore, a new local water supply or conjunctive storage capability would help San Diego County adapt to projected changes in climate due to global warming.

Water quality benefits

There are no explicitly identified water quality benefits for this project.

Distribution of project benefits, and identification of beneficiaries

Four local partners are currently pursuing development of the Strategy: the Otay Water District, City of San Diego, San Diego County Water Authority, and Sweetwater Authority. As it evolves, a flexible Strategy may involve other local water agency partners and potentially private sector participants. While both federal and state partners already have played crucial roles in development and implementation of this Strategy, additional participation will be necessary for the project to be successful.

Increasing use of the SDF will increase local water supplies and reduce demand on the imported water system, potentially reducing costs and increasing reliability for water consumers in the San Diego Region while also reducing pressure on other users of MWD imported water, both from the Bay-Delta and the Colorado River.

Table 13.3: Project Beneficiaries Summary

Local	Regional	Statewide
Local communities dependant on SDF water will likely see increased availability of water and possibly decreased relative prices compared to imported water	Water agencies and some 1.5 million water consumers in San Diego County, and potentially other southern California consumers outside the County	Other users of MWD imported water from the Bay-Delta and the Colorado River

Project Benefits Timeline Description

Phase 3 of the USGS Implementation Study is anticipated to span from July 2008 through June 2012. Upon completion in 2012, this study will enable other aspects of the South San Diego County Water

Supply Strategy to be implemented. Water supply and environmental benefits will not be realized until projects are implemented to expand use of the SDF. This study is a precondition for achieving those other benefits over a longer timeframe.

Potential Adverse Effects from the Project

The Sweetwater Authority adopted an Interim Groundwater Management Plan in 2001. The document states that they will "not cause a decline in the long term static water levels…increase seawater intrusion or cause environmental impacts or damage other producers in the alluvial portion of the basin through the operations of Sweetwater Authority's groundwater projects" (Welsh 2001).

Most of the water in the SDF is brackish and requires desalination before it can be used. A separate study currently underway is considering the feasibility of a Regional Concentrate Conveyance Facility (Brine Line) and the Otay River Basin Groundwater Desalination Facility. These two facilities will deal with potential negative environmental impacts by determining how to dispose of the concentrate that derives from the desalination process.

Summary of Findings, Tables

Currently, the San Diego Formation produces only about 4 MGD of desalinated brackish water and 2 MGD of potable well water within the Sweetwater Authority's service area. However, reliable assessments currently estimate that the SDF holds upward of 1,000,000 acre-feet of water. The opportunity to expand use of the SDF for sustainable water extraction and potential in-lieu conjunctive use is significant, but requires carefully coordinated, high-quality scientific analyses of its potential.

This project will promote increased use of the SDF either as a new source or for conjunctive use, facilitating efficient use of local water, increasing the region's water supply reliability, and increasing the ability to efficiently use water at the lowest possible cost. The water supply benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. These benefits are presented in the following table.

Table 13.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Reduce dependence on imported water	++
Increased water supply reliability/flexibility	++

Work Item #14: El Monte Valley Groundwater Recharge and River Restoration Project, Phases 1 and 2

The El Monte Valley Groundwater Recharge and Restoration Project would recharge the El Monte Valley Basin using up to 2,240 AFY of highly treated recycled water (provided by the Santee WRF), raise the groundwater level to support habitat restoration, and subsequently withdraw this new supply of groundwater to supply the R.M. Levy Water Treatment Plant. The project area is located outside the service area of MWD and within one mile of established residential and commercial development (Lakeside community in the County of San Diego).

This project is part of a coordinated effort to jointly implement two projects—the El Monte Valley Groundwater Recharge and Restoration Project and the Santee WRF Project—that will enhance local supplies through an expansion of recycled water production coupled with increased groundwater recharge using recycled water. The Santee WRF Expansion Project includes the design and construction

of facilities necessary to expand the Title 22 treatment capacity of the WRF from 2 MGD to 4 MGD, with further expansion to 10 MGD and advanced treatment in a subsequent phase.

In 2006, the Padre Dam MWD and the HWD entered into discussions to combine two projects they were independently pursuing into one integrated project. The scheduling of these projects has been closely coordinated to ensure that each project can meet its individual objectives while at the same time maximizing the value of recycled water resource that will become available. Because the WRF is the closest water source to the El Monte Valley, the two projects are not just integrated, but interdependent, as well.

This integrated project will result in the following water supply and quality benefits:

- Assurance of an adequate, long-term water supply for Santee Lakes Recreation Preserve, which is supplied by the WRF;
- Promotion of the El Monte Valley Recharge Project as a model project to encourage public interest in greater use of recycled water throughout San Diego County;
- Production of a local, drought-proof water supply for 10,000 San Diego County households;
- 2,240 AF reduction in San Diego County Water Authority demand for imported water from Metropolitan Water District (increasing to 5,000 AFY with implementation of Phase 3);
- Over 80% achievement of the San Diego County Water Authority's 2020 goal for local groundwater production;
- 100% increase in the availability of economical recycled water to Padre Dam's commercial, Home Owner's Associations and large landscape customers.

This integrated project will result in the water supply and quality benefits summarized below. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-15.

Table 14.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits		
Avoided cost of additional imports	Monetized	Local and Regional
Increased financial incentives for local resources	Monetized	Local
Increased local potable groundwater supply	Qualitative	Local
Improved water supply reliability	Qualitative	Local and Regional
Water Quality Benefits		
Improved groundwater quality	Monetized	Local
Reduced wastewater discharge to Sycamore Creek and the Pacific Ocean	Physical quantification	Local, Regional, and State
Reduced Import of Salts into the Region	Physical quantification	Local, Regional
Avoided Point Loma Wastewater Treatment Plant upgrade	Monetized	Local
Avoided Santee WRF upgrade	Monetized	Local
Other Benefits (described in Attachment 9)		
High quality sand resources	Monetized	Local
Improved flood control and stormwater	Qualitative	Local and Regional

runoff control		
Restoration of natural habitat	Qualitative	Local and Regional
Enhanced Recreation and Public Access	Qualitative	Local and Regional
Promotion of regional collaboration	Qualitative	Regional and State
Bay-Delta Habitat Protection	Qualitative	Statewide
Reduction in Greenhouse Gas Emissions	Qualitative	Statewide
Disadvantaged community benefits	Qualitative	Local, Regional

Table 14.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$48.2 M
Monetizable Benefits	
Water Supply Benefits	
Avoided cost of additional imports	$19.4 M
Increased financial incentives for local resources	$4.0 M
Water Quality Benefits	Not monetized
Avoided O&M and treatment costs for existing wells	$0.23 M
Avoided Point Loma WWTP Upgrade	$4.8 M
Avoided Santee WRF upgrade	$4.1 M
Other Expected Benefits	
High Quality Sand Resources	$16.4 M
Total Benefits	$48.8 M
Qualitative Benefits	Qualitative indicator*
Increased local potable groundwater supply	+
Reliability of local water supply (potentially $9.9 million)	++
Improved flood control and stormwater runoff control	+
Restoration of natural habitat	++
Enhanced Recreation and Public Access	+
Promotion of regional collaboration	+
Bay-Delta Habitat Protection	+
Reduction in Greenhouse Gas Emissions	+
Disadvantaged community benefits	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Present value costs for Phase 2 of the El Monte Valley Project are expected to be approximately $48.2 million (in 2006 U.S.$), including construction, capital, and O&M costs over the expected 50-year project lifetime (2011-2060). The total capital costs will be $62,578,538 million in 2006 dollars. Construction will take about 8 years to complete and will be finished by June 2016; capital costs are assumed to be spread evenly over this period. Annual O&M costs for this project will be approximately $0.4 million (in 2006 U.S.$) and will begin to accrue in 2016 after construction is finished. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-15.

The "Without Project" Baseline

Without this project, the Santee WRF would continue to discharge 2 MGD of wastewater into Sycamore Creek, which already has set total maximum daily loads (TMDLs) for nitrogen (N) and phosphorus (P). Addition of advanced treatment processes, such as reverse osmosis, would be required in the future to meet the current total maximum daily load (TMDL) limits for discharge into Sycamore Creek. Capital costs for advanced treatment are estimated at $3.3 million in 2006 dollars.

Not implementing the Santee WRF Project would also prevent the El Monte Valley Groundwater Recharge and Restoration Project from occurring, as this project depends on receiving recycled water from the Santee WRF to recharge the El Monte Basin. Without the Groundwater Recharge and Restoration Project, several critical impacts would occur including: (1) increase the need for additional water supply in the future, (2) revert recharge lands to a golf course, which would eliminate the river restoration efforts, (3) reduce diversification of regional water supply, and (4) result in underutilization of existing sand resources.[36] Other impacts of not implementing these projects include continued discharge from the Santee wastewater plant—which would continue contributions of the N and P loads to Sycamore Creek.

The Padre Dam MWD is a proponent of the Santee WRF Expansion Project and provides water, wastewater, recycled water, and recreation services for 96,700 residents of San Diego County. Padre Dam's neighbor, HWD, is a proponent for this project and provides water service for 251,800 San Diego County residents.

Water Supply and Water Quality Benefits

The El Monte Valley Groundwater Recharge and River Restoration project is intrinsically related to the Santee Water Reclamation Facility Expansion Project (work item #4). Both projects would need to be implemented to receive the full range of water supply and water quality benefits described in detail below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-15.

Allocation of Benefits Across Projects

The discussion that follows reflects the combined (i.e., joint) benefits of the two projects operating in an integrated fashion. The total monetized present value benefits then need to be allocated between the two projects. This is done by apportioning benefits in proportion to the share of total present value costs of the combined projects. As the El Monte Valley Groundwater Recharge and Restoration Project accounts for 57.3% of the combined total present value cost of both projects ($48.2 million/$84.1 million = 57.2%), we assume the benefits can be allocated by the same percentage. Thus, the present value benefits assigned to the El Monte Valley Groundwater Recharge Project are 57.2% of the combined estimates, as described below.

[36] The groundwater basin is in a narrow valley with high quality sand along the San Diego River. With the river restoration project, this high quality sand will be removed.

Water Supply Benefits

Avoided cost of additional imports

By providing a new local water supply, the proposed Santee WRF Expansion Project and the El Monte Valley Groundwater Recharge Project would offset imported water demand by 2,240 AFY. The Water Authority supplies imported water to its member agencies. The rate for new imported water is projected to be $786/AF in 2011 (in 2006 U.S.$). The proposed projects would avoid imported water purchases of approximately $2.0 million per year beginning in 2011. Assuming a 6% real discount rate and an escalating cost of imported water, the present value (in 2006 US$) of total avoided purchases of imported water over the 50-year project life is estimated to be approximately $34 million.

The discussion above reflects the combined (i.e., joint) benefits of the two projects operating in an integrated fashion. Apportioning benefits in proportion to the share of total present value costs of the combined projects attributed to the El Monte Valley Groundwater Recharge and Restoration Project (57.2%), then the present value benefits assigned to the El Monte Valley Groundwater Recharge and Restoration Project is $19.4 million ($34 million * 57.3%).

Increased Financial Incentives for Local Resources

Additionally, these two projects would receive financial incentives from SDCWA and the Metropolitan Water District for offsetting the region's imported water demand with recycled water that will be produced at the Santee WRF. The incentive is $250/AF of imported water replaced with recycled water, or approximately $560,000 annually (2,240 AF * $250/AF). Assuming a 6% real discount rate, the present value (in 2006 US$) of total financial incentives for using recycled water over the 50-year project life is estimated to be approximately $7.0 million. Apportioning these benefits between the combined projects based on the share of total present value costs attributed to the El Monte Valley Groundwater Recharge and Restoration Project (57.2%), then the present value benefits assigned to the El Monte Valley Groundwater Recharge and Restoration Project is $4.0 million ($7.0 million * 57.2%).

Increased Local Potable Groundwater Supply

These projects enable HWD to use additional groundwater storage of 6,000 to 8,000 AF for water supply and emergency storage use.[37] The recharged El Monte Groundwater Basin will also serve for groundwater storage. Local well owners will be converted from well supply to potable water supply from the local water purveyor (Lakeside Water District). The project will convert existing wells in the zone of influence from the project's spreading basins used for percolating highly treated recycled water. The local well owners will have a more reliable and high quality potable water source for new connections to Lakeside Water District's potable water distribution system (Black and Veatch, 2006).

Improved Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. These projects will provide a local water source that will help Padre Dam MWD and HWD sustain water supplies through drought periods or import supply reductions. The additional water made available is expected to be 10% of HWD's current annual demand.

Although interest in water supply reliability is increasing, only a few studies have directly attempted to quantify its value. The results from these studies do indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that the annual

[37] Based on a hydraulic model performed to determine the storage volume in the El Monte Basin in the vicinity of the project (Final Technical Memorandum — Investigation of Use of Raw Water for Habitat Restoration, 2006).

value of reliability ranges from $88 to $461 per household (updated to 2006 $s) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

The challenge for use of these values to determine a value of the project is recognizing how to reasonably interpret these survey-based household monetary values The values noted above reflect a willingness-to-pay to ensure complete reliability (zero drought-related use restrictions in the future), whereas the these integrated projects enhance only overall reliability, but do not guarantee 100% reliability. Thus, the dollar values from the studies will probably overstate the reliability value provided by the project. One simple way to roughly adjust for this "whole versus part" problem is to attribute a portion of the total value of reliability to the portion of the problem that is solved by the project.

For both projects we adjust the lower bound of the literature values downward from $88 per household per year to $1.23 per household per year to adjust for the partial increase in reliability and the relatively small amount of new water supply relative to total potential shortfalls relative to demands.[38] When multiplied by the approximately 704,000 households in the greater region, the potential benefit from increased reliability is $0.87 million per year, for a present value of $10.8 million over the 50-year project lifetime. Apportioning these benefits between the combined projects based on the share of total present value costs attributed to the El Monte Valley Groundwater Recharge and Restoration Project (57.2%), then the present value benefits assigned to the El Monte Valley Groundwater Recharge and Restoration Project is $6.2million ($10.8 million * 57.2%). While uncertainties exist in applying values from the literature to this situation, we have included this as a conservative estimate of the monetized water supply reliability benefit for this project.

Due to uncertainties in applying values from the literature to the proposed program, we have not included this as a monetized benefit for this project. Instead, this value is provided here to give an idea of the possible magnitude associated with this benefit.

Water Quality Benefits

Avoided Groundwater Treatment Costs

Groundwater quality in the El Monte Valley is expected to improve with the implementation of these two projects. The following table summarizes several water quality parameters, current levels of these parameters, and expected levels (expected once the projects are implemented).

Table 14.3: Projected Improvements in Groundwater Quality with Project

Water Quality Parameter	Current Level	Expected Level with Project
Total dissolved solids	430-2600 mg/L	<500 mg/L (<200 mg/l long term)
Total organic carbon	4-10 mg/L	<5 mg/L (<0.2 mg/l long term)
Iron	1-260 ug/L	<100 ug/L

The improvement in groundwater quality in the El Monte Basin will result in reduced operations and maintenance (O&M) costs of existing wells by $10,000 each year. Cleaning up groundwater will also lower dissolved organic carbon content, which will reduce algae, improve taste and odor of water, and reduce treatment costs by an additional $22,400 each year (based on $10/AF savings for 2,240 AFY yield). Together, these avoided treatment costs result in a total present value savings of approximately $405,000 over the 50-year life span of the projects. Apportioning these benefits between the combined

[38] The contribution of the roughly 2240 AFY added by this project toward 100% reliability can be characterized relative the size of a potential 20% shortfall in regional supply. A 20% supply shortfall in the region would be about 160,000 AF (based on a projected total supply need of roughly 800,000 AF between 2010 and 2020). Expanding RW use by 2,240 AFY would offset about 1.4% of such a shortfall (2,240/160,000), implying an approximate value per household of 1.4% of $88 per year (lower bound), which equals about $1.23 per household annually.

projects based on the share of total present value costs attributed to the El Monte Valley Groundwater Recharge and Restoration Project (57.2%), then the present value benefits assigned to the El Monte Valley Groundwater Recharge and Restoration Project is $232,000 ($405,000 * 57.2%).

Reduced discharge to the Pacific Ocean and Sycamore Creek

The Point Loma WWTP currently discharges approximately 175 MGD of advanced primary effluent to the Pacific Ocean. With this project, Point Loma will discharge only 165 MGD.

Discharges of nitrogen (N) and phosphorous (P) to Sycamore Creek will be greatly reduced or eliminated completely when the El Monte Valley Recharge Project begins taking water from the Santee WRF. The Santee WRF currently discharges approximately 0.8 MGD on an average annual basis. With this project, up to 2 MGD of Title 22 water will be reused rather than discharged from the Santee WRF to Sycamore Creek.

With an expansion to 4.0 MGD, initially an annual average flow of 2 MGD is available to be sent to El Monte, 1.4 MGD ultimately. In this phase of the expansion, all of the excess water treated in the winter months (in excess of lake demand and current customers) is available to be sent to El Monte because the maximum month excess of 2.54 MGD at build-out is less than the estimated capacity of the El Monte Valley Basin (currently estimated to be 4.5 MGD). Under this phase of the project, if the El Monte Valley Project takes all the WRF water available to them, there would be zero discharge to Sycamore Creek and therefore no discharge of N and P to the stream.

With the 10 MGD expansion (Phase 3) an annual average of 4.5 MGD can be sent to El Monte basin. In this phase of the expansion not all of the excess water treated in the winter months (in excess of lake demand and current customers) can be sent to El Monte because the maximum month excess of 6.5 MGD at build-out is greater than the estimated capacity of the El Monte Valley Basin (currently estimated to be 4.5 MGD). Under this phase of the project, if the El Monte Valley Project takes all the WRF water available to them, there would be an annual average discharge to Sycamore Creek of 1.43 MGD or a 28% reduction to the current TMDL limits, which are based on 2 MGD discharge with N and P concentrations of 1.0 mg/l and 0.1 mg/l, respectively. The project team is currently studying the possibility of increasing flows to the El Monte basin above 4.5 MGD in the winter months. Should this be possible, discharges to Sycamore Creek could be further reduced. Additional customers can be found along the supply line to the El Monte Valley that could further reduce the N and P discharged to Sycamore Creek.

Avoided Point Loma Wastewater Treatment Plant upgrade

Phase II of this project would reduce the load of wastewater traveling through the Point Loma WWTP by 4 MGD. Currently, the WWTP treats approximately 175 MGD of wastewater. By reducing the load by 4 MGD, the Santee and El Monte Projects would reduce the amount of water treated by 2.3%. The cost to upgrade the Point Loma WWTP is currently estimated to be up to $750 million. The Santee and El Monte Projects would avoid 2.3% of this cost, or $17.1 million (2.3% * $750 million). The WWTP would likely not need any upgrades until 2018, though it is not guaranteed that the upgrade will be required at all. The total present value benefit of avoiding any upgrade costs in the year 2018 is $8.5 million. The portion of this cost attributed to the El Monte Valley Groundwater Recharge and Restoration Project is $4.8 million (57.2% * $8.5 million).

Avoided Santee WRF treatment upgrade

The implementation of the Santee and El Monte Projects will help avoid a water treatment upgrade at the Santee WRF. If the Santee WRF continues to discharge wastewater, they would have to pay $3.4 million to add tertiary treatment, with an additional $382,000 per year in increased operation costs ($2007). With the Santee and El Monte Projects, this cost would be avoided. The total present value benefit of avoiding

treatment costs at the Santee WRF is $7.1 million. The portion of this cost attributed to the El Monte Valley Groundwater Recharge and Restoration Project is $4.0 million (57.2% * $7.1 million).

Reduced Import of Salts into the Region

The proposed project would avoid import of total dissolved solids (commonly referred to as salts or salinity) into the region. Control of total dissolved solids (TDS) concentrations in local water bodies is a goal of the basin plan for the region. The recommended secondary drinking water standard for total dissolved solids is 500 mg/l with an upper limit of 1000 mg/l due to taste considerations. Concentrations above 500 mg/l can have significant impact on municipal and agricultural values by lowering the useful lifetime of water-using devices, and by lowering the yield of salt-sensitive crops.

Water delivered from Metropolitan Water District (MWD) typically is a blend of about 60% Colorado River water and 40% State Water Project water. Colorado River water has a salinity of around 650 mg/l, while the typical TDS value for SWP water is 250 mg/l. Combined, delivered water has a TDS value of around 490 mg/l. By avoiding import of 2,240 AF per year of imported water into the San Diego region, import of 1,354 tons of salts per year will be avoided. Over the lifetime of the project, a total of 67,700 tons of salts will not be imported into the region. The portion of this benefit allocated to the El Monte Valley Groundwater Recharge and Restoration Project is 38,700 tons (57.2% * 67,700 tons)

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the Santee WRF Expansion and the El Monte Valley Groundwater Recharge and Restoration Project's beneficiaries. These projects would benefit surrounding residents through increased flood protection, local well owners through improved quality drinking water, the surrounding habitat through restoration (including protection of species), and SDCWA through achieving over 80% of its 2020 goals for local groundwater production.

Table 14.4: Project Beneficiaries Summary

Local	Regional	Statewide
Well owners, surrounding habitat, surrounding residents Padre Dam MWD and HWD customers Disadvantaged communities	Recreational Users of the Preserve, SDCWA, Point Loma Wastewater Treatment Facility (Avoided Capacity Expansions), MWD	Bay-Delta Ecosystem, Recreational Users of the Preserve, Visitors to Region, California Citizens, State Water Project/Delta

Project Benefits Timeline Description

The El Monte Valley Groundwater Recharge and Restoration Project would provide benefits in excess of the 50-year project lifetime (2011-2060).

Potential Adverse Effects from the Project

With the river restoration as part of the El Monte Groundwater Recharge and Restoration Project, sediment will have to be removed. This will cause temporary noise, dust, and traffic issues.

Summary of Findings, Tables

The key water supply and water quality benefits associated with the proposed project are: improved water supply reliability and increased financial incentives for using recycled water instead of imported water. Monetary estimates for improved financial benefits have been included in the analysis to provide a relative sense of the potential magnitude of the benefit and are described in more detail below. We used

this monetized benefit to compare against the cost of the project. The financial incentive of $250/AF is provided by SDCWA for using recycled water in place of imported water. The present value benefit of this incentive is $7.0 million; approximately $4.0 million of this is apportioned to the El Monte Valley Groundwater Recharge and Restoration Project.

These projects will produce one benefit that can be physically quantified: reduced discharge to Sycamore Creek. Under Phase 2 of these projects, if the El Monte Valley Project takes all the WRF water available to them, there would be zero discharge to Sycamore Creek and therefore no discharge of N and P to the stream. Under Phase 3, however, if the El Monte Valley Project takes all the WRF water available to them, there would be an annual average discharge to Sycamore Creek of 1.43 MGD or a 28% reduction to that of the current TMDL limits, which are based on 2 MGD discharge with N and P concentrations of 1.0 mg/l and 0.1 mg/l, respectively.

These projects will generate several avoided costs: avoided imported water costs, avoided O&M and treatment costs for existing groundwater, avoided costs for upgrading the Point Loma WWTP, and avoided costs associated with upgrading the Santee WRF. Without this project, imported water would be necessary to supply Padre Dam and HWD's customers. The present value benefit of using recycled water from Santee WRF in lieu of imported supplies is $33.8 million. The portion of this benefit attributed to the El Monte Valley Groundwater Recharge and Restoration Project is $19.4 million ($33.8 million * 57.2%).

Improving groundwater quality also provides benefits in the form of avoided O&M costs for wells and avoided treatment costs. The present value benefit of avoiding these costs is $0.4 million, or $0.23 million for the El Monte Valley Groundwater Recharge and Restoration Project.

The project will reduce 2.4 percent of the loading to Point Loma WWTP, reducing the projected costs associated with upgrading that facility. The present value of this avoided cost is approximately $8.5 million. The portion attributed to this project is approximately $4.8 million. In addition, if this project were not implemented, Padre Dam MWD would need to implement a $3.3 million treatment upgrade at the Santee WRF which could be avoided with this project. The present value of this benefit is approximately $7.1 million, $4.1 million of which is attributed to this project.

In summary, the monetizable water supply and water quality benefits alone do not outweigh the costs. However, when considered along with the monetizable, non-water supply or water quality benefits expected to be generated by the project ($28.5 million in high quality sand, refer to attachment 9) and improved water supply reliability (as much as $10.8 million for the combined project), the benefits of the projects outweigh the costs.

These projects also generate significant additional qualitative water supply and water quality benefits, such as increased potable water supply. A summary of the qualitative benefits is provided in the following table.

Table 14.5: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Water Supply Benefits	
Increased local potable groundwater supply	+
Reliability of local water supply	++

* Magnitude of effect on net benefits
\+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases, summarized below.

Table 14.6: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided imported water costs	++	The avoided cost estimate for offset water imports is based on projected increases in the cost of delivery MWD-supplied waters from the SWP and Colorado River. Recent and future climatic conditions (e.g., drought, decreased snow pack, climate change) and regulatory/ legal issues (e.g., federal Court rulings reducing SWP extractions from the Bay-Delta) combine to make it more likely than not that the future availability of MWD-provided imported waters will be increasingly constrained, and that costs will escalate at rates higher than experienced in the recent past. The projections also are driven by "normal year" expectations, whereas dry year conditions will add additional cost pressures (and may move some of the imported water to higher cost Tier 2 levels). On net, the projected benefits due to reducing the local demands for imported waters are probably understated in this analysis.
Improved water supply reliability	++	The monetized value of added reliability is not included in the benefit-cost comparison. If we had added the present value benefit of improved water supply reliability in the overall benefit-cost analysis, it would increase net benefits. This value could be an over or underestimation of the actual value San Diego residential water customers place on improved reliability. The values used to calculate this benefit were conservative (based on the lowest end of the empirical range found in the literature). The value of reliability to commercial, institutional, and industrial (CII) customers was not included in the illustrative empirical analysis.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

EDUCATION AND OUTREACH PROGRAM

Work Item #15: San Diego Regional Pollution Prevention

The San Diego Regional Pollution Prevention Project will remove over 250,000 lbs of debris from San Diego County's coastline and waterways, and assess the water quality within San Diego County through citizen monitoring. It will involve San Diego Coastkeeper (Coastkeeper) coordinating monthly cleanups and continuing to conduct citizen monitoring to strengthen the Water Quality Standards Program. It seeks to establish a baseline of trash and water quality data that will be transferable to the local communities in the region. Data collected through this project will be incorporated into two web-based, publicly accessible data portals. Stakeholder involvement and community participation are at the core of this project. The project will engage over 3000 volunteers in cleanups and teach a minimum of 300 members of the community – citizens, decision makers, tribal members, and other stakeholders — how to access publicly available water quality data and to analyze and interpret these data to identify water quality impacts on a watershed level.

This project seeks to remove debris from waterways and coastal ecosystems; to address the growing gap between water agencies and the community; to promote citizen monitoring and responsible data management practices; and to teach standardized and accepted water quality monitoring methodologies to all levels of education, including at events such as World Water Monitoring Day.

This project will result in the water supply and quality benefits summarized in the following tables. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-16.

Table15.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality Benefits		
Improved access and quality of water quality data	Qualitative	Local and Regional
Removal of 250,000 lbs of debris from San Diego's 11 waterways and coastal areas	Qualitative	Local and Regional
Other Benefits (described in Attachment 9)		
Increased public education and environmental awareness	Qualitative	Local, Regional, and State
Recreation and Public Access	Qualitative	Local and Regional

Table 15.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$0.68 M
	Qualitative indicator*
Qualitative Benefits	
Improved access and quality of water quality data	++
Increased public education and environmental awareness	++
Recreation and Public Access	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The present value of total costs for this project is $0.68 million The Water Quality Assessment and Outreach Project is expected to begin in August 2008 and last through July 2010. During this time, the Coastkeeper will establish a regional water monitoring training and resource center; develop and implement a public outreach and education campaign; and manage data, analyze data, and develop the San Diego Region Watersheds Water Quality 'Watersheds Report.' Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-16.

The "Without Project" Baseline

In addition to the 250,000 lbs of debris that would not be removed from waterways and the coast by this project, without the Pollution Prevention Project, there would continue to be a gap in trash, water quality and bioassessment data. There are large gaps in Bioassessment, water chemistry, and trash data due to a lack of funding. The data collected in this project will be used to empower citizens to become more involved and to educate citizens about local and regional water quality issues.

These data would also be helpful to set total maximum daily load (TMDL) levels and list 303(d) waterbodies. On a national scale, fewer than 25% of waterways have undergone any type of assessment for water quality, and of those that have been assessed, 40% have been identified as impaired. San Diego is no exception. Los Angeles has recently adopted a TMDL for trash, emphasizing the serious nature of degradation of water quality that trash can cause. This project not only seeks to establish a baseline of data, but also to make these data useful to the local communities that live in this watershed through the data access, assessment, and interpretation, as well as workshop and the Watersheds Report.

In San Diego County, there is a need to provide readily available, easily understood water quality information to San Diego County residents. Without this project, new data would not be collected due to limited resources, nor would data be made be readily available to a wide array of watershed users. All data collected through this project will be incorporated into two web-based, publicly accessible data portals: the currently available website for the Common Ground Project, and a new open source, industry-compliant technology platform. Citizens and agencies can use these data as a tool to teach about quality and encourage positive behavior change. Additionally, workshops focusing on how to access monitoring data will be provided for university students, citizen groups, decision makers, and other stakeholders so that they can refer to available up-to-date data and draw conclusions on the benefits of implemented projects and Best Management Practices (BMPs), and through this knowledge improve the health of these waterways.

Citizen monitoring supports the following water quality monitoring that is currently being conducted throughout the county:

- Storm event / wet weather monitoring (with each event)
- Dry weather monitoring (1x / year) by municipalities
- Beach water quality monitoring (by the County department of public health)

This project's monitoring activities would provide a valuable dataset for dry weather conditions and trash conditions and allow for source water protection, watershed assessment, and tracking of nonpoint source pollution.

Water Supply and Water Quality Benefits

Water supply and water quality benefits of the project are described below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-16.

Water quality benefits

Removal of 250,000 lbs of Debris from Waterways and Coastal Areas
This project will engage over 3000 members of the community in coastal and inland watershed cleanups. Debris will be weighed and quantified according to classification. Data will be managed in-house and incorporated with other watershed data, allowing for targeted programs to be developed to address trash accumulation on a watershed level. Benefit results directly to the local area and the Region by removal of the debris, and also through the development of targeted programs to address trash trends by local area.

Improved Access and Quality of Water Quality Data

Industrial and military operations along San Diego's waterfronts, urban runoff, and decades of neglect have combined to leave San Diego with dozens of toxic waterways that pose a serious public health threat in addition to environmental degradation. Presently, elevated levels of nutrients, metals, coliform bacteria, enteroccocus, toxicity, and pesticides in urban stormwater continue to harm the beneficial uses assigned to these waterbodies. Continued monitoring, assessment and public outreach following these activities is critical to develop ways to prevent the further degradation of San Diego's waters.

The San Diego Regional Water Quality Assessment and Outreach Project will help the County collect more data on various water quality parameters, such as air and water temperature, dissolved oxygen, pH, conductivity, phosphate, nitrate, hardness, microbiology, copper, lead, zinc, and other constituents.[39]

As of 2006, 100 waterbody segments in San Diego County have been listed as impaired under the Clean Water Act's 303(d) list, and yet only three have adopted cleanup plans (TMDLs). This project will increase the amount of information available about various waterbodies in San Diego County to help identify impaired waterbodies and set reasonable TMDLs.

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the San Diego Regional Water Quality Assessment and Outreach Project's beneficiaries. These projects would benefit the citizens of San Diego County by making water quality data available and understandable.

Table15.3: Project Beneficiaries Summary

Local	Regional	Statewide
Citizens of San Diego County		

Project Benefits Timeline Description

The Regional Water Quality Assessment and Outreach Project would provide benefits in excess of the 50-year project lifetime (2011-2060).

[39] Other parameters include: ammonia, nitrite, urea, total suspended solids, oil & grease / hydrocarbons, silicate, sulfate, and sulfite. In addition, metals monitoring can include: arsenic, cadmium, chromium, iron, and nickel. As pyrethroid pesticides become more prevalent in the environment and as lab analyses costs decrease, the also monitor PCBs, PAHs, and OP.

Potential Adverse Effects from the Project

As a result of this project, some areas may be disturbed by volunteers coming in to clean up trash and collect data. However, one of the criteria for choosing cleanup and monitoring locations is security and safety of the area so our volunteers remain comfortable and safe throughout the sampling event. This criterion should help minimize any damage to cleanup and monitoring locations.

Summary of Findings, Tables

This project will indirectly lead to water quality benefits through increased efforts to collect water quality and bioassessment data and through increased public awareness. The water quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. These benefits are presented in the following table.

Table15.4 Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Improved access and quality of water quality data	++

Work Item #16: Biofiltration Wetland Creation and Education Program

The Biofiltration Wetland Creation and Education Program will develop a demonstration wetland within the San Diego Wild Animal Park (Park), which will be used to educate visitors about water conservation and the importance of conserving wetlands. The wetlands will improve water quality within the Park through natural biological filtration, enhance wetlands habitat, and reduce water consumption. The constructed wetlands will be biological filters that are very effective at removing high biological oxygen demand (BOD), total suspended solids, organic nitrogen, and nitrates. In addition to constructed wetlands, providing pond edge habitat is another important aspect of this project.

Currently, two large ponds (East Africa and South Africa, each approximately 12 million gallons) collect water flowing through two separate valleys. Water passing through these large field exhibits drains into the ponds, and because of the terrain features, much of the fecal waste cannot be adequately collected and removed. Fecal waste accumulates in streambeds passing through the exhibits eventually reaching the ponds. The East African Pond overflows to a holding pond that then overflows through a culvert pipe off property and eventually into the San Dieguito Watershed. This project would connect these two ponds through a constructed wetland, which will provide natural treatment and virtually eliminate pollutant discharges to offsite and downstream locations.

The following tables summarize the benefits of this project. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-17.

Table16.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply		
Avoided cost of additional imports	Monetized	Local and Regional
Avoided cost of pump operation	Monetized	Local, Regional, and State
Avoided water supply project	Monetized	Local
Improved water supply reliability	Qualitative	Local and Regional

Type of Benefit	Assessment Level	Beneficiaries
Water Quality		
Improved water quality	Physical Quantification	Local and Regional
Avoided water quality treatment project	Monetized	Local
Other Benefits (described in Attachment 9)		
Improved habitat for threatened and endangered species	Qualitative	Local
Increased public education and environmental awareness	Qualitative	Local, Regional, and State

Table16.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$1.2 M
Monetizable Benefits	
Water Supply Benefits	
Avoided cost of additional supply	$0.1 M
Avoided cost of pump operation	$1.1 M
Avoided water supply project	$0.07 M
Water Quality Benefits	
Avoided water quality project	$5.0 M
Total Monetized Benefits	$6.2 M
	Qualitative indicator*
Qualitative Benefits	
Water Supply Benefits	
Improved water supply reliability	+
Other Benefits	
Improved habitat for threatened and endangered species	++
Increased public education and environmental awareness	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Present value costs for the Biofiltration Wetland Creation and Education Program are expected to be approximately $1.2 M (in 2006 U.S.$), including construction, capital, and O&M costs over the expected 50-year project lifetime (2010-2059).[40] The expected annual operations and maintenance (O&M) costs are $35,000, which includes the costs for equipment, maintenance, monitoring, water testing, and administration. The total capital cost is $0.8 million. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-17.

[40] Assumed 30% of capital costs in 2008 and 70% in 2009.

The "Without Project" Baseline

Without this project, fecal waste will continue to accumulate in streambeds passing through the exhibits and eventually reach the ponds. The East African Pond overflows to a holding pond that then overflows through a culvert pipe off property and eventually into the San Dieguito Watershed. The pond connection and wetland addition will help too minimize this impact and will bring a much needed education focus on how important healthy water systems are in the community. Also, without this project, the Park would have to upgrade its current water supply and distribution system.

Connecting the two large ponds through a constructed wetland would have multiple benefits. First, the connection would balance each pond and virtually inhibit any overflow. This would, in turn, have far-reaching positive effects downstream throughout the entire San Dieguito Watershed. Within the Park, it would make more water available to pump through the waterways, keeping the exhibits and public areas with constant water flow. The flow through the constructed wetlands would also provide the added benefit of controlling bacteria levels and enhancing overall water quality through aeration and bio-filtration.

An additional benefit would be the opportunity to educate approximately 1.5 million guests annually about the importance of conserving water and California's valuable waterways. The Park's Education Department will provide high school students with hands-on education programs focused on water testing, monitoring, wetland and riparian restoration, and water conservation. These students will be trained to act as water conservation ambassadors by sharing their stories and experiences with the Park's general public. They will use engaging displays and interactive tools to encourage the guests to become active stewards of our natural waterways. The Park will also have community restoration days where individuals can volunteer to help plant some of the riparian habitat. Information about the proposed project will be placed on signs near the wetland location and on the Park's *Journey into Africa* tour, which will pass the proposed wetland and offer beautiful views of the project.

Water Supply and Water Quality Benefits

Water supply and water quality benefits of the project are described below. Detailed benefit information associated with the project, including present value calculations, is presented in Appendix 8-17.

Water Supply Benefits

Avoided cost of additional supply

The Park currently purchases water from the City of Escondido (potable water) and from the City of San Diego (groundwater) to fill the East Africa and South Africa Ponds, as well as for the Park's Valley Reservoir and the Park's Reclamation Pond, when needed. This project will eliminate overflow into the San Dieguito watershed, thereby allowing the Park to capture the overflow and prevent them from purchasing additional water to replace the loss. The Valley Well pump, which is located within the Park, adds up to 400,000 gallons per day (gdp) to the ponds. This well would still be needed if this project is implemented because the off grounds overflow would be directed to the lower pond. However, the Park would need to pump much less water from it once the wetlands are constructed. The created wetland would reduce demand for imported water by reusing current supply and inhibiting off grounds overflow. Approximately 45 AFY of imported water purchases would be avoided.[41] The Park purchases a combination of groundwater from the City of San Diego ($0.05 per 1000 gallons or $163/AF) and potable water from the City of Escondido ($2.87 per 1,000 gallons or $936/AF). Conservatively assuming the cost of water is $163 / AF, the avoided water cost is expected to be approximately $7,300 each year, for a present value benefit of $0.1 million.

[41] This is based on a combination of ground and city water purchases throughout the year, totaling approximately 40,000 gal/day savings.

Avoided Water Supply Project.

If this project is not implemented, the Park will have to upgrade its current water supply and distribution system. This would cost approximately $90,000, and would occur in 2010. By implementing this project, the cost of upgrading the supply and distribution systems is avoided. The present value of this avoided cost is $71,300.

Improved water supply reliability.

By making more efficient use of local supplies and thus reducing demands for imported water by 45 AFY, this project would increase the overall reliability of the regional water supply. The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. This project will reduce reliance on imported water and will help sustain water supplies through drought periods or import supply reductions.

Water Quality Benefits

Improved water quality.

This project would use the natural filtration system of the wetland to treat water flowing between the ponds. Previously, untreated and unhealthy water that overflowed off the grounds into the San Dieguito River would be treated and kept on grounds. The proposed wetlands will bring current levels of nitrates (5 parts per million) and bacteria (15,000 MPN) down to zero. Not data have been collected on the effect of the current overflow on the watershed, however; the Park has data on bacteria levels in the overflow water. This overflow water contains a lot of bacteria, which is likely causing harm to the watershed.

Avoided water quality project costs.

The wetland construction would help avoid costs related to necessary future filtration and disinfection systems. These systems are estimated to cost up to $10 million for filtration and disinfection to remove bacteria, and would be assumed to be implemented in 2008 and 2009. The proposed 0.75-acre wetland will be able to treat 40% of the water, so by implementing this project, the Park would save $4 million in avoided water quality project costs ($10 million * 40%). The present value benefit of avoiding this project is $5.0 million.

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the Biofiltration Wetland Creation and Education Program's beneficiaries. This project would benefit surrounding residents benefiting from improved water quality in the San Dieguito Watershed, park visitors benefiting from improved education experience at the Park, threatened and endangered species within and outside of the park.

Table16.3: Project Beneficiaries Summary

Local	Regional	Statewide
Visitors of San Diego Wild Animal Park Downstream water users Threatened and endangered species within the park	San Dieguito River Watershed	Visitors of San Diego Wild Animal Park

Project Benefits Timeline Description

The Biofiltration Wetland Creation and Education Program would provide benefits in excess of the 50-year project lifetime (2010-2059).

Potential Adverse Effects from the Project

The constructed wetlands will require additional maintenance and monitoring by the Zoological Society of San Diego. Additional personnel and costs will be needed to perform horticultural maintenance and upkeep.

Summary of Findings, Tables

The Biofiltration Wetland Creation and Education Program would produce important water quality and water supply benefits. This project would also generate several avoided costs: avoided cost of additional imports, avoided cost of pumping, avoided water supply project costs, and avoided water quality project costs. Without this project, imported water would be necessary to supply water to the Park's ponds. The present value of this avoided cost is $0.1 million.

By implementing this project, the Park would avoid paying power costs associated with pumping water from the Valley Pump well. These costs are $70,400/year (in 2006 U.S.$). Again, the wetland will prevent water from overflowing off site and keep the water onsite, which eliminates the need to replace the overflow water. The present value benefit of avoiding power use and costs is $1.1 million.

Construction of the wetland to eliminate overflow prevents the Park from having to undertake another project to improve water supply. The present value of avoiding this alternative project is approximately $0.07 million. It would also prevent the Park from undertaking a water quality project, which would be necessary to improve the quality of overflow water leaving the site and polluting the San Dieguito Watershed. The present value of avoiding this alternative water quality project would be $5.0 million.

In summary, the benefits associated with this project far outweigh the costs.

This project also generates additional qualitative water supply and water quality benefits, such as improved water supply reliability. These benefits are presented in the following table.

Table16.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Improved water supply reliability	+

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the calculation of improved water supply reliability. Such issues are listed in the following table.

Table16.5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Improved water supply reliability	+	Assuming we use the present value benefit of improved water supply reliability in the overall benefit cost analysis, it would drive the net benefits up
Avoided water supply benefit	+	Because the ratio of City of San Diego supplies to City of Escondido supplies that would be offset by the project is unknown, the water supply benefit was calculated using the conservative unit cost of $163 / AF. $163 / AF is the less expensive of the Park's two supplies (City of San Diego groundwater), with the City of Escondido potable supplies costing $936 /AF. The actual present value of the avoided water purchases could be nearly six times greater than that

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
		cited here, depending on the actual proportion of City of San Diego to City of Escondido water used at the Park.

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #17: San Dieguito Watershed Management Plan Implementation

The San Dieguito Watershed Management Plan Implementation project will coordinate the San Dieguito Watershed Council, prioritize the actions in the Management Plan, and oversee the creation of Working Groups to proactively address them. The overall goals of the action plan include the following:

- The Protection and Enhancement of Water Quality
- The Conservation, Reuse, Protection, and Maintenance of Local Water Supply
- The Protection, Enhancement, and Restoration of Native Habitats and Biological Resources
- The Support of Social and Community Resources Needs and Watershed Stewardship

The project will include grant writing and reporting, coordination of Working Groups, and management of public relations. The project will increase the coordination of the watershed projects and the associated water supply and water quality benefits of the projects.

The following tables summarize the benefits of this project. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-18.

Table17.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply/ Water Quality		
Increased coordination of watershed projects	Qualitative	Local, regional
Other Benefits (discussed in Attachment 9)		
Public Education and Awareness	Qualitative	Local, regional

Table17.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$85,960
	Qualitative indicator*
Qualitative Benefits	
Improved coordination of watershed projects	++
Public Education and Awareness	++

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.

++ = Likely to increase net benefits significantly.

Costs

The total cost of this project is $102,263 ($85,960 present value). Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-18.

The "Without Project" Baseline

Without the project, Council activities will be reliant on volunteer assistance for activities such as seeking grant funding for Council initiatives, writing and submitting such grant applications and carrying out other activities associated with establishing Working Groups. There is a very low likelihood that volunteers – with outside full-time positions – would be willing or able to take on these types of assignments. Council members agree that without this project, the Council will most likely remain a discussion forum and not move to action on many, or any, topics related to the Plan.

Water Supply and Water Quality Benefits

Improved coordination of the watershed plan

The primary goal of the San Dieguito Watershed Management Plan (WMP) is to maintain and enhance the long-term health of the watershed's resources while balancing the effects of urbanization and changes in land use. This project will increase coordination of the various projects; and thus increase the likelihood of individual projects being implemented in a timely fashion and ensure communication between project working groups. Specific benefits to be gained from the increased coordination include: synergy in planning and carrying out projects, including outreach to the public on watershed education topics; opportunities for close cooperation on public outreach, water quality, invasives control, open space preservation and other areas having to do with watershed resources that are shared by Council members; and, making it easier for downstream entities to address or improve watershed quality because upstream entities are able to cooperate with them (for example, attempts by downstream municipalities to improve water quality by addressing runoff issues will be made more difficult or impossible if upstream municipalities do not address the same issues).

While the benefits to water supply and water quality are indirect, they are likely to be significant.

Improve public awareness

The project will foster a consistent message that will engage communities and educate the public on the inter-connectiveness of water supply, water quality and natural resources while promoting individual and community ownership of the problems and solutions. The project will include stakeholder meetings to identify and address public interests and perceptions, address stakeholder questions and issues, and ensure that the plan and any proposed solutions are in keeping with public interests, and provide for pubic ownership and support of proposed solutions. Stakeholder meetings may also assist in identifying areas where public education and outreach is required and help focus the plan toward the public's key water management issues and potential solutions. Stakeholder meetings are also essential in identifying and resolving potential water conflicts within the region. While the benefits to water supply and water quality are indirect, they are significant.

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the expected beneficiaries of this project.

Table17.3: Project Beneficiaries Summary

Local	Regional	Statewide
Local residents and communities within the San Dieguito Watershed	Recreational Users of the San Dieguito River Park	Recreational Users of the San Dieguito River Park

Project Benefits Timeline Description

This project will span three years.

Potential Adverse Effects from the Project

No adverse effects are anticipated from this project.

Summary of Findings, Tables

This project will indirectly lead to water supply and water quality benefits by prioritizing and facilitating projects included in the watershed management plan and through increased public awareness. The water quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. These benefits are presented in the following table.

Table17.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Improved coordination of watershed projects	++

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the calculation of improved water supply reliability. Such issues are listed in the following table.

Table17.5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Benefits relating to water supply and water quality	U	Water supply and water quality benefits are indirectly related to this project, but are not monetizable

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #18: San Diego River Watershed San Dieguito Watershed Management Plan Implementation

This project will support the creation implementation of the San Diego River Watershed Management Plan. Funding will support identification of long-term funding strategies and sources to continue implementation of the Watershed Management Plant beyond the grant period. The project will support the efforts of the IRWMP by coordinating stakeholders groups and their projects, with particular attention to disadvantaged communities. The project includes data management through a clearinghouse tracking project status and archiving data collected throughout the watershed. An annual “State of the Watershed” report will be used for public education and outreach.

The San Diego River Watershed San Dieguito Watershed Management Plan Implementation project will advance multiple water management projects that result in water quality improvement, ecosystem improvement, fish and wildlife enhancement, flood control enhancement, erosion control enhancement, public safety enhancement, recreation and public access enhancement, water supply reliability enhancement, reduced wastewater discharges, improved water management coordination, enhanced scientific knowledge and public understanding/awareness, and funding and economic benefits.

The project will have indirect benefits to water supply and quantity which can be classified into 2 categories:

- Increased coordination of watershed projects
- Improved public awareness

The following tables summarize the benefits of this project. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-19.

Table18.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply/ Water Quality		
Increased coordination of watershed projects	Qualitative	Local, regional
Other Benefits (discussed in Attachment 9)		
Improved public awareness	Qualitative	Local, regional
Disadvantaged Community Involvement	Qualitative	Local, regional

Table18.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$99,635
Qualitative Benefits	**Qualitative indicator***
Improved coordination of watershed projects	++
Public Education and Awareness	+
Disadvantaged Community Involvement	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The total project cost $118,532 ($99,635 present value), to be used for workshops and outreach activities, website costs, Annual state of the Watershed Report and Forum, an ongoing funding plan, and stakeholder meetings. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-19.

The "Without Project" Baseline

Without the benefits provided by this project, there will be no stable, yet flexible process and structure that allows for and encourages cooperation, coordination, open communication and collaboration on watershed management activities. Communities in the watershed, and in particular disadvantaged communities, would have limited means to gaining knowledge about the watershed and its issues, and stewardship activities they can participate in that would benefit the watershed. Disadvantaged communities would continue to remain underrepresented in planning efforts. There would be limited means to identify and address public interests and perceptions, address stakeholder questions and issues, and ensure that the San Diego River Watershed Management Plan and any proposed solutions are in keeping with public interests, and provide for public ownership and support of the proposed solutions.

In addition, there would be limited means to identify and resolve potential water management conflicts. Data collection organizations and individuals in the Region would continue to work independently and lack a comprehensive, central repository where data can be evaluated, formulated, compared and shared with interested stakeholders and gaps in data would continue to exist. Without a web-based system, data would only be available as it currently is, through data-to-data transfers, which will certainly result in the delay of projects, since a web-based system makes information about projects instantly and easily available to all interested stakeholders at once.

Water Supply and Water Quality Benefits

<u>Improved coordination of the watershed plan</u>

The project will include prioritization of projects within the watershed plan and coordination on which stakeholders will be involved in each project. In this manner, stakeholders that are prepared to take action on a specific activity can begin the process of data collection, analysis, modeling, solution generation and selection, environmental documentation, and implementation. Coordination specifically involves collective pooling of technical and financial resources to address common or inter-related issues, reviewing current projects, sharing information by making it available to interested stakeholders and the general public, deciding upon measures that will maximize the benefits to the San Diego River Watershed and determining funding availability and implementing selected measures.

Improving coordination of watershed improvement efforts will aid in protecting the San Diego River Watershed. Without involving a diversity of citizens, public and private organizations, local governments, and resource specialists, there cannot be an exchange and continuous flow of knowledge, resources, and support that would enable stakeholders to more effectively understand and address water management issues within the watershed. The watershed planning process cannot happen and will not be successful without the input, interest and commitment of stakeholders. Ultimately, to successfully protect, restore and enhance the San Diego River Watershed, stakeholders have to work together – sharing the costs and reaping the benefits of watershed improvements. Benefits of improved coordination include:

1. Avoiding duplication of planning, implementation, design, compliance, or implementation efforts;
2. Identifying and resolving jurisdictional, legal, administrative or water rights issues among implementing agencies;
3. Providing a unified approach for identifying, collaborating, and more efficiently addressing regulatory challenges;
4. More efficiently addressing environmental challenges;
5. Enhancing efficiency of monitoring (e.g. combining monitoring efforts and reducing monitoring duplication) and data management;
6. Resolving potentially conflicting water management needs;
7. Allowing for overall cost reduction through sharing facilities, economy of scale, or eliminating duplicative planning, implementation, design or compliance efforts;
8. Allowing for cost sharing among organizations;
9. Increasing public awareness, public education, and stakeholder involvement; and
10. Providing synergistic effects to optimize attainment of San Diego Regional Watershed Management Plan objectives.

While the benefits to water supply and water quality are indirect, they are likely to be significant.

Improve public awareness

The project will foster a consistent message that will engage communities and educate the public on the inter-connectiveness of water supply, water quality and natural resources while promoting individual and community ownership of the problems and solutions. The project will include stakeholder meetings to identify and address public interests and perceptions, address stakeholder questions and issues, and ensure that the plan and any proposed solutions are in keeping with public interests, and provide for pubic ownership and support of proposed solutions. Stakeholder meetings may also assist in identifying areas where public education and outreach is required and help focus the plan toward the public's key water management issues and potential solutions. Stakeholder meetings are also essential in identifying and resolving potential water conflicts within the region. While the benefits to water supply and water quality are indirect, they are significant.

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the expected beneficiaries of this project.

Table18.3: Project Beneficiaries Summary

Local	Regional	Statewide
Local stakeholders and the general public	General public	Visitors to the San Diego Watershed

Project Benefits Timeline Description

The project will span two years, with a beginning date in July of 2008. Stakeholder meetings will be held quarterly from August 2008 through August 2010. A data clearinghouse and the development and distribution of water quality education materials will be completed by May 2009.

Potential Adverse Effects from the Project

No adverse effects are anticipated from this project.

Summary of Findings, Tables

This project will indirectly lead to water supply and water quality benefits by prioritizing and facilitating projects included in the watershed management plan and through increased public awareness. The water quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. These benefits are presented in the following table.

Table18.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Improved coordination of watershed projects	++
Improved public awareness	+

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the calculation of improved water supply reliability. Such issues are listed in the following table.

Table18.5: Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Benefits relating to water supply and water quality	U	Water supply and water quality benefits are indirectly related to this project, but are not monetizable

*Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
- = Likely to decrease benefits.
-- = Likely to decrease net benefits significantly.
U = Uncertain, could be + or -.

Work Item #19: City of San Diego Green Mall Porous Paving and Infiltration

The City of San Diego Green Mall low impact development (LID) Porous Paving and Infiltration project will retrofit storm water systems on two commercial & industrial streets in the Chollas Creek sub-watershed of the Pueblo Hydrologic Unit (in the City of San Diego), allowing urban runoff and pollutants carried with it to infiltrate into the ground instead of discharging directly to the storm drain system and adjacent water bodies. This project will replace existing asphalt street paving with pervious concrete, move curbs and gutters into the street, and install bio-retention systems of crushed rock and trees in the created space. The project also involves educational outreach to the surrounding community and a monitoring component.

This is a model approach for LID in commercial and industrial areas. The City has named the approach a "Green Mall." Implementation of this project will guide the implementation of approximately 72 other infiltration and runoff reduction projects similar in scope (such as, porous paving and bio-retention planters in streets and parking lots, rain barrels, etc) that the City's Storm Water Pollution Prevention Division anticipates in other hydrologic unit as part of Municipal Storm Water Permit and TMDL compliance in future years.

This project's benefits can be classified into 7 categories:

- Infiltrate storm water and deposit pollutants within top few inches of soil
- Guide implementation of other infiltration and runoff reduction projects
- Potentially decrease stormwater treatment costs
- Increase quality and abundance of riparian habitat in the Chollas Creek sub-watershed
- Potentially increase levels of recreational opportunities and enjoyment and aesthetics
- Enhance flood control
- Provide outreach and education

The following tables summarize the benefits of this project. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-20.

Table19.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality		
Infiltrate storm water and deposit pollutants within top few inches of soil	Qualitative	Local, regional
Guides implementation of other infiltration and runoff reduction projects	Qualitative	Local, regional, statewide
Potential to decrease treatment costs	Qualitative	Local, regional
Other Benefits (described in Attachment 9)		
Increased quality and abundance of riparian habitat in the Chollas Creek sub-watershed	Qualitative	Local, regional
Potential to increase levels of recreational opportunities and enjoyment and aesthetics	Qualitative	Local, regional, statewide
Enhanced Flood control	Qualitative	Local, regional
Disadvantaged community	Qualitative	Local
Outreach and education	Qualitative	Local

Table19.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$458,640
	Qualitative indicator*
Qualitative Benefits	
Infiltrate storm water and deposit pollutants within top few inches of soil	+
Guides implementation of other infiltration and runoff reduction projects	++
Potential to decrease treatment costs	+
Increased quality and abundance of riparian habitat in the Chollas Creek sub-watershed	+
Potential to increase levels of recreational opportunities and enjoyment and aesthetics	+
Enhanced Flood control	+
Disadvantaged community	+
Outreach and education	+

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

The total estimated cost of the Green Mall LID pilot project is $507,731, for a present value of $458,640. Both capital and maintenance costs ($30,000) will be expended in 2008 and 2009. The largest capital cost is construction and implementation. Operations and maintenance costs are estimated to be $15,000 in both 2008 and 2009. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-20.

The "Without Project" Baseline

If the project were not pursued, the impervious pavement would remain and runoff would continue to drain into the Chollas Creek sub-watershed. No additional knowledge on the method would be learned and it would potentially be less likely and/or less efficient to implement other LID porous pavement and infiltration projects.

Water Supply and Water Quality Benefits

The primary goal of the project is to infiltrate storm water, leaving pollutants within the top few inches of the soil. The goal is to be a pilot project aiding the City's Storm Water Pollution Prevention Division implement approximately 72 infiltration and runoff reduction projects similar in scope.

Water Quality Benefits

Infiltrate storm water and deposit pollutants within top few inches of soil

Infiltration will reduce the volume of runoff flowing through the storm drain system, thereby reducing its capacity to convey pollutants into Chollas Creek, San Diego Bay, and the Pacific Ocean. The infiltration action and the flow of runoff through the bio-retention planter boxes will also slow the flow rate of the runoff, further reducing its capacity to convey pollutants and erode exposed soils downstream. The soil underneath the porous paving and bio-retention planter boxes will also treat runoff of pollutants. Metals, bacteria, sediment, and nutrients will be captured and retained by the soils underneath the porous paving and the bio-retention planter boxes. The planter boxes will also be designed to contain trash and debris. Through natural processes, the vegetation will be able to eliminate the metals, bacteria, and nutrients, and the trash and debris captured will be collected and disposed of properly.

The project site is located within the Chollas Creek watershed, which is listed as impaired on the Clean Water Act 303(d) list for diazanon, dissolved copper, dissolved lead, dissolved zinc, and bacteria. The San Diego Regional Water Quality Control Board has adopted TMDLs for all of these pollutants.

Guide implementation of other infiltration and runoff reduction projects

The City's Storm Water Pollution Prevention Division anticipates implementing approximately 72 infiltration and runoff reduction projects similar in scope (such as, porous paving and bio-retention planters in streets and parking lots, rain barrels, etc) in other HUs as part of Municipal Storm Water Permit and TMDL compliance in future years.

Potential to decrease treatment costs

This project will help the City determine the effectiveness of porous paving, bio-retention and other infiltration approaches in meeting stringent Municipal Storm Water Permit, TMDL, and ASBS requirements (both present and future). Properly engineered and designed infiltration may prove to be a cost-effective alternative to building costly and land intensive end-of-pipe treatment facilities. By implementing this project (and others of similar scope in other locations), the City can evaluate and fine tune a cost-effective solution to urban runoff pollution that should be maximized before resorting to more expensive and invasive types of treatment controls.

Costs for consolidated treatment systems and purchase of required lands ranges from approximately $750 million to $1 billion (City of San Diego, 2006).

Distribution of Project Benefits, and Identification of Beneficiaries

The following table summarizes the project's beneficiaries.

Table19.3: Project Beneficiaries Summary

Local	Regional	Statewide
Residents who care about water quality in the Chollas Creek sub-watershed, the San Diego Bay and/or the Pacific Ocean Local municipalities and or agencies who are interested porous pavement and infiltration techniques	Residents who care about water quality in the Chollas Creek sub-watershed, the San Diego Bay and/or the Pacific Ocean Agencies who are interested porous pavement and infiltration techniques	Individuals who care about state water quality or are impacted by San Diego Bay and/or Pacific Ocean water quality Agencies who are interested porous pavement and infiltration techniques

Project Benefits Timeline Description

The construction and implementation will occur in 2008 and 2009. Project benefits are expected to last 50 years, through 2059. knowledge learned from the pilot project can be used throughout time in conducting similar projects.

Potential Adverse Effects from the Project

Excessive groundwater infiltration has the potential to damage street, sidewalk and building improvements. To address this potential concern, the project will use the City's draft Strategic Plan for Watershed Activity Implementation guidelines for site selection and sizing of infiltration planters and pervious concrete or porous asphalt paving. These guidelines will be used to help avoid potential negative impacts, such as undermining the foundations of nearby structures with too much groundwater. Implementation of this project, as well as future ones of similar scope, will contribute to the refinement of the guidelines.

In addition, there is some concern that the pollutants infiltrated by the porous paving may adversely affect groundwater resources. An informal literature review and discussion with industry experts by the City reveals that this concern is largely unfounded based on monitoring of other similar infiltration applications. Monitoring at other locations found that the metals and other pollutants infiltrated along freeway infiltration strips and other applications were trapped within the first six inches of soil, the majority of which was trapped within the first few centimeters. However, to address this potential concern, the City's interim infiltration guidelines also identify conservative infiltration restrictions to protect any potential groundwater resources.

Summary of Findings, Tables

The Green Mall LID porous pavement and infiltration project will decrease runoff and the associated pollutants to Chollas Creek, the San Diego Bay, and ultimately the Pacific Ocean. The project will serve as a pilot to improve knowledge of the techniques used for porous pavement and infiltration projects. The present value costs of this project are $427,270. The water supply and quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. These benefits are presented in the following table.

Table19.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Infiltrate storm water and deposit pollutants within top few inches of soil	+
Guide implementation of other infiltration and runoff reduction projects	++
Potential to decrease treatment costs	+

Work Item #20: Chollas Creek Runoff Reduction and Groundwater Recharge Project

The Chollas Creek Runoff Reduction and Groundwater Recharge Project is a project to reduce runoff from three County of San Diego facilities in the Chollas Creek subwatershed of the Pueblo San Diego hydrological unit. These facilities occupy sites that are highly impervious and could be retrofitted with low impact development (LID) components to reduce runoff and promote infiltration. The Project includes retrofitting portions of one of the traditional parking lots with porous pavement over a stone reservoir, two parking lots at one site with proprietary concrete vaults over stone, and a third site with vegetative low impact development features to capture runoff from the parking lots, and, where feasible, to also capture runoff from roof drains. The purpose of this retrofitting is to prevent runoff from these impervious surfaces from transporting pollutants -- particularly copper, lead, and zinc that have been directly deposited on the properties through atmospheric deposition and discharged through the storm drain system -- to Chollas Creek, which has been listed as impaired by copper, lead, and zinc and is the subject of a total maximum daily load (TMDL) currently proposed for approval by the San Diego Regional Water Quality Control Board.

This project will reduce runoff from these facilities as well as guide the implementation of other runoff reduction and groundwater infiltration projects through demonstrating the use of porous pavement and other LID measures. The following tables summarize the benefits of this project. Detailed cost and benefit information associated with the project, including present value calculations, is presented in Appendix 8-21.

Table20.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality		
Infiltrate storm water and reduce runoff pollution	Qualitative	Local, regional
Guides implementation of other runoff reduction and groundwater infiltration projects stormwater BMPs	Qualitative	Local, regional, statewide
Other Benefits (discussed in Attachment 9)		
Disadvantaged communities	Qualitative	Local
Reduced erosion of downstream channels	Qualitative	Local

Table 20.2: Benefit-Cost Analysis Overview

	Present Value ($2006)
Costs – Total Capital and O&M	$659,862
	Qualitative indicator*
Qualitative Benefits	
Infiltrate storm water and reduce runoff pollution	+
Guides implementation of other runoff reduction and groundwater infiltration projects	++
Disadvantaged community benefits	+
Reduced erosion of downstream channels	++

* Magnitude of effect on net benefits
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Costs

Total project costs are $728,556 (present value of $659,862) and will be expended between 2008 and 2009. Detailed cost information associated with the project, including present value calculations, is presented in Appendix 8-21.

The "Without Project" Baseline

If the project were not pursued, the impervious pavement would remain and runoff would continue to drain into the Chollas Creek sub-watershed. No additional knowledge on the method would be learned and it would potentially be less likely and/or less efficient to implement other runoff reduction and groundwater recharge projects.

In the past, agencies have utilized land acquisition programs to protect water quality in domestic water reservoirs. If the proposed project is not implemented to promote the installation of porous pavements to reduce runoff and to promote treatment of runoff that does occur, it will be necessary to buy more and more land to protect source water areas to protect water quality in domestic water reservoirs. It will also be necessary to import more water if urban runoff losses continue to increase because of increases in impervious areas within the County's coastal watersheds.

Water Supply and Water Quality Benefits

The project will support expected long-term regional water management needs by helping to reduce the rate of increase in imperviousness of the Chollas Creek Watershed and eventually other County watersheds and may result in reductions of imperviousness through re-development using porous paving and other low impact development techniques and stormwater BMPs. This will help to reduce urban runoff, reduce impacts of peak flow runoff to creeks, increase replenishment of groundwater resources, and improve water quality. This will, in turn, improve downstream receiving waters.

In the Porous Pavement and Model Municipal Operations Center Demonstration Project, 100 percent of metals and other contaminants were prevented from discharging to the San Diego River through the municipal storm drains. The seasonal mean Event Mean Concentrations (EMC) for runoff from the Reference Area was used to estimate load reductions achieved by each type of porous pavement (Table 8 of Appendix I, Porous Paving & Treatment Train Monitoring Program, Final Report, Kinnetic Labs, Inc., February 2007). In addition, the porous pavement prevented the discharge of nearly 34,000 cubic feet of

water that would have been associated with the 8.15 inches of rainfall experienced during the 2005/2006 season (San Diego Watershed, 2007).

Distribution of Project Benefits, and Identification of Beneficiaries

Benefits of the Chollas Creek Runoff Reduction and Groundwater Recharge Project will be realized at the local, regional, and state levels, as shown in the table below.

Table 20.3: Project Beneficiaries Summary

Local	Regional	Statewide
Residents of the Chollas Creek Watershed	Residents who utilize San Diego Bay; Regional agencies that are interested in runoff reduction, groundwater infiltration techniques and implementation of TMDLs (particularly Metals TMDLs); permittees and other agencies concerned with hydromodification.	State agencies that are interested in runoff reduction, groundwater infiltration techniques, implementation of TMDLs (particularly Metals TMDLs), and the implementation of low impact development to reduce hydromodification.

Project Benefits Timeline Description

The construction and implementation will occur in 2009 and 2010. Project benefits are expected to last 50 years, through 2059. Knowledge learned from this type of project can be used throughout time in conducting similar projects.

Potential Adverse Effects from the Project

There will be temporary negative impacts to parking and access at the facilities included in the project. There could be short term impacts to air quality due to dust. No long term negative impacts are anticipated.

Summary of Findings, Tables

The Chollas Creek Runoff Reduction and Groundwater Recharge Project will decrease runoff and the associated pollutants to Chollas Creek and increase recharge to groundwater. The project will improve knowledge of the techniques used for runoff reduction and groundwater infiltration projects. The present value costs of this project are $589,811. The water supply and quality benefits of this project are not physically quantifiable or monetizable. There are no identified avoided costs as a result of this project and no generic monetizable benefits can be reasonably estimated. Consequently, the qualitative benefits of this project must be balanced against the monetized cost. These benefits are presented in the following table.

Table 20.4: Qualitative Benefits Summary – Water Supply and Water Quality

Benefit	Qualitative Indicator
Infiltrate storm water and reduce runoff pollution	+
Guides implementation of other runoff reduction and groundwater infiltration projects	++

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Appendix 8: Calculation of Costs and Benefits Presented in Attachment 8

Appendix 8-1:

Estimating the Future Avoided Import Water Supply Costs of Developing Local Supplies in the San Diego Region

1. Introduction

Water produced by conservation, reuse, other "local sources" will offset the need to use imported waters, which would largely be derived from the State Water Project (SWP) and/or Colorado River Aqueduct (CRA), as wholesaled to SDCWA by the Metropolitan Water District of Southern California (MWD).[1] The value of adding new local supplies can thus be estimated based on the costs avoided by reducing local demands for imported water. This assumes that expanding local desalinated capacity beyond levels already anticipated would be more expensive than increasing imports, at the margin.[2]

The cost savings arising from reducing demands for imported water should be estimated based on the projected future cost of imports, at the margin. This in turn requires a projection of the cost of providing additional imported water, at the levels needed in the future if local resources are not expanded as envisioned in the regional plan. The key empirical question for valuation is thus, "What is the future cost, at the margin, of acquiring another AF of imported MWD (or other imported) water, and having it delivered (and treated, where applicable) to the users of the local supply alternatives?"[3]

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[1] SDCWA also provides imported water from the Imperial Irrigation District (IID) water transfer and canal lining projects. For this analysis, we do not consider offsetting imports from IID. IID waters are more expensive waters than comparable (raw) MWD imports ($584/AF, compared to MWD Tier 1 water at $351/AF, in 2008). This implies that our estimated cost savings for avoided MWD imports is likely to be conservative (i.e., at the lower end of what is likely to be experienced for the whole portfolio). Canal lining projects produce a relatively fixed amount of water (i.e., there is a maximum quantity of water that can be saved by lining the canals), so changes in future quantities delivered are not generally relevant to this analysis.

[2] If imported water is not readily available at the levels necessary in the future to meet local demand, then the avoided water supply costs would need to be estimated based on the projected cost of expanded future use (i.e., more than currently planned) "local" desal.

[3] Cost of treatment and delivery need to be included in the avoided import water costs, to provide a suitable "apples-to-apples" comparison of import water costs to the local supplies. This is because the costs used in these analyses for local supplies are generally inclusive of treatment and delivery.

There are several empirical and conceptual challenges to forecasting the future avoided cost of import water. This appendix discusses these issues and how they were addressed to develop the avoided water supply costs that are used to evaluate the benefits of those projects that provide local water (or conserve water) in the San Diego region.

2. SDCWA's Previous Water Rate Projections

SDCWA has projected rates and charges for M&I uses to the year 2014.[4] These projections include actual rates through 2007, adopted rates for 2008, and forecasts for 2009 and the following five years (i.e., through 2014, inclusive). These projections from serve as our starting point, though as discussed below, these costs require updating given several factors that are likely to drive marginal import water costs above these initial projections. These factors include a recent federal court ruling that is likely to significantly limit future SWP extractions from the Bay-Delta.

SDCWA projects its M&I rates based on its estimated "untreated melded M&I supply rate." This melded rate is a weighted average cost per acre foot of the Authority's three nonlocal supplies, plus some minor related costs. The three water sources melded in the rate are IID water transfers, water derived from canal lining projects, and imported Tier 1 water from MWD. Table 1 shows the derivation of the untreated melded M&I supply rate for 2008, and Table 2 shows the same information for projected 2009 costs (both tables are based on information provided in a report to the SDCWA Board of Directors, Administrative and Finance Committee, June 20, 2007).[5]

Table 1: Untreated Melded Rate Basis - 2008			
2008 Melded Rates (w/Tier 1)			
source	**AF (000)**	**$/AF**	**cost ($M)**
MWD Tier 1	470.2	$ 351	$ 165.0
IID	50	$ 584	$ 29.2
Canal	21.5	$ 283	$ 6.1
Other costs			$ 10.7
total	**541.7**	**$ 389.56**	**$ 211.0**

[4] San Diego County Water Authority, Adopted Operating Multiyear Budget, Fiscal Years 2007-2008 and 2008-2009, Section 1 page 68: Water Authority Rates and Charges on a Per-Acre-Foot Basis Calendar Years 2004-2014 M&I Rates. http://www.sdcwa.org/about/financial-operatingbudget.phtml

[5] Pages 157 –164 of the July 2007 SDCWA Board Meeting materials, accessed from the SDCWA web site, December 21, 2007.

Table 2 presents the Water Authority's untreated melded rate basis.

Table 2: Untreated Melded Rate Basis - 2009			
2009 Melded Rates (w/Tier 1, pre Delta ruling)			
(before Court ruling, etc, influenced rates)			
source	**AF (000)**	**$/AF**	**cost ($M)**
MWD Tier 1	445.1	$ 385	$ 171.4
IID	60	$ 578	$ 34.7
Canal	33.7	$ 310	$ 10.4
Other costs			$ 14.0
total	**538.8**	**$ 427.78**	**$ 230.5**
MWD increase		**9.69%**	

The Authority's M&I rates also account for the melded cost of treating and delivering imported waters. Table 3 provides the build up of the projected total M&I rates, for the adopted 2008 rates, plus the Authority's projected rates in 2009 through 2014. These are nominal costs, reflecting 2007 price levels. The bottom row in Table 3 also shows the projected costs in real 2006 dollar terms, netting out an assumed annual 3% general price inflation in each year (per state instructions).

Table 3: SDCWA pre-Delta Ruling Forecast, Using Untreated Tier 1 MWD Rate in Melded Rate							
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Customer Service Charge	24	26	28	33	37	41	39
Storage Charge	41	42	59	68	88	97	119
Transportation Rate	60	63	59	69	62	68	71
Untreated Melded M&I Rate	390	428	462	492	513	533	551
Melded Tretament Rate	164	170	177	184	209	212	218
Total	679	729	785	846	909	951	998
2006 real price	***$ 640***	***$ 667***	***$ 697***	***$ 730***	***$ 761***	***$ 773***	***$ 788***

3. Key Factors Likely to Result in Higher Import Water Costs than Previously Projected

There are several factors that indicate that future import water costs are likely to be higher than forecast by SDCWA in its earlier projections, as shown above. These factors include the following:

1. The recent findings of a federal court regarding the adverse environmental impact of extractions from the Bay-Delta to supply the SWP. Beginning in October 2007, shortly

after the court indicated a likely one-third reduction in allowable Delta extractions, MWD began signaling that future water rates would escalate more than originally anticipated, suggesting rate increases of 10% or higher (perhaps 20%) for 2009, and suggesting like-sized increases might be repeated over successive years as well.[6]

2. Continuing drought in the Colorado River watershed, as well as the increasing likelihood of dry years in relevant in-state watersheds (in part, due to climate change), and including reduced snowpack prospects within California, suggest that all of MWD's import water sources are likely to be increasingly strained in future years. Continuing constraints on these supply sources inevitably will force the cost of MWD source waters upward.

3. SDCWA rate projections are driven by "normal year" circumstances. The Authority's "dry year" projections reveal higher local demands and reduced local supplies, with the difference covered by increased reliance on MWD imports (relative to the normal year purchases, such as reflected in Tables 1 and 2 to derive the melded supply cost). For example, the Authority's 2010 dry year forecast relies on 542,000 AF being acquired from MWD, as contrasted to the 2010 normal year forecast of MWD purchases of under 446,000 AF (SDCWA Updated 2005 Urban Water Management Plan, September 2007, Tables 8-1 and 8-2). This 22% increase in imported MWD water in the dry scenario, relative to the purchases under a normal year scenario, would likely come at considerable expense, given heightened competition statewide for water in a dry year. In addition, dry years demands, coupled with diminished yields from some local supplies, would likely result in a significant portion of the MWD water acquisitions (especially at the margin) to be priced at the Tier 2 rate (rather than the lower Tier 1 rate used in the Authority's water supply cost forecast). [7]

4. As noted above, the SDCWA projections are based on acquiring MWD water at the Tier 1 rate. Absent the local water supply resources being developed in the greater San Diego County planning region (as represented by several projects in this grant submission), demands for MWD-supplied import water might well result in Tier 2 acquisitions. This is particularly likely when considering acquisitions of MWD import water at the margin,

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[6] While apparently not part of an official MWD statement or press release, this information has been released indirectly through the media (e.g., Becerra and Saillant, "MWD warns of water cuts, higher rates," *L.A. Times*, October 9, 2007), and in bond rating evaluations (e.g., "Fitch Rates Metropolitan Water District…," *Market Watch*, November 2, 2007, accessed from www.marketwatch.com/news/…, January 3, 2008).

[7] Existing agreements suggest that Tier 1 pricing has applied to SDCWA acquisition of MWD water up to 500,000 AF (MWD Regional Urban Water Management Plan, September 2005, page II-32). Acquisitions beyond the applicable Tier 1 limit are subject to Tier 2 rates.

which is the applicable scenario for adding local supply options as in this grant submittal (and, as noted above, is particularly applicable in dry years).

Given the above factors, there is good reason to anticipate that the future marginal cost of acquiring and delivering imported water will be higher than the SDCWA-projected rates shown in Table 3.

3. Updated Import Water Cost Projection Scenarios

We develop two updated import water cost forecasts to reflect the avoided cost, at the margin, of reducing such imports in the years ahead. Each is described below.

Scenario 1: Higher Near-Term Escalation of Projected MWD Tier 1 Rates (2009 and 2010)

The first alternative retains the conservative assumption that the offsets in future MWD imports would all remain under the Tier 1 pricing regime. However, the cost of Tier 1 MWD water in this scenario is assumed to escalate by 50% more than SDCWA had previously projected, for 2009 and 2010, to reflect the impact of the court ruling on MWD rates.[8] Then, for 2011 through 2014, we revert to the average annual escalation that SDCWA has previously projected (6.6%). This results in a relatively modest 8.1% average annual increase over the 6-year period of 2009 through 2014, for the overall untreated melded water supply rate.

The results for the scenario of higher near-term escalation of MWD Tier 1 rates are summarized in Table 4. For example, the nominal cost (in 2007 dollars) for imported water, treated and delivered, is projected to be $743/AF (compared to $729/AF under the prior SDCWA projection, which was shown in Table 3). In real 2006 dollars (the basis required for this analysis by the state), the 2009 cost is $680 per AF (shown in the bottom row of Table 4).

[8] SDCWA projections were completed prior to the ruling that indicated significant impacts on extractions from the Bay-Delta, and the associated October 2007 signals from MWD of higher-than-previously-anticipated rates. As a numeric example, the SDCWA melded rate for 2009 reflected an assumed MWD untreated Tier 1 cost of $385/AF, which is a 9.7% increase over the 2008 rate. In this scenario, we update the projected 2009 Tier 1 rate by 14.5% (50% above the prior 9.7% escalation), and thus derive an estimated nominal cost of $402/AF for 2009 Tier 1 water.

Table 4: Scenario Using Melded Untreated Tier 1 Rate, based on updated, post Oct 07 Delta Ruling							
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Customer Service Charge	24	26	28	33	37	41	39
Storage Charge	41	42	59	68	88	97	119
Transportation Rate	60	63	59	69	62	68	71
Untreated Melded M&I Rate	390	$ 442	$ 494	$ 527	$ 562	$ 599	$ 639
Melded Tretament Rate	164	170	177	184	209	212	218
Total	679	743	817	881	958	1017	1086
2006 real price	***$ 640***	***$ 680***	***$ 726***	***$ 760***	***$ 802***	***$ 827***	***$ 857***

Scenario 2: Applying Tier 2 rates for Marginal Increases in Imports

The second import cost projection is developed based on the scenario of local water resources offsetting Tier 2 MWD water, at the margin (rather than Tier 1). This projection applies predicted Tier 2 rates within the Authority total M&I rate build up, instead of the melded supply costs driven by Tier 1 costs.

MWD currently sets 2008 Tier 2 rates at about 28% above Tier 1 rates (likewise, in 2007, Tier 2 was priced at 29% above Tier 1). Hence, we assume 2009 and 2010 Tier 2 rates are 28% above the original SDCWA projections for Tier 1 rates in each of those years. This is likely to be a conservative (i.e., low) estimate for Tier 2 rates, because the projected Tier 2 rates in these projections is driven by the older projections for Tier 1 rates (rather than the updated, post-Delta ruling Tier 1 rates developed under scenario 1). Beyond 2010, Tier 2 rates are escalated at the average annual rate projected originally by the Authority for its 6-year forecast of M&I rates (from Table 3), which is 6.6%.

The results for Tier 2-based marginal avoided costs scenario are summarized in Table 4. For example, the nominal cost (in 2007 dollars) for imported Tier 2 water, treated and delivered, is projected to be $793/AF (compared to $729/AF under the prior SDCWA projection, which was shown in Table 3). In real 2006 dollars (the basis required for this analysis by the state), the 2009 cost is $726 per AF (shown in the bottom row of Table 5).

Table 5: Scenario Using Tier 2 MWD Untreated Rate, based on pre Oct 07 Delta Ruling							
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Customer Service Charge	24	26	28	33	37	41	39
Storage Charge	41	42	59	68	88	97	119
Transportation Rate	60	63	59	69	62	68	71
MWD Tier 2 Rate	449	$ 492	$ 551	$ 588	$ 627	$ 668	$ 713
Melded Tretament Rate	164	170	177	184	209	212	218
Total	$ 738	$ 793	$ 874	$ 942	$ 1023	$ 1086	$ 1160
2006 real price	***$ 696***	***$ 726***	***$ 777***	***$ 812***	***$ 857***	***$ 883***	***$ 915***

4. Projected Import Water Costs Avoided, at the Margin

The above discussion shows that there are several reasons to expect the marginal avoided import water costs – such as generated by local water supply development and conservation projects – to increase appreciably in the years ahead. The discussion that follows uses real 2006 dollars as the basis for all results portrayed (unless otherwise specified).

The original SDCWA projections (Table 3) indicate real rate of $667 per AF for 2009, but this rate is likely to be lower than will actually materialize, given developments evident since October 2007 (predominantly, the federal court ruling foreshadowing significant reductions in SWP extractions of Bay-Delta water). Our alternative projections suggest $680/AF in 2009 under scenario 1 (Table 4, for higher MWD Tier 1 rate escalations) or $726/AF under scenario 2 (Table 5, based on a Tier 2 water as the marginal offset, where Tier 2 is priced conservatively in the projections).

We believe it is reasonable to develop projected import water costs avoided, at the margin, by averaging the results of the two scenarios developed as updates to the original, pre-Delta ruling SDCWA projections. This is shown in Table 6, which portrays forecast rates in 2006 real terms, for 2008 through 2014, based on the average of the two scenarios developed here (both of which are built primarily upon original SDCWA projections, and updated per the discussion provided above). For 2015 and years beyond, we apply a real cost increase of 2.5% annually for avoided imports at the margin.[9]

[9] SDCWA's original (pre-October 2007 Delta ruling) projected nominal rate increases over 6 yrs (2009 through 2014 projected, inclusive) is 147%, which is an average annual nominal rate of over 6.6%. Assuming (per State instructions) a 3% real annual rate of increase in general, then SDCWA water costs will rise at a real annual rate of 3.6% above the average real rate. To be conservative in the out years of 2015 and beyond, we reduce this 3.6% real increase to 2.5%.

Table 6: Average of Projected Marginal Import Costs Avoided							
Averaged Projected Costs	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
(in 2006 real dollars)							
	$ 668	***$ 703***	***$ 751***	***$ 786***	***$ 829***	***$ 855***	***$ 886***

5. Conclusions

The water supply benefits of local water resource development and conservation projects are typically characterized according to the avoided costs of obtaining the added yields from the least expensive of the other viable supply options. For the San Diego region, these avoided the least expensive water supply costs pertain to imported water, as furnished to the region by MWD. In the future, the least expensive avoided costs could pertain to local desalination, if that were to become less expensive than the imports. Treatment and distribution costs also need to be factored into the cost of avoided import water, because the local options typically include the cost of delivering treated water to the relevant users.

SDCWA projected M&I rates provide a sound basis for beginning the exercise of estimating the avoided cost of imported water. However, the Authority's available rate projections do not account for several relevant factors, and they pre-date the Bay-Delta court ruling and subsequent MWD signals that import water prices were likely escalate faster than originally anticipated. Accordingly, we have developed two scenarios for making relatively modest adjustments to the SDCWA forecasted rates.

On net, we believe that the avoided costs developed here (and summarized in Table 6) are generally conservative projections, meaning that we believe it is more likely than not that actual import water costs, at the margin, may be higher than the levels derived here. The key factors that drive this belief include the following:

(1) the Authority's rate projections appear to be driven by normal years, whereas in dry years (which may occur more frequently than in the past), the demands for imports increase and upward pressure of prices escalate,

(2) at the margin, and especially in dry years (but also conceivably in normal ones), offset supplies may need to reflect Tier 2 water rather than Tier 1 water,

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Note that these SDCWA rate increases were projected in mid 2007, BEFORE MWD suggested additional planned 10%+ rate hikes (to take effect in 2009 and beyond) in response to the anticipated one-third reduction in Sacramento-San Joaquin Delta deliveries, as a result of a federal court ruling (LA Times, Oct 9, 2007).

(3) the Tier 2-based scenario applies projected Tier 2 rates that do not account for the MWD price bump anticipated after the Bay Delta ruling,

(4) the Tier 1-based scenario only escalates MWD supply charges by 50% above the prior projection, and only for two years (whereas the price impact could be larger and/or of longer duration), and

(5) if import waters become as scarce as is conceivable, then prices will escalate faster and local desalination (which appears to cost on the order of between $900 to $1000 per AF, and perhaps higher for delivery) may become the least expensive alternative.[10]

Thus, on net, we would expect rates seen in the future are more likely than not to exceed rates used here (and as shown in Table 6).

[10] Data obtained for the Poseidon Carlsbad facility indicate that the capital expense of that plant is $228 million. Amortizing those costs (using a 7% interest rate and 20 year payment period) results in an annualized capital cost of about $21.5 million. Annual O&M costs are projected at $32.3 million. Thus total annualized costs may be $53.8 million. If the facility produces desalinated water at the project rate of 56,000 AF per year, then the annualized costs run at about $960 per AF (in 2007 $s).

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Table 3-3 – Annual Cost of Implementation of Integrated Landscape and Agriculture Efficiency Programs (All costs in 2006 Dollars)										
YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table B-1	Capital and Other Initial Costs Not Included in Table B-1	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007									1.06	
2008	$5,504,384							$5,504,384	1.12	$4,898,882
2009								$0	1.19	$0
2010								$0	1.26	$0
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$4,898,882
Comment Box										

Table 12 - Annual Water Supply and Water Quality Benefits - Implementation of Integrated Landscape and Agriculture Efficiency Programs
(All benefits should be in 2006 dollars)

YEAR	Benefit: Purchase of additional imported water - audits					Benefit: Purchase of additional imported water - retrofits					Benefit: Purchase of additional imported water - water budget					Benefit: Purchase of additional imported water - ordinance-relates					Benefit: Reduced salt loading to the Region					Discounting Calculations for Economic Benefits		
	Measure of Benefit: Acre-Feet					Measure of Benefit: Acre-Feet					Measure of Benefit: Acre-Feet					Measure of Benefit: Acre-Feet					Measure of Benefit: tons per year							
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
2007	0	0	0	$0.00	$0	0	0	0	$0.00	$0	0	0	0	$0.00	$0	0	0	0	$0.00	$0	0	0	0			$0	1.06	$0
2008	500	0	500	$668.00	$334,000	530	0	530	$668.00	$354,040	2571	0	2571	$668.00	$1,717,428	6	0	6	$668.00	$4,008	2187	0	2187			$2,405,468	1.12	$2,140,858
2009	500		500	$703.00	$351,500	530	0	530	$703.00	$372,590	2571	0	2571	$703.00	$1,807,413	6	0	6	$703.00	$4,218	2187	0	2187			$2,531,503	1.19	$2,125,499
2010	500		500	$751.00	$375,500	530	0	530	$751.00	$398,030	2571	0	2571	$751.00	$1,930,821	6	0	6	$751.00	$4,506	2187	0	2187			$2,704,351	1.26	$2,142,099
2011	500		500	$786.00	$393,000	530	0	530	$786.00	$416,580	2571	0	2571	$786.00	$2,020,806	6	0	6	$786.00	$4,716	2187	0	2187			$2,830,386	1.34	$2,115,029
2012			0	$829.00	$0	530	0	530	$829.00	$439,370	2571	0	2571	$829.00	$2,131,359	6	0	6	$829.00	$4,974	1885	0	1885			$2,570,729	1.42	$1,812,263
2013			0	$855.00	$0			0	$855.00	$0			0	$855.00	$0			0	$855.00	$0	0	0	0			$0	1.50	$0
2014			0	$886.00	$0			0	$886.00	$0			0	$886.00	$0			0	$886.00	$0	0	0	0			$0	1.59	$0
2015			0	$908.00	$0			0	$908.00	$0			0	$908.00	$0			0	$908.00	$0	0	0	0			$0	1.69	$0
2016			0	$931.00	$0			0	$931.00	$0			0	$931.00	$0			0	$931.00	$0	0	0	0			$0	1.79	$0
2017			0	$954.00	$0			0	$954.00	$0			0	$954.00	$0			0	$954.00	$0	0	0	0			$0	1.90	$0
2018			0	$978.00	$0			0	$978.00	$0			0	$978.00	$0			0	$978.00	$0	0	0	0			$0	2.01	$0
																										Total Present Value of (Sum of the values in		$10,335,746

Comment Box:

Table 11 – Annual Cost of Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0.00	1.06	$0
2008	$375,202.10							$375,202.10	1.12	$333,929
2009	$375,202.10							$375,202.10	1.19	$315,027
2010	$375,202.10							$375,202.10	1.26	$297,195
2011	$375,202.10							$375,202.10	1.34	$280,373
2012								$0.00	1.42	$0
2013								$0.00	1.50	$0
2014								$0.00	1.59	$0
2015								$0.00	1.69	$0
2016								$0.00	1.79	$0
2017								$0.00	1.90	$0
2018								$0.00	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$1,226,524

Comment Box

Table 12- Annual Water Supply and Water Quality Benefits of Irrigation Hardware Giveaway and Dry Weather Runoff Reduction Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Water conserved through WBICs					Benefit: Reduced salt loading to the Region							
	Measure of Benefit: Acre-Feet					Measure of Benefit: tons TDS					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0	$0.00	$0.00	0	0	0			$0.00	1.06	$0
2008	91	0	91	$668.00	$60,788.00	55	0	55			$60,788.00	1.12	$54,275
2009	91	0	91	$703.00	$63,973.00	55	0	55			$63,973.00	1.19	$53,759
2010	91	0	91	$751.00	$68,341.00	55	0	55			$68,341.00	1.26	$54,132
2011	91	0	91	$786.00	$71,526.00	55	0	55			$71,526.00	1.34	$53,448
2012	91	0	91	$829.00	$75,439.00	55	0	55			$75,439.00	1.42	$53,182
2013	91	0	91	$886.00	$80,626.00	55	0	55			$80,626.00	1.50	$53,621
2014	91	0	91	$908.15	$82,641.65	55	0	55			$82,641.65	1.59	$51,850
2015	91	0	91	$930.85	$84,707.69	55	0	55			$84,707.69	1.69	$50,138
2016	91	0	91	$954.13	$86,825.38	55	0	55			$86,825.38	1.79	$48,483
2017	91	0	91	$977.98	$88,996.02	55	0	55			$88,996.02	1.90	$46,882
2018													
												Total Present Value of Discounted Benefits	$519,771

Comment

Managament
Round 2, Step 2 Implementation Grant Application
Appendix 8-4

Table 11: Annual Cost of Over-Irrigation / Bacteria Reduction Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs8	Discount Factor	Discounted Costs8
2007								$0	1.06	$0
2008	$78,957		$2,906				$7,981	$89,845	1.12	$79,961
2009	$157,914		$5,813				$15,963	$179,689	1.19	$150,871
2010	$78,957		$2,906				$7,981	$89,845	1.26	$71,165
2011										
2012										
2013										
2014										
2015										
2016										
2017										
2018										
Total Present Value of Discounted Costs (Sum of Column (j))										$301,998

Comment Box
Assumes 1/4 of costs are expended in 2008 and 2100 and 1/2 in 2009.

Table 12 Annual Water Supply and Water Quality Benefits of the of Over-Irrigation / Bacteria Reduction Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided Imported water purchases					Benefit: Reduced TDS Loading to Region							
	Measure of Benefit: Acre-Feet					Measure of Benefit: tons TDS					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0	$0.0	$0	0	0	0.00			$0	1.06	$0
2008	88.25	0	88.25	$668.0	$58,951	53	0	53.34			$58,951	1.12	$52,635
2009	176.5	0	176.5	$703.0	$124,080	107	0	106.68			$124,080	1.19	$104,268
2010	264.75	0	264.75	$751.0	$198,827	160	0	160.02			$198,827	1.26	$157,490
2011	353	0	353	$786.0	$277,458	213	0	213.36			$277,458	1.34	$207,333
2012	353	0	353	$829.0	$292,637	213	0	213.36			$292,637	1.42	$206,298
2013	353	0	353	$886.0	$312,758	213	0	213.36			$312,758	1.50	$208,002
2014	353	0	353	$908.2	$320,577	213	0	213.36			$320,577	1.59	$201,134
2015	353	0	353	$930.9	$328,591	213	0	213.36			$328,591	1.69	$194,493
2016	353	0	353	$954.1	$336,806	213	0	213.36			$336,806	1.79	$188,071
2017	353	0	353	$978.0	$345,226	213	0	213.36			$345,226	1.90	$181,861
2018	353	0	353	$1,002.4	$353,857	213	0	213.36			$353,857	2.01	$175,856
2019	353	0	353	$1,027.5	$362,703	213	0	213.36			$362,703	2.13	$170,050
2020	353	0	353	$1,053.2	$371,771	213	0	213.36			$371,771	2.26	$164,435
2021	353	0	353	$1,079.5	$381,065	213	0	213.36			$381,065	2.40	$159,005
2022	353	0	353	$1,106.5	$390,592	213	0	213.36			$390,592	2.54	$153,755
2023	353	0	353	$1,134.2	$400,357	213	0	213.36			$400,357	2.69	$148,678
2024	353	0	353	$1,162.5	$410,366	213	0	213.36			$410,366	2.85	$143,769
2025	353	0	353	$1,191.6	$420,625	213	0	213.36			$420,625	3.03	$139,022
2026	353	0	353	$1,221.4	$431,140	213	0	213.36			$431,140	3.21	$134,432
2027	353	0	353	$1,251.9	$441,919	213	0	213.36			$441,919	3.40	$129,993
2028	353	0	353	$1,283.2	$452,967	213	0	213.36			$452,967	3.60	$125,701
2029	353	0	353	$1,315.3	$464,291	213	0	213.36			$464,291	3.82	$121,550
2030	353	0	353	$1,348.2	$475,898	213	0	213.36			$475,898	4.05	$117,537
2031	353	0	353	$1,381.9	$487,796	213	0	213.36			$487,796	4.29	$113,656
2032	353	0	353	$1,416.4	$499,991	213	0	213.36			$499,991	4.55	$109,903
2033	264.75	0	264.75	$1,451.8	$384,368	160	0	160.02			$384,368	4.82	$79,706
2034	176.5	0	176.5	$1,488.1	$262,651	107	0	106.68			$262,651	5.11	$51,383
2035	88.25	0	88.25	$1,525.3	$134,609	53	0	53.34			$134,609	5.42	$24,843
2036													
											Total Present Value of Discounted Benefits (Sum of the values in		$3,964,855

Comment Box:

Table 11 – Annual Cost of Santee Water Reclamation Facility Expansion Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008	$5,773,196							$5,773,196	1.12	$5,138,124
2009	$5,773,196							$5,773,196	1.19	$4,847,287
2010	$11,546,392							$11,546,392	1.26	$9,145,824
2011				$1,350,000				$1,350,000	1.34	$1,008,799
2012				$1,350,000				$1,350,000	1.42	$951,697
2013				$1,350,000				$1,350,000	1.50	$897,827
2014				$1,350,000				$1,350,000	1.59	$847,007
2015				$1,350,000				$1,350,000	1.69	$799,063
2016				$1,350,000				$1,350,000	1.79	$753,833
2017				$1,350,000				$1,350,000	1.90	$711,163
2018				$1,350,000				$1,350,000	2.01	$670,909
2019				$1,350,000				$1,350,000	2.13	$632,933
2020				$1,350,000				$1,350,000	2.26	$597,106
2021				$1,350,000				$1,350,000	2.40	$563,308
2022				$1,350,000				$1,350,000	2.54	$531,422
2023				$1,350,000				$1,350,000	2.69	$501,342
2024				$1,350,000				$1,350,000	2.85	$472,964
2025				$1,350,000				$1,350,000	3.03	$446,193
2026				$1,350,000				$1,350,000	3.21	$420,936
2027				$1,350,000				$1,350,000	3.40	$397,110
2028				$1,350,000				$1,350,000	3.60	$374,632
2029				$1,350,000				$1,350,000	3.82	$353,426
2030				$1,350,000				$1,350,000	4.05	$333,421
2031				$1,350,000				$1,350,000	4.29	$314,548
2032				$1,350,000				$1,350,000	4.55	$296,744
2033				$1,350,000				$1,350,000	4.82	$279,947
2034				$1,350,000				$1,350,000	5.11	$264,101
2035				$1,350,000				$1,350,000	5.42	$249,152
2036				$1,350,000				$1,350,000	5.74	$235,049
2037				$1,350,000				$1,350,000	6.09	$221,744
2038				$1,350,000				$1,350,000	6.45	$209,192
2039				$1,350,000				$1,350,000	6.84	$197,351
2040				$1,350,000				$1,350,000	7.25	$186,181
2041				$1,350,000				$1,350,000	7.69	$175,642
2042				$1,350,000				$1,350,000	8.15	$165,700
2043				$1,350,000				$1,350,000	8.64	$156,321
2044				$1,350,000				$1,350,000	9.15	$147,472
2045				$1,350,000				$1,350,000	9.70	$139,125
2046				$1,350,000				$1,350,000	10.29	$131,250
2047				$1,350,000				$1,350,000	10.90	$123,821
2048				$1,350,000				$1,350,000	11.56	$116,812
2049				$1,350,000				$1,350,000	12.25	$110,200
2050				$1,350,000				$1,350,000	12.99	$103,962
2051				$1,350,000				$1,350,000	13.76	$98,078
2052				$1,350,000				$1,350,000	14.59	$92,526
2053				$1,350,000				$1,350,000	15.47	$87,289
2054				$1,350,000				$1,350,000	16.39	$82,348
2055				$1,350,000				$1,350,000	17.38	$77,687
2056				$1,350,000				$1,350,000	18.42	$73,289
2057				$1,350,000				$1,350,000	19.53	$69,141
2058				$1,350,000				$1,350,000	20.70	$65,227

Table 11 – Annual Cost of Santee Water Reclamation Facility Expansion Project (All costs in 2006 Dollars)										
YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2059				$1,350,000				$1,350,000	21.94	$61,535
2060				$1,350,000				$1,350,000	23.26	$58,052
Total Present Value of Discounted Costs (Sum of Column (j))										$35,985,809

Comment Box

Table 12 - Annual Water Supply and Water Quality Benefits of Santee Water Reclamation Facility Expansion Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided purchase of additional imported water					Benefit: Financial incentives for using recycled water					Benefit: Reduced salt import to Region							
	Measure of Benefit: Acre-Feet					Measure of Benefit: Acre-Feet					Measure of Benefit: tons of TDS					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007																		
2008		0	0	$668.00	$0	0		0	$250.00	$0	0	0	0			$0	1.12	$0
2009		0	0	$703.00	$0	0		0	$250.00	$0	0	0	0			$0	1.19	$0
2010		0	0	$751.00	$0	0		0	$250.00	$0	0	0	0			$0	1.26	$0
2011	2240	0	2240	$786.00	$1,760,640	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,320,640	1.34	$1,734,117
2012	2240	0	2240	$829.00	$1,856,960	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,416,960	1.42	$1,703,861
2013	2240	0	2240	$855.00	$1,915,200	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,475,200	1.50	$1,646,149
2014	2240	0	2240	$886.00	$1,984,640	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,544,640	1.59	$1,596,539
2015	2240	0	2240	$908.00	$2,033,920	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,593,920	1.69	$1,535,337
2016	2240	0	2240	$930.70	$2,084,768	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,644,768	1.79	$1,476,825
2017	2240	0	2240	$953.97	$2,136,887	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,696,887	1.90	$1,420,687
2018	2240	0	2240	$977.82	$2,190,309	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,750,309	2.01	$1,366,820
2019	2240	0	2240	$1,002.26	$2,245,067	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,805,067	2.13	$1,315,125
2020	2240	0	2240	$1,027.32	$2,301,194	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,861,194	2.26	$1,265,509
2021	2240	0	2240	$1,053.00	$2,358,724	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,918,724	2.40	$1,217,881
2022	2240	0	2240	$1,079.33	$2,417,692	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,977,692	2.54	$1,172,157
2023	2240	0	2240	$1,106.31	$2,478,134	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,038,134	2.69	$1,128,255
2024	2240	0	2240	$1,133.97	$2,540,087	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,100,087	2.85	$1,086,096
2025	2240	0	2240	$1,162.32	$2,603,590	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,163,590	3.03	$1,045,608
2026	2240	0	2240	$1,191.37	$2,668,679	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,228,679	3.21	$1,006,717
2027	2240	0	2240	$1,221.16	$2,735,396	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,295,396	3.40	$969,359
2028	2240	0	2240	$1,251.69	$2,803,781	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,363,781	3.60	$933,466
2029	2240	0	2240	$1,282.98	$2,873,876	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,433,876	3.82	$898,979
2030	2240	0	2240	$1,315.05	$2,945,723	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,505,723	4.05	$865,838
2031	2240	0	2240	$1,347.93	$3,019,366	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,579,366	4.29	$833,987
2032	2240	0	2240	$1,381.63	$3,094,850	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,654,850	4.55	$803,373
2033	2240	0	2240	$1,416.17	$3,172,221	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,732,221	4.82	$773,943
2034	2240	0	2240	$1,451.57	$3,251,527	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,811,527	5.11	$745,649
2035	2240	0	2240	$1,487.86	$3,332,815	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,892,815	5.42	$718,445
2036	2240	0	2240	$1,525.06	$3,416,135	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,976,135	5.74	$692,285
2037	2240	0	2240	$1,563.19	$3,501,538	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,061,538	6.09	$667,127
2038	2240	0	2240	$1,602.27	$3,589,077	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,149,077	6.45	$642,930
2039	2240	0	2240	$1,642.32	$3,678,804	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,238,804	6.84	$619,655
2040	2240	0	2240	$1,683.38	$3,770,774	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,330,774	7.25	$597,264
2041	2240	0	2240	$1,725.47	$3,865,043	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,425,043	7.69	$575,721
2042	2240	0	2240	$1,768.60	$3,961,669	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,521,669	8.15	$554,993
2043	2240	0	2240	$1,812.82	$4,060,711	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,620,711	8.64	$535,047
2044	2240	0	2240	$1,858.14	$4,162,229	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,722,229	9.15	$515,851
2045	2240	0	2240	$1,904.59	$4,266,285	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,826,285	9.70	$497,375
2046	2240	0	2240	$1,952.21	$4,372,942	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,932,942	10.29	$479,591
2047	2240	0	2240	$2,001.01	$4,482,265	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,042,265	10.90	$462,472
2048	2240	0	2240	$2,051.04	$4,594,322	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,154,322	11.56	$445,990
2049	2240	0	2240	$2,102.31	$4,709,180	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,269,180	12.25	$430,121
2050	2240	0	2240	$2,154.87	$4,826,909	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,386,909	12.99	$414,841
2051	2240	0	2240	$2,208.74	$4,947,582	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,507,582	13.76	$400,126
2052	2240	0	2240	$2,263.96	$5,071,272	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,631,272	14.59	$385,955
2053	2240	0	2240	$2,320.56	$5,198,054	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,758,054	15.47	$372,306
2054	2240	0	2240	$2,378.57	$5,328,005	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,888,005	16.39	$359,159
2055	2240	0	2240	$2,438.04	$5,461,205	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,021,205	17.38	$346,494
2056	2240	0	2240	$2,498.99	$5,597,735	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,157,735	18.42	$334,293
2057	2240	0	2240	$2,561.46	$5,737,679	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,297,679	19.53	$322,538
2058	2240	0	2240	$2,625.50	$5,881,121	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,441,121	20.70	$311,212
2059	2240	0	2240	$2,691.14	$6,028,149	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,588,149	21.94	$300,298
2060	2240	0	2240	$2,758.42	$6,178,852	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,738,852	23.26	$289,781
																		$40,814,150
																		42.8%
																		$17,453,759

Comment Box:

Table 3–5 Annual Costs of Avoided Projects - Santee Water Reclamation Facility Expansion Project
(All avoided costs should be in 2006 dollars)

	Costs				Costs				Costs				Discounting Calculations		
(a)	(b)	(c)	(d)	(e)	(b)	(c)	(d)	(e)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Alternative (Avoided Project Name): Avoided O&M and treatment costs for existing wells				Alternative (Avoided Project Name): Avoided Point Loma WWTP Upgrade				Alternative (Avoided Project Name): Avoided Santee WWTP Upgrade						
YEAR	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives	Total Cost Avoided for All Alternatives	Discount Factor	Discounted Costs
2007														1.06	
2008				$0									$0	1.12	$0
2009				$0									$0	1.19	$0
2010				$0									$0	1.26	$0
2011			$32,400	$32,400					$3,298,000		$370,540	$3,668,540	$3,700,940	1.34	$2,765,558
2012			$32,400	$32,400							$370,540	$370,540	$402,940	1.42	$284,057
2013			$32,400	$32,400							$370,540	$370,540	$402,940	1.50	$267,978
2014			$32,400	$32,400							$370,540	$370,540	$402,940	1.59	$252,810
2015			$32,400	$32,400							$370,540	$370,540	$402,940	1.69	$238,500
2016			$32,400	$32,400							$370,540	$370,540	$402,940	1.79	$225,000
2017			$32,400	$32,400							$370,540	$370,540	$402,940	1.90	$212,264
2018			$32,400	$32,400	$17,000,000	$0	$0	$17,000,000			$370,540	$370,540	$17,402,940	2.01	$8,648,728
2019			$32,400	$32,400							$370,540	$370,540	$402,940	2.13	$188,914
2020			$32,400	$32,400							$370,540	$370,540	$402,940	2.26	$178,221
2021			$32,400	$32,400							$370,540	$370,540	$402,940	2.40	$168,133
2022			$32,400	$32,400							$370,540	$370,540	$402,940	2.54	$158,616
2023			$32,400	$32,400							$370,540	$370,540	$402,940	2.69	$149,638
2024			$32,400	$32,400							$370,540	$370,540	$402,940	2.85	$141,168
2025			$32,400	$32,400							$370,540	$370,540	$402,940	3.03	$133,177
2026			$32,400	$32,400							$370,540	$370,540	$402,940	3.21	$125,639
2027			$32,400	$32,400							$370,540	$370,540	$402,940	3.40	$118,527
2028			$32,400	$32,400							$370,540	$370,540	$402,940	3.60	$111,818
2029			$32,400	$32,400							$370,540	$370,540	$402,940	3.82	$105,489
2030			$32,400	$32,400							$370,540	$370,540	$402,940	4.05	$99,518
2031			$32,400	$32,400							$370,540	$370,540	$402,940	4.29	$93,884
2032			$32,400	$32,400							$370,540	$370,540	$402,940	4.55	$88,570
2033			$32,400	$32,400							$370,540	$370,540	$402,940	4.82	$83,557
2034			$32,400	$32,400							$370,540	$370,540	$402,940	5.11	$78,827
2035			$32,400	$32,400							$370,540	$370,540	$402,940	5.42	$74,365
2036			$32,400	$32,400							$370,540	$370,540	$402,940	5.74	$70,156
2037			$32,400	$32,400							$370,540	$370,540	$402,940	6.09	$66,185
2038			$32,400	$32,400							$370,540	$370,540	$402,940	6.45	$62,439
2039			$32,400	$32,400							$370,540	$370,540	$402,940	6.84	$58,904
2040			$32,400	$32,400							$370,540	$370,540	$402,940	7.25	$55,570
2041			$32,400	$32,400							$370,540	$370,540	$402,940	7.69	$52,425
2042			$32,400	$32,400							$370,540	$370,540	$402,940	8.15	$49,457
2043			$32,400	$32,400							$370,540	$370,540	$402,940	8.64	$46,658
2044			$32,400	$32,400							$370,540	$370,540	$402,940	9.15	$44,017
2045			$32,400	$32,400							$370,540	$370,540	$402,940	9.70	$41,525
2046			$32,400	$32,400							$370,540	$370,540	$402,940	10.29	$39,175
2047			$32,400	$32,400							$370,540	$370,540	$402,940	10.90	$36,957
2048			$32,400	$32,400							$370,540	$370,540	$402,940	11.56	$34,865
2049			$32,400	$32,400							$370,540	$370,540	$402,940	12.25	$32,892
2050			$32,400	$32,400							$370,540	$370,540	$402,940	12.99	$31,030
2051			$32,400	$32,400							$370,540	$370,540	$402,940	13.76	$29,274
2052			$32,400	$32,400							$370,540	$370,540	$402,940	14.59	$27,617
2053			$32,400	$32,400							$370,540	$370,540	$402,940	15.47	$26,053
2054			$32,400	$32,400							$370,540	$370,540	$402,940	16.39	$24,579
2055			$32,400	$32,400							$370,540	$370,540	$402,940	17.38	$23,187
2056			$32,400	$32,400							$370,540	$370,540	$402,940	18.42	$21,875
2057			$32,400	$32,400							$370,540	$370,540	$402,940	19.53	$20,637
2058			$32,400	$32,400							$370,540	$370,540	$402,940	20.70	$19,469
2059			$32,400	$32,400							$370,540	$370,540	$402,940	21.94	$18,367
2060			$32,400	$32,400							$370,540	$370,540	$402,940	23.26	$17,327
														Total Present Value of	$15,943,590
														% Avoided Cost Claimed by	42.8%
														Total Present Value of Discounted Avoided Project Costs Claimed by Proposal	$6,818,115

Table 11 – Annual Cost of Recycled Water Retrofit Assistance Program (All costs in 2006 Dollars)										
YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other[1]	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008	$328,748.45							$328,748	1.12	$292,585
2009	$1,150,619.59							$1,150,620	1.19	$966,082
2010	$164,374.23							$164,374	1.26	$130,200
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
2019								$0	2.13	$0
2020								$0	2.26	$0
2021								$0	2.40	$0
2022								$0	2.54	$0
2023								$0	2.69	$0
2024								$0	2.85	$0
2025								$0	3.03	$0
2026								$0	3.21	$0
2027								$0	3.40	$0
2028								$0	3.60	$0
2029								$0	3.82	$0
2030								$0	4.05	$0
2031								$0	4.29	$0
2032								$0	4.55	$0
2033								$0	4.82	$0
2034								$0	5.11	$0
2035								$0	5.42	$0
2036								$0	5.74	$0
2037								$0	6.09	$0
2038								$0	6.45	$0
2039								$0	6.84	$0
2040								$0	7.25	$0
2041								$0	7.69	$0
2042								$0	8.15	$0
2043								$0	8.64	$0
2044								$0	9.15	$0
2045								$0	9.70	$0
2046								$0	10.29	$0
2047								$0	10.90	$0
2048								$0	11.56	$0
2049								$0	12.25	$0
2050								$0	12.99	$0
2051								$0	13.76	$0
2052								$0	14.59	$0
2053								$0	15.47	$0
2054								$0	16.39	$0
2055								$0	17.38	$0

Table 11 – Annual Cost of Recycled Water Retrofit Assistance Program (All costs in 2006 Dollars)										
YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other[1]	Total Costs	Discount Factor	Discounted Costs
2056								$0	18.42	$0
2057								$0	19.53	$0
2058								$0	20.70	$0
2059								$0	21.94	$0
2060								$0	23.26	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$1,388,867

Comment Box:

Table 12- Annual Water Supply and Water Quality Benefits of Recycled Water Retrofit Assistance Program
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided Imported Water Purchases					Benefit: Reduced Salt Loading to the Region							
	Measure of Benefit: Acre-Feet					Measure of Benefit: metric tons of salts					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0	0	0	0	0	0	0	0	0	1	0
2008	200	400	200	668	133600	242	121	121		0	133600	1	118904
2009	900	1800	900	703	632700	1088	544	544		0	632700	1	531227
2010	1000	2000	1000	751	751000	1209	604	604			751000	1	594862
2011	1000	2000	1000	786	786000	1209	604	604			786000	1	587345
2012	1000	2000	1000	829	829000	1209	604	604			829000	1	584412
2013	1000	2000	1000	855	855000	1209	604	604			855000	2	568624
2014	1000	2000	1000	886	886000	1209	604	604			886000	2	555887
2015	1000	2000	1000	908	908000	1209	604	604			908000	2	537444
2016	1000	2000	1000	931	930700	1209	604	604			930700	2	519698
2017	1000	2000	1000	954	953968	1209	604	604			953968	2	502538
2018	1000	2000	1000	978	977817	1209	604	604			977817	2	485945
2019	1000	2000	1000	1002	1002262	1209	604	604			1002262	2	469900
2020	1000	2000	1000	1027	1027319	1209	604	604			1027319	2	454384
2021	1000	2000	1000	1053	1053002	1209	604	604			1053002	2	439381
2022	1000	2000	1000	1079	1079327	1209	604	604			1079327	3	424873
2023	1000	2000	1000	1106	1106310	1209	604	604			1106310	3	410844
2024	1000	2000	1000	1134	1133968	1209	604	604			1133968	3	397278
2025	1000	2000	1000	1162	1162317	1209	604	604			1162317	3	384161
2026	1000	2000	1000	1191	1191375	1209	604	604			1191375	3	371476
2027	1000	2000	1000	1221	1221159	1209	604	604			1221159	3	359211
2028	1000	2000	1000	1252	1251688	1209	604	604			1251688	4	347350
2029	1000	2000	1000	1283	1282980	1209	604	604			1282980	4	335881
2030	1000	2000	1000	1315	1315055	1209	604	604			1315055	4	324790
2031	1000	2000	1000	1348	1347931	1209	604	604			1347931	4	314066
2032	1000	2000	1000	1382	1381629	1209	604	604			1381629	5	303696
2033	1000	2000	1000	1416	1416170	1209	604	604			1416170	5	293668
2034	1000	2000	1000	1452	1451574	1209	604	604			1451574	5	283972
2035	1000	2000	1000	1488	1487864	1209	604	604			1487864	5	274595
2036	1000	2000	1000	1525	1525060	1209	604	604			1525060	6	265528
2037	1000	2000	1000	1563	1563187	1209	604	604			1563187	6	256761
2038	1000	2000	1000	1602	1602266	1209	604	604			1602266	6	248283
2039	1000	2000	1000	1642	1642323	1209	604	604			1642323	7	240085
2040	1000	2000	1000	1683	1683381	1209	604	604			1683381	7	232158
2041	1000	2000	1000	1725	1725466	1209	604	604			1725466	8	224492
2042	1000	2000	1000	1769	1768602	1209	604	604			1768602	8	217080
2043	1000	2000	1000	1813	1812817	1209	604	604			1812817	9	209912
2044	1000	2000	1000	1858	1858138	1209	604	604			1858138	9	202981
2045	1000	2000	1000	1905	1904591	1209	604	604			1904591	10	196279
2046	1000	2000	1000	1952	1952206	1209	604	604			1952206	10	189798
2047	1000	2000	1000	2001	2001011	1209	604	604			2001011	11	183531
2048	1000	2000	1000	2051	2051037	1209	604	604			2051037	12	177471
2049	1000	2000	1000	2102	2102312	1209	604	604			2102312	12	171611
2050	1000	2000	1000	2155	2154870	1209	604	604			2154870	13	165945
2051	1000	2000	1000	2209	2208742	1209	604	604			2208742	14	160465
2052	1000	2000	1000	2264	2263961	1209	604	604			2263961	15	155167
2053	1000	2000	1000	2321	2320560	1209	604	604			2320560	15	150043
2054	1000	2000	1000	2379	2378574	1209	604	604			2378574	16	145089
2055	1000	2000	1000	2438	2438038	1209	604	604			2438038	17	140299
2056	1000	2000	1000	2499	2498989	1209	604	604			2498989	18	135666
2057	1000	2000	1000	2561	2561464	1209	604	604			2561464	20	131186
2058	800	1600	800	2626	2100400	967	484	484			2100400	21	101484
2059	100	200	100	2691	269114	121	60	60			269114	22	12267
											Total Present Value of Discounted Benefits (Sum of the values in		16089992

Comment Box: Note that use of RW in this project ramps up from 200 AFY, to 900 AFY to 1000 AFY during the first three years (these values were estimated using the anticpated percentages of funding allocated during years 2008, 2009 and 2010) Beginning in 2010 benefits of the full 1,000 AFY of "additional" RW used at sites are generated. Because there is an assumed 50-yr project life, RW use decreases from 1000 AFY to 800 AFY to 100 AFY in years 2057, 2058 & 2059.

Table 11 – Annual Cost of City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse / Reservoir Augmentation Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other[1]	Total Costs (a+b+…g)	Discount Factor	Discounted Costs (h÷i)
2007								$0.00	1.06	$0.00
2008								$0.00	1.12	$0.00
2009	$3,381,458.76		$5,000.00	$15,000.00	$5,000.00	$0.00	$0.00	$3,406,458.76	1.19	$2,860,128.46
2010	$6,762,917.53		$5,000.00	$15,000.00	$5,000.00	$0.00	$0.00	$6,787,917.53	1.26	$5,376,666.46
2011	$3,381,458.76		$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$3,424,458.76	1.34	$2,558,954.80
2012			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	1.42	$30,313.30
2013			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	1.50	$28,597.46
2014			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	1.59	$26,978.73
2015			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	1.69	$25,451.63
2016			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	1.79	$24,010.98
2017			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	1.90	$22,651.86
2018			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.01	$21,369.68
2019			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.13	$20,160.08
2020			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.26	$19,018.94
2021			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.40	$17,942.40
2022			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.54	$16,926.79
2023			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.69	$15,968.67
2024			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	2.85	$15,064.78
2025			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	3.03	$14,212.06
2026			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	3.21	$13,407.60
2027			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	3.40	$12,648.68
2028			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	3.60	$11,932.72
2029			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	3.82	$11,257.28
2030			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	4.05	$10,620.08
2031			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	4.29	$10,018.94
2032			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	4.55	$9,451.83
2033			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	4.82	$8,916.82
2034			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	5.11	$8,412.10
2035			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	5.42	$7,935.94
2036			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	5.74	$7,486.74
2037			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	6.09	$7,062.96
2038			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	6.45	$6,663.17
2039			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	6.84	$6,286.01
2040			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	7.25	$5,930.20
2041			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	7.69	$5,594.52
2042			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	8.15	$5,277.85
2043			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	8.64	$4,979.11
2044			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	9.15	$4,697.27
2045			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	9.70	$4,431.39
2046			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	10.29	$4,180.55
2047			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	10.90	$3,943.92
2048			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	11.56	$3,720.68
2049			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	12.25	$3,510.07
2050			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	12.99	$3,311.39
2051			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	13.76	$3,123.95
2052			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	14.59	$2,947.13
2053			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	15.47	$2,780.31
2054			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	16.39	$2,622.93
2055			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	17.38	$2,474.46
2056			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	18.42	$2,334.40
2057			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	19.53	$2,202.26
2058			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	20.70	$2,077.61
2059			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	21.94	$1,960.01
2060			$8,000.00	$25,000.00	$10,000.00	$0.00	$0.00	$43,000.00	23.26	$1,849.06
									Total Present Value of Discounted Costs (Sum of Column (j))	$11,300,467

Comment Box:

Table 12 - Annual Water Supply and Water Quality Benefits of City of San Diego Recycled Water Distribution System Expansion, Parklands Retrofit, and Indirect Potable Reuse / Reservoir Augmentation Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided Imported Water Purchases					Benefit: Avoided introduction of additional salts to basin							
	Measure of Benefit: Acre-Feet					Measure of Benefit: metric tons					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits (Sum of Annual $	Discount Factor	Discounted Benefits
2007	0	0	0	$0	$0	0	0	0			0	1.06	$0
2008	0	0	0	$668	$0	0	0	0			0	1.12	$0
2009	0	0	0	$703	$0	0	0	0			0	1.19	$0
2010	0	0	0	$751	$0	0	0	0			0	1.26	$0
2011	0	1904	1904	$786	$1,496,544	1151	0	1151			1496544	1.34	$1,118,305
2012	0	1904	1904	$829	$1,578,416	1151	0	1151			1578416	1.42	$1,112,721
2013	0	1904	1904	$855	$1,627,920	1151	0	1151			1627920	1.50	$1,082,660
2014	0	1904	1904	$886	$1,686,944	1151	0	1151			1686944	1.59	$1,058,410
2015	0	1904	1904	$908	$1,728,832	1151	0	1151			1728832	1.69	$1,023,293
2016	0	1904	1904	$931	$1,772,053	1151	0	1151			1772053	1.79	$989,505
2017	0	1904	1904	$954	$1,816,354	1151	0	1151			1816354	1.90	$956,833
2018	0	1904	1904	$978	$1,861,763	1151	0	1151			1861763	2.01	$925,239
2019	0	1904	1904	$1,002	$1,908,307	1151	0	1151			1908307	2.13	$894,689
2020	0	1904	1904	$1,027	$1,956,015	1151	0	1151			1956015	2.26	$865,147
2021	0	1904	1904	$1,053	$2,004,915	1151	0	1151			2004915	2.40	$836,581
2022	0	1904	1904	$1,079	$2,055,038	1151	0	1151			2055038	2.54	$808,958
2023	0	1904	1904	$1,106	$2,106,414	1151	0	1151			2106414	2.69	$782,247
2024	0	1904	1904	$1,134	$2,159,074	1151	0	1151			2159074	2.85	$756,418
2025	0	1904	1904	$1,162	$2,213,051	1151	0	1151			2213051	3.03	$731,442
2026	0	1904	1904	$1,191	$2,268,377	1151	0	1151			2268377	3.21	$707,291
2027	0	1904	1904	$1,221	$2,325,087	1151	0	1151			2325087	3.40	$683,937
2028	0	1904	1904	$1,252	$2,383,214	1151	0	1151			2383214	3.60	$661,354
2029	0	1904	1904	$1,283	$2,442,794	1151	0	1151			2442794	3.82	$639,517
2030	0	1904	1904	$1,315	$2,503,864	1151	0	1151			2503864	4.05	$618,401
2031	0	1904	1904	$1,348	$2,566,461	1151	0	1151			2566461	4.29	$597,982
2032	0	1904	1904	$1,382	$2,630,622	1151	0	1151			2630622	4.55	$578,237
2033	0	1904	1904	$1,416	$2,696,388	1151	0	1151			2696388	4.82	$559,144
2034	0	1904	1904	$1,452	$2,763,798	1151	0	1151			2763798	5.11	$540,682
2035	0	1904	1904	$1,488	$2,832,893	1151	0	1151			2832893	5.42	$522,829
2036	0	1904	1904	$1,525	$2,903,715	1151	0	1151			2903715	5.74	$505,566
2037	0	1904	1904	$1,563	$2,976,308	1151	0	1151			2976308	6.09	$488,873
2038	0	1904	1904	$1,602	$3,050,715	1151	0	1151			3050715	6.45	$472,731
2039	0	1904	1904	$1,642	$3,126,983	1151	0	1151			3126983	6.84	$457,122
2040	0	1904	1904	$1,683	$3,205,158	1151	0	1151			3205158	7.25	$442,028
2041	0	1904	1904	$1,725	$3,285,287	1151	0	1151			3285287	7.69	$427,433
2042	0	1904	1904	$1,769	$3,367,419	1151	0	1151			3367419	8.15	$413,320
2043	0	1904	1904	$1,813	$3,451,604	1151	0	1151			3451604	8.64	$399,672
2044	0	1904	1904	$1,858	$3,537,895	1151	0	1151			3537895	9.15	$386,476
2045	0	1904	1904	$1,905	$3,626,342	1151	0	1151			3626342	9.70	$373,715
2046	0	1904	1904	$1,952	$3,717,001	1151	0	1151			3717001	10.29	$361,375
2047	0	1904	1904	$2,001	$3,809,926	1151	0	1151			3809926	10.90	$349,443
2048	0	1904	1904	$2,051	$3,905,174	1151	0	1151			3905174	11.56	$337,905
2049	0	1904	1904	$2,102	$4,002,803	1151	0	1151			4002803	12.25	$326,747
2050	0	1904	1904	$2,155	$4,102,873	1151	0	1151			4102873	12.99	$315,958
2051	0	1904	1904	$2,209	$4,205,445	1151	0	1151			4205445	13.76	$305,526
2052	0	1904	1904	$2,264	$4,310,581	1151	0	1151			4310581	14.59	$295,438
2053	0	1904	1904	$2,321	$4,418,346	1151	0	1151			4418346	15.47	$285,683
2054	0	1904	1904	$2,379	$4,528,804	1151	0	1151			4528804	16.39	$276,250
2055	0	1904	1904	$2,438	$4,642,024	1151	0	1151			4642024	17.38	$267,128
2056	0	1904	1904	$2,499	$4,758,075	1151	0	1151			4758075	18.42	$258,308
2057	0	1904	1904	$2,561	$4,877,027	1151	0	1151			4877027	19.53	$249,779
2058	0	1904	1904	$2,626	$4,998,952	1151	0	1151			4998952	20.70	$241,532
2059	0	1904	1904	$2,691	$5,123,926	1151	0	1151			5123926	21.94	$233,557
2060	0	1904	1904	$2,758	$5,252,024	1151	0	1151			5252024	23.26	$225,845
											Total Present Value of Discounted Benefits Based on Unit Value		$28,749,230

Comment Box:

Table 11 – Annual Cost of San Vicente Source Water Protection through Watershed Acquisition and Restoration
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007	$0	$0	$0	$0	$0	$0	$0	$0	1.06	$0
2008	$394,647	$0	$5,000	$0	$15,000	$0	$0	$414,647	1.12	$369,035
2009	$394,647	$0	$5,000	$0	$28,000	$0	$0	$427,647	1.19	$359,061
2010	$394,647	$0	$0	$0	$0	$0	$0	$394,647	1.26	$312,598
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$1,040,693

Comment Box

Table 11 – Annual Cost of El Capitan Watershed Acquisition and Restoration Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007	$0	$0	$0	$0	$0	$0	$0	$0	1.06	$0
2008	$311,262	$0	$0	$0	$0	$0	$0	$311,262	1.12	$277,022
2009	$933,787	$0	$0	$0	$0	$0	$0	$933,787	1.19	$784,026
2010								$0	1.26	$0
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$1,061,048

Comment Box:

Table 11 – Annual Cost of Northern San Diego County Invasive Non-Native Species Control Program (All costs in 2006 Dollars)										
YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table B-1	Capital and Other Initial Costs Not Included in Table B-1	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2008	$758,172							$758,172	1.12	$674,771
2009	$758,172							$758,172	1.19	$636,576
2010	$758,172							$758,172	1.26	$600,543
2011	$758,172							$758,172	1.34	$566,550
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$2,478,441

Comment Box

Table12 - Annual Water Supply and Water Quality Benefits of Northern San Diego County Invasive Non-Native Species Control Program
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Water savings from Arundo removal					Benefit: Water savings from Tamarisk removal							
	Measure of Benefit: Acre-Feet/Year					Measure of Benefit: Acre-Feet/Year					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits (Sum of Annual $	Discount Factor	Discounted Benefits
2008	1498	0	1498			474	0	474					
2009	1498	0	1498			474	0	474					
2010	1498	0	1498			474	0	474					
2011	1498	0	1498			474	0	474					
2012	1498	0	1498			474	0	474					
2013	1498	0	1498			474	0	474					
2014	1498	0	1498			474	0	474					
2015	1498	0	1498			474	0	474					
2016	1498	0	1498			474	0	474					
2017	1498	0	1498			474	0	474					
2018	1498	0	1498			474	0	474					
2019	1498	0	1498			474	0	474					
2020	1498	0	1498			474	0	474					
2021	1498	0	1498			474	0	474					
2022	1498	0	1498			474	0	474					
2023	1498	0	1498			474	0	474					
2024	1498	0	1498			474	0	474					
2025	1498	0	1498			474	0	474					
2026	1498	0	1498			474	0	474					
2027	1498	0	1498			474	0	474					
2028	1498	0	1498			474	0	474					
2029	1498	0	1498			474	0	474					
2030	1498	0	1498			474	0	474					
2031	1498	0	1498			474	0	474					
2032	1498	0	1498			474	0	474					
2033	1498	0	1498			474	0	474					
2034	1498	0	1498			474	0	474					
2035	1498	0	1498			474	0	474					
2036	1498	0	1498			474	0	474					
2037	1498	0	1498			474	0	474					
2038	1498	0	1498			474	0	474					
2039	1498	0	1498			474	0	474					
2040	1498	0	1498			474	0	474					
2041	1498	0	1498			474	0	474					
2042	1498	0	1498			474	0	474					
2043	1498	0	1498			474	0	474					
2044	1498	0	1498			474	0	474					
2045	1498	0	1498			474	0	474					
2046	1498	0	1498			474	0	474					
2047	1498	0	1498			474	0	474					
2048	1498	0	1498			474	0	474					
2049	1498	0	1498			474	0	474					
2050	1498	0	1498			474	0	474					
2051	1498	0	1498			474	0	474					
2052	1498	0	1498			474	0	474					
2053	1498	0	1498			474	0	474					
2054	1498	0	1498			474	0	474					
2055	1498	0	1498			474	0	474					
2056	1498	0	1498			474	0	474					
2057	1498	0	1498			474	0	474					
												Total Present Value of Discounted Benefits (Sum of the values in	$0.00

Table12 - Annual Water Supply and Water Quality Benefits of Northern San Diego County Invasive Non-Native Species Control Program (All benefits should be in 2006 dollars)													
(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Water savings from Arundo removal					Benefit: Water savings from Tamarisk removal							
	Measure of Benefit: Acre-Feet/Year					Measure of Benefit: Acre-Feet/Year					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits (Sum of Annual $	Discount Factor	Discounted Benefits
Comment Box:													

Table 11 – Annual Cost of Santa Margarita Conjunctive Use Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007		$13,830,000						$13,830,000	1.06	$13,047,170
2008								$0	1.12	$0
2009								$0	1.19	$0
2010	$59,195,091							$59,195,091	1.26	$46,888,057
2011	$59,195,091							$59,195,091	1.34	$44,234,016
2012	$59,195,091							$59,195,091	1.42	$41,730,204
2013				$3,250,000				$3,250,000	1.50	$2,161,436
2014				$3,250,000				$3,250,000	1.59	$2,039,090
2015				$3,250,000				$3,250,000	1.69	$1,923,670
2016				$3,250,000				$3,250,000	1.79	$1,814,783
2017				$3,250,000				$3,250,000	1.90	$1,712,059
2018				$3,250,000				$3,250,000	2.01	$1,615,150
2019				$3,250,000				$3,250,000	2.13	$1,523,727
2020				$3,250,000				$3,250,000	2.26	$1,437,478
2021				$3,250,000				$3,250,000	2.40	$1,356,111
2022				$3,250,000				$3,250,000	2.54	$1,279,350
2023				$3,250,000				$3,250,000	2.69	$1,206,934
2024				$3,250,000				$3,250,000	2.85	$1,138,617
2025				$3,250,000				$3,250,000	3.03	$1,074,167
2026				$3,250,000				$3,250,000	3.21	$1,013,365
2027				$3,250,000				$3,250,000	3.40	$956,005
2028				$3,250,000				$3,250,000	3.60	$901,892
2029				$3,250,000				$3,250,000	3.82	$850,841
2030				$3,250,000				$3,250,000	4.05	$802,680
2031				$3,250,000				$3,250,000	4.29	$757,246
2032				$3,250,000				$3,250,000	4.55	$714,383
2033				$3,250,000				$3,250,000	4.82	$673,946
2034				$3,250,000				$3,250,000	5.11	$635,798
2035				$3,250,000				$3,250,000	5.42	$599,809
2036				$3,250,000				$3,250,000	5.74	$565,858
2037				$3,250,000				$3,250,000	6.09	$533,828
2038				$3,250,000				$3,250,000	6.45	$503,612
2039				$3,250,000				$3,250,000	6.84	$475,105
2040				$3,250,000				$3,250,000	7.25	$448,212
2041				$3,250,000				$3,250,000	7.69	$422,842
2042				$3,250,000				$3,250,000	8.15	$398,908
2043				$3,250,000				$3,250,000	8.64	$376,328
2044				$3,250,000				$3,250,000	9.15	$355,026
2045				$3,250,000				$3,250,000	9.70	$334,930
2046				$3,250,000				$3,250,000	10.29	$315,972
2047				$3,250,000				$3,250,000	10.90	$298,087
2048				$3,250,000				$3,250,000	11.56	$281,214
2049				$3,250,000				$3,250,000	12.25	$265,296
2050				$3,250,000				$3,250,000	12.99	$250,280
2051				$3,250,000				$3,250,000	13.76	$236,113
2052				$3,250,000				$3,250,000	14.59	$222,748
2053				$3,250,000				$3,250,000	15.47	$210,139
2054				$3,250,000				$3,250,000	16.39	$198,245
2055				$3,250,000				$3,250,000	17.38	$187,023
2056				$3,250,000				$3,250,000	18.42	$176,437
2057				$3,250,000				$3,250,000	19.53	$166,450
2058				$3,250,000				$3,250,000	20.70	$157,028
2059				$3,250,000				$3,250,000	21.94	$148,140
2060				$3,250,000				$3,250,000	23.26	$139,755
2061				$3,250,000				$3,250,000	24.65	$131,844
2062				$3,250,000				$3,250,000	26.13	$124,381

Table 11 – Annual Cost of Santa Margarita Conjunctive Use Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
Total Present Value of Discounted Costs (Sum of Column (j))										$182,011,788

Comment Box: Costs not included in Table 8 are $13,830,000 (in 2006 dollars) for Open Space Management Zone land acquisition, as land was acquired before March 20, 2007.

Table 12 - Annual Water Supply and Water Quality Benefits of Santa Margarita Conjunctive Use Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided Imported Water Purchases (through MWD)					Benefit: Avoided Import of Salts into the San Diego Region					Benefit: Reduced TDS concentrations for existing water supplies							
	Measure of Benefit: Acre-Feet					Measure of Benefit: tons of salt					Measure of Benefit: mg/L					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0	$0	$0	0	0	0			0	0	0	$1,803	$0	$0	1.06	$0
2008	0	0	0	$668	$0	0	0	0			0	0	0	$1,803	$0	$0	1.12	$0
2009	0	0	0	$703	$0	0	0	0			0	0	0	$1,803	$0	$0	1.19	$0
2010	0	0	0	$751	$0	0	0	0			0	0	0	$1,803	$0	$0	1.26	$0
2011	0	0	0	$786	$0	0	0	0			0	0	0	$1,803	$0	$0	1.34	$0
2012	0	0	0	$829	$0	0	0	0			0	0	0	$1,803	$0	$0	1.42	$0
2013	6800	0	6800	$886	$6,024,800	4110	0	4110			1150	425	725	$1,803	$1,306,813	$7,331,613	1.50	$4,875,941
2014	6800	0	6800	$908	$6,175,420	4110	0	4110			1150	425	725	$1,803	$1,306,813	$7,482,233	1.59	$4,694,445
2015	6800	0	6800	$931	$6,329,806	4110	0	4110			1150	425	725	$1,803	$1,306,813	$7,636,618	1.69	$4,520,102
2016	6800	0	6800	$954	$6,488,051	4110	0	4110			1150	425	725	$1,803	$1,306,813	$7,794,863	1.79	$4,352,611
2017	6800	0	6800	$978	$6,650,252	4110	0	4110			1150	425	725	$1,803	$1,306,813	$7,957,064	1.90	$4,191,682
2018	6800	0	6800	$1,002	$6,816,508	4110	0	4110			1150	425	725	$1,803	$1,306,813	$8,123,321	2.01	$4,037,042
2019	6800	0	6800	$1,027	$6,986,921	4110	0	4110			1150	425	725	$1,803	$1,306,813	$8,293,733	2.13	$3,888,426
2020	6800	0	6800	$1,053	$7,161,594	4110	0	4110			1150	425	725	$1,803	$1,306,813	$8,468,406	2.26	$3,745,584
2021	6800	0	6800	$1,080	$7,340,634	4110	0	4110			1150	425	725	$1,803	$1,306,813	$8,647,446	2.40	$3,608,277
2022	6800	0	6800	$1,106	$7,524,150	4110	0	4110			1150	425	725	$1,803	$1,306,813	$8,830,962	2.54	$3,476,275
2023	6800	0	6800	$1,134	$7,712,253	4110	0	4110			1150	425	725	$1,803	$1,306,813	$9,019,066	2.69	$3,349,360
2024	6800	0	6800	$1,163	$7,905,060	4110	0	4110			1150	425	725	$1,803	$1,306,813	$9,211,872	2.85	$3,227,322
2025	6800	0	6800	$1,192	$8,102,686	4110	0	4110			1150	425	725	$1,803	$1,306,813	$9,409,499	3.03	$3,109,962
2026	6800	0	6800	$1,221	$8,305,253	4110	0	4110			1150	425	725	$1,803	$1,306,813	$9,612,066	3.21	$2,997,088
2027	6800	0	6800	$1,252	$8,512,885	4110	0	4110			1150	425	725	$1,803	$1,306,813	$9,819,697	3.40	$2,888,517
2028	6800	0	6800	$1,283	$8,725,707	4110	0	4110			1150	425	725	$1,803	$1,306,813	$10,032,519	3.60	$2,784,075
2029	6800	0	6800	$1,315	$8,943,849	4110	0	4110			1150	425	725	$1,803	$1,306,813	$10,250,662	3.82	$2,683,595
2030	6800	0	6800	$1,348	$9,167,446	4110	0	4110			1150	425	725	$1,803	$1,306,813	$10,474,258	4.05	$2,586,917
2031	6800	0	6800	$1,382	$9,396,632	4110	0	4110			1150	425	725	$1,803	$1,306,813	$10,703,444	4.29	$2,493,888
2032	6800	0	6800	$1,416	$9,631,548	4110	0	4110			1150	425	725	$1,803	$1,306,813	$10,938,360	4.55	$2,404,361
2033	6800	0	6800	$1,452	$9,872,336	4110	0	4110			1150	425	725	$1,803	$1,306,813	$11,179,149	4.82	$2,318,197
2034	6800	0	6800	$1,488	$10,119,145	4110	0	4110			1150	425	725	$1,803	$1,306,813	$11,425,957	5.11	$2,235,262
2035	6800	0	6800	$1,525	$10,372,123	4110	0	4110			1150	425	725	$1,803	$1,306,813	$11,678,936	5.42	$2,155,426
2036	6800	0	6800	$1,563	$10,631,426	4110	0	4110			1150	425	725	$1,803	$1,306,813	$11,938,239	5.74	$2,078,568
2037	6800	0	6800	$1,603	$10,897,212	4110	0	4110			1150	425	725	$1,803	$1,306,813	$12,204,025	6.09	$2,004,570
2038	6800	0	6800	$1,643	$11,169,642	4110	0	4110			1150	425	725	$1,803	$1,306,813	$12,476,455	6.45	$1,933,319
2039	6800	0	6800	$1,684	$11,448,883	4110	0	4110			1150	425	725	$1,803	$1,306,813	$12,755,696	6.84	$1,864,707
2040	6800	0	6800	$1,726	$11,735,106	4110	0	4110			1150	425	725	$1,803	$1,306,813	$13,041,918	7.25	$1,798,631
2041	6800	0	6800	$1,769	$12,028,483	4110	0	4110			1150	425	725	$1,803	$1,306,813	$13,335,296	7.69	$1,734,992
2042	6800	0	6800	$1,813	$12,329,195	4110	0	4110			1150	425	725	$1,803	$1,306,813	$13,636,008	8.15	$1,673,694
2043	6800	0	6800	$1,858	$12,637,425	4110	0	4110			1150	425	725	$1,803	$1,306,813	$13,944,238	8.64	$1,614,648
2044	6800	0	6800	$1,905	$12,953,361	4110	0	4110			1150	425	725	$1,803	$1,306,813	$14,260,173	9.15	$1,557,765
2045	6800	0	6800	$1,953	$13,277,195	4110	0	4110			1150	425	725	$1,803	$1,306,813	$14,584,007	9.70	$1,502,962
2046	6800	0	6800	$2,001	$13,609,125	4110	0	4110			1150	425	725	$1,803	$1,306,813	$14,915,937	10.29	$1,450,160
2047	6800	0	6800	$2,051	$13,949,353	4110	0	4110			1150	425	725	$1,803	$1,306,813	$15,256,165	10.90	$1,399,281
2048	6800	0	6800	$2,103	$14,298,087	4110	0	4110			1150	425	725	$1,803	$1,306,813	$15,604,899	11.56	$1,350,251
2049	6800	0	6800	$2,155	$14,655,539	4110	0	4110			1150	425	725	$1,803	$1,306,813	$15,962,351	12.25	$1,303,001
2050	6800	0	6800	$2,209	$15,021,927	4110	0	4110			1150	425	725	$1,803	$1,306,813	$16,328,740	12.99	$1,257,461
2051	6800	0	6800	$2,264	$15,397,475	4110	0	4110			1150	425	725	$1,803	$1,306,813	$16,704,288	13.76	$1,213,568
2052	6800	0	6800	$2,321	$15,782,412	4110	0	4110			1150	425	725	$1,803	$1,306,813	$17,089,225	14.59	$1,171,258
2053	6800	0	6800	$2,379	$16,176,973	4110	0	4110			1150	425	725	$1,803	$1,306,813	$17,483,785	15.47	$1,130,472
2054	6800	0	6800	$2,438	$16,581,397	4110	0	4110			1150	425	725	$1,803	$1,306,813	$17,888,209	16.39	$1,091,152
2055	6800	0	6800	$2,499	$16,995,932	4110	0	4110			1150	425	725	$1,803	$1,306,813	$18,302,744	17.38	$1,053,244
2056	6800	0	6800	$2,562	$17,420,830	4110	0	4110			1150	425	725	$1,803	$1,306,813	$18,727,643	18.42	$1,016,693
2057	6800	0	6800	$2,626	$17,856,351	4110	0	4110			1150	425	725	$1,803	$1,306,813	$19,163,163	19.53	$981,450
2058	6800	0	6800	$2,692	$18,302,760	4110	0	4110			1150	425	725	$1,803	$1,306,813	$19,609,572	20.70	$947,465
2059	6800	0	6800	$2,759	$18,760,329	4110	0	4110			1150	425	725	$1,803	$1,306,813	$20,067,141	21.94	$914,692
2060	6800	0	6800	$2,828	$19,229,337	4110	0	4110			1150	425	725	$1,803	$1,306,813	$20,536,149	23.26	$883,085
2061	6800	0	6800	$2,899	$19,710,070	4110	0	4110			1150	425	725	$1,803	$1,306,813	$21,016,883	24.65	$852,601
2062	6800	0	6800	$2,971	$20,202,822	4110	0	4110			1150	425	725	$1,803	$1,306,813	$21,509,635	26.13	$823,199
																Total Present Value of Discounted Benefits		$113,227,243

Comment Box:

Table 11 – Annual Cost of Carlsbad Desalination Project Local Conveyance
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008								$0	1.12	$0
2009	$26,688,586							$26,688,586	1.19	$22,408,251
2010	$53,377,171		$10,000	$30,000	$20,000	$10,000	$460,000	$53,907,171	1.26	$42,699,529
2011			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.34	$1,868,145
2012			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.42	$1,762,401
2013			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.50	$1,662,643
2014			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.59	$1,568,531
2015			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.69	$1,479,746
2016			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.79	$1,395,987
2017			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	1.90	$1,316,969
2018			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.01	$1,242,423
2019			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.13	$1,172,098
2020			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.26	$1,105,752
2021			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.40	$1,043,163
2022			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.54	$984,116
2023			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.69	$928,411
2024			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	2.85	$875,859
2025			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	3.03	$826,283
2026			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	3.21	$779,512
2027			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	3.40	$735,389
2028			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	3.60	$693,763
2029			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	3.82	$654,493
2030			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	4.05	$617,446
2031			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	4.29	$582,497
2032			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	4.55	$549,525
2033			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	4.82	$518,420
2034			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	5.11	$489,075
2035			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	5.42	$461,392
2036			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	5.74	$435,275
2037			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	6.09	$410,637
2038			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	6.45	$387,393
2039			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	6.84	$365,466
2040			$30,000	$120,000	$180,000	$295,000	$1,875,000	$2,500,000	7.25	$344,779
									Total Present Value of Discounted Costs (Sum of Column (j))	$92,365,369

Comment Box:

Table 12 - Annual Water Supply and Water Quality Benefits of Carlsbad Desalination Project Local Conveyance
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided Imported Water Purchases					Benefit: Avoided introduction of additional salts (TDS) to basin							
	Measure of Benefit: Acre-Feet					Measure of Benefit: metric tons					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0	$ -	$ -	0	0	0			$0	1.06	$0.00
2008	0	0	0	$ 668	$ -	0	0	0			$0	1.12	$0.00
2009	0	0	0	$ 703	$ -	0	0	0			$0	1.19	$0.00
2010	0	0	0	$ 751	$ -	0	0	0			$0	1.26	$0.00
2011	0	56000	56000	$ 786	$ 44,016,000	33847	18670	15177			$44,016,000	1.34	$32,891,315.74
2012	0	56000	56000	$ 829	$ 46,424,000	33847	18670	15177			$46,424,000	1.42	$32,727,088.13
2013	0	56000	56000	$ 855	$ 47,880,000	33847	18670	15177			$47,880,000	1.50	$31,842,934.60
2014	0	56000	56000	$ 886	$ 49,616,000	33847	18670	15177			$49,616,000	1.59	$31,129,692.22
2015	0	56000	56000	$ 908	$ 50,848,000	33847	18670	15177			$50,848,000	1.69	$30,096,853.07
2016	0	56000	56000	$ 931	$ 52,119,200	33847	18670	15177			$52,119,200	1.79	$29,103,089.06
2017	0	56000	56000	$ 954	$ 53,422,180	33847	18670	15177			$53,422,180	1.90	$28,142,138.00
2018	0	56000	56000	$ 978	$ 54,757,735	33847	18670	15177			$54,757,735	2.01	$27,212,916.47
2019	0	56000	56000	$ 1,002	$ 56,126,678	33847	18670	15177			$56,126,678	2.13	$26,314,376.77
2020	0	56000	56000	$ 1,027	$ 57,529,845	33847	18670	15177			$57,529,845	2.26	$25,445,505.84
2021	0	56000	56000	$ 1,053	$ 58,968,091	33847	18670	15177			$58,968,091	2.40	$24,605,324.04
2022	0	56000	56000	$ 1,079	$ 60,442,293	33847	18670	15177			$60,442,293	2.54	$23,792,884.10
2023	0	56000	56000	$ 1,106	$ 61,953,351	33847	18670	15177			$61,953,351	2.69	$23,007,270.00
2024	0	56000	56000	$ 1,134	$ 63,502,184	33847	18670	15177			$63,502,184	2.85	$22,247,595.99
2025	0	56000	56000	$ 1,162	$ 65,089,739	33847	18670	15177			$65,089,739	3.03	$21,513,005.56
2026	0	56000	56000	$ 1,191	$ 66,716,982	33847	18670	15177			$66,716,982	3.21	$20,802,670.47
2027	0	56000	56000	$ 1,221	$ 68,384,907	33847	18670	15177			$68,384,907	3.40	$20,115,789.84
2028	0	56000	56000	$ 1,252	$ 70,094,530	33847	18670	15177			$70,094,530	3.60	$19,451,589.23
2029	0	56000	56000	$ 1,283	$ 71,846,893	33847	18670	15177			$71,846,893	3.82	$18,809,319.78
2030	0	56000	56000	$ 1,315	$ 73,643,065	33847	18670	15177			$73,643,065	4.05	$18,188,257.33
2031	0	56000	56000	$ 1,348	$ 75,484,142	33847	18670	15177			$75,484,142	4.29	$17,587,701.66
2032	0	56000	56000	$ 1,382	$ 77,371,245	33847	18670	15177			$77,371,245	4.55	$17,006,975.67
2033	0	56000	56000	$ 1,416	$ 79,305,526	33847	18670	15177			$79,305,526	4.82	$16,445,424.58
2034	0	56000	56000	$ 1,452	$ 81,288,165	33847	18670	15177			$81,288,165	5.11	$15,902,415.28
2035	0	56000	56000	$ 1,488	$ 83,320,369	33847	18670	15177			$83,320,369	5.42	$15,377,335.53
2036	0	56000	56000	$ 1,525	$ 85,403,378	33847	18670	15177			$85,403,378	5.74	$14,869,593.32
2037	0	56000	56000	$ 1,563	$ 87,538,462	33847	18670	15177			$87,538,462	6.09	$14,378,616.18
2038	0	56000	56000	$ 1,602	$ 89,726,924	33847	18670	15177			$89,726,924	6.45	$13,903,850.55
2039	0	56000	56000	$ 1,642	$ 91,970,097	33847	18670	15177			$91,970,097	6.84	$13,444,761.15
2040	0	56000	56000	$ 1,683	$ 94,269,350	33847	18670	15177			$94,269,350	7.25	$13,000,830.36
2041													
											Total Present Value of Discounted Benefits Based on Unit Value		$659,357,120.51
											% of Total Benefits Claimed by Proposal		25%
											Total Present Value of Benefits Claimed by Proposal		$164,839,280.13

Comment Box:

Table 11 – Annual Cost of San Diego Region Four Intertie Conceptual Design
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs (h÷i)
2007	$0		$0	$0	$0	$0	$0	$0	1.06	$0
2008	$755,872		$0	$0	$0	$0	$0	$755,872	1.12	$672,723
2009	$1,511,744		$0	$0	$0	$0	$0	$1,511,744	1.19	$1,269,290
2010	$755,872		$0	$0	$0	$0	$0	$755,872	1.26	$598,722
2011	$0		$0	$0	$0	$0	$0	$0	1.34	$0
2012	$0		$0	$0	$0	$0	$0	$0	1.42	$0
2013	$0		$0	$0	$0	$0	$0	$0	1.50	$0
2014	$0		$0	$0	$0	$0	$0	$0	1.59	$0
2015	$0		$0	$0	$0	$0	$0	$0	1.69	$0
2016	$0		$0	$0	$0	$0	$0	$0	1.79	$0
2017	$0		$0	$0	$0	$0	$0	$0	1.90	$0
2018	$0		$0	$0	$0	$0	$0	$0	2.01	$0
2019	$0		$0	$0	$0	$0	$0	$0	2.13	$0
2020	$0		$0	$0	$0	$0	$0	$0	2.26	$0
2021	$0		$0	$0	$0	$0	$0	$0	2.40	$0
2022	$0		$0	$0	$0	$0	$0	$0	2.54	$0
2023	$0		$0	$0	$0	$0	$0	$0	2.69	$0
2024	$0		$0	$0	$0	$0	$0	$0	2.85	$0
2025	$0		$0	$0	$0	$0	$0	$0	3.03	$0
2026	$0		$0	$0	$0	$0	$0	$0	3.21	$0
2027	$0		$0	$0	$0	$0	$0	$0	3.40	$0
2028	$0		$0	$0	$0	$0	$0	$0	3.60	$0
2029	$0		$0	$0	$0	$0	$0	$0	3.82	$0
2030	$0		$0	$0	$0	$0	$0	$0	4.05	$0
2031	$0		$0	$0	$0	$0	$0	$0	4.29	$0
2032	$0		$0	$0	$0	$0	$0	$0	4.55	$0
2033	$0		$0	$0	$0	$0	$0	$0	4.82	$0
2034	$0		$0	$0	$0	$0	$0	$0	5.11	$0
2035	$0		$0	$0	$0	$0	$0	$0	5.42	$0
2036	$0		$0	$0	$0	$0	$0	$0	5.74	$0
2037	$0		$0	$0	$0	$0	$0	$0	6.09	$0
2038	$0		$0	$0	$0	$0	$0	$0	6.45	$0
2039	$0		$0	$0	$0	$0	$0	$0	6.84	$0
2040	$0		$0	$0	$0	$0	$0	$0	7.25	$0
2041	$0		$0	$0	$0	$0	$0	$0	7.69	$0
2042	$0		$0	$0	$0	$0	$0	$0	8.15	$0
2043	$0		$0	$0	$0	$0	$0	$0	8.64	$0
2044	$0		$0	$0	$0	$0	$0	$0	9.15	$0
2045	$0		$0	$0	$0	$0	$0	$0	9.70	$0
2046	$0		$0	$0	$0	$0	$0	$0	10.29	$0
2047	$0		$0	$0	$0	$0	$0	$0	10.90	$0
2048	$0		$0	$0	$0	$0	$0	$0	11.56	$0
2049	$0		$0	$0	$0	$0	$0	$0	12.25	$0
2050	$0		$0	$0	$0	$0	$0	$0	12.99	$0
2051	$0		$0	$0	$0	$0	$0	$0	13.76	$0
2052	$0		$0	$0	$0	$0	$0	$0	14.59	$0
2053	$0		$0	$0	$0	$0	$0	$0	15.47	$0
2054	$0		$0	$0	$0	$0	$0	$0	16.39	$0
2055	$0		$0	$0	$0	$0	$0	$0	17.38	$0
2056	$0		$0	$0	$0	$0	$0	$0	18.42	$0
									Total Present Value of Discounted Costs (Sum of Column (j))	$2,540,735

Comment Box:

Table 11 – Annual Cost of San Diego Region Four Intertie Full Scale Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs (h÷i)
2007	$0		$0	$0	$0	$0	$0	$0	1.06	$0
2008	$0		$0	$0	$0	$0	$0	$0	1.12	$0
2009	$0		$0	$0	$0	$0	$0	$0	1.19	$0
2010	$0		$0	$0	$0	$0	$0	$0	1.26	$0
2011	$0		$0	$0	$0	$0	$0	$0	1.34	$0
2012	$1,166,000,000		$0	$4,330,000	$4,330,000	$0	$0	$1,174,660,000	1.42	$828,088,948
2013	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	1.50	$5,759,395
2014	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	1.59	$5,433,391
2015	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	1.69	$5,125,841
2016	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	1.79	$4,835,699
2017	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	1.90	$4,561,980
2018	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.01	$4,303,755
2019	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.13	$4,060,146
2020	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.26	$3,830,326
2021	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.40	$3,613,515
2022	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.54	$3,408,977
2023	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.69	$3,216,016
2024	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	2.85	$3,033,977
2025	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	3.03	$2,862,243
2026	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	3.21	$2,700,229
2027	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	3.40	$2,547,386
2028	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	3.60	$2,403,194
2029	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	3.82	$2,267,164
2030	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	4.05	$2,138,834
2031	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	4.29	$2,017,768
2032	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	4.55	$1,903,555
2033	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	4.82	$1,795,806
2034	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	5.11	$1,694,157
2035	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	5.42	$1,598,261
2036	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	5.74	$1,507,794
2037	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	6.09	$1,422,447
2038	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	6.45	$1,341,931
2039	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	6.84	$1,265,973
2040	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	7.25	$1,194,314
2041	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	7.69	$1,126,711
2042	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	8.15	$1,062,935
2043	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	8.64	$1,002,769
2044	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	9.15	$946,008
2045	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	9.70	$892,461
2046	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	10.29	$841,944
2047	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	10.90	$794,287
2048	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	11.56	$749,327
2049	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	12.25	$706,913
2050	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	12.99	$666,899
2051	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	13.76	$629,150
2052	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	14.59	$593,537
2053	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	15.47	$559,941
2054	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	16.39	$528,246
2055	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	17.38	$498,345
2056	$0		$0	$4,330,000	$4,330,000	$0	$0	$8,660,000	18.42	$470,137
									Total Present Value of Discounted Costs (Sum of Column (j))	$922,002,633

Comment Box: Costs in 2008, 2009, and 2010 are for the proposed conceptual design. All other costs are extrapolated from the 1993 U.S. Army Corps of Engineers study for actual construction and operation of a similar Four Reservoir Intertie Project. For purposes of this analysis, it is assumed that construction of all aspects of the Intertie Project occur during year 2012.

Table 14 - Other Annual Water Supply or Water Quality Benefits - San Diego Region Four Reservoir Intertie Project

(In 2006 Dollars)

(a)	(b)	(b)	(b)	(b)		(c)	(d)
YEAR	Type of Benefit: Water Supply Reliability/Flexibiliy	Type of Benefit: Capture of Local Water	Type of Benefit Claimed: Capture of Local Water	Type of Benefit Claimed: Storage of Imported Water	Total Annual Benefit ($)	Discount Factor	Discounted Benefits (b ÷ c)
	Benefit generated by increased water supply reliability.	MWD provides a $250/af subsidy for increased storage of local water.	Water conserved by preveting overspill events, based upon the cost of imported water	Describe the Benefit Claimed: MWD provides a $250/af subsidy for storing water in wet years for use in dry years. We assume 10,000 af available every other year.			
	Annual Benefit ($)	Annual Benefit ($)	Annual Benefit ($)	Annual Benefit ($)			
2007	$0	$0	$0	$0	$0	1.06	$0
2008	$0	$0	$0	$0	$0	1.12	$0
2009	$0	$0	$0	$0	$0	1.19	$0
2010	$0	$0	$0	$0	$0	1.25	$0
2011	$0	$0	$0	$0	$0	1.31	$0
2012	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.37	$33,145,985
2013	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.43	$31,755,245
2014	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.49	$30,476,510
2015	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.55	$29,296,774
2016	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.61	$28,204,969
2017	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.67	$27,191,617
2018	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.73	$26,248,555
2019	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.79	$25,368,715
2020	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.85	$24,545,946
2021	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.91	$23,774,869
2022	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	1.97	$23,050,761
2023	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.03	$22,369,458
2024	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.09	$21,727,273
2025	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.15	$21,120,930
2026	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.21	$20,547,511
2027	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.27	$20,004,405
2028	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.33	$19,489,270
2029	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.39	$19,000,000
2030	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.45	$18,534,694
2031	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.51	$18,091,633
2032	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.57	$17,669,261
2033	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.63	$17,266,160
2034	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.69	$16,881,041
2035	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.75	$16,512,727
2036	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.81	$16,160,142
2037	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.87	$15,822,300
2038	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.93	$15,498,294
2039	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	2.99	$15,187,291
2040	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.05	$14,888,525
2041	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.11	$14,601,286
2042	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.17	$14,324,921
2043	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.23	$14,058,824
2044	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.29	$13,802,432
2045	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.35	$13,555,224
2046	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.41	$13,316,716
2047	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.47	$13,086,455
2048	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.53	$12,864,023
2049	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.59	$12,649,025
2050	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.65	$12,441,096
2051	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.71	$12,239,892
2052	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.77	$12,045,093
2053	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.83	$11,856,397
2054	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.89	$11,673,522
2055	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	3.95	$11,496,203
2056	$38,720,000	$1,700,000	$3,740,000	$1,250,000	$45,410,000	4.01	$11,324,190
Proposal Life	$1,742,400,000	$76,500,000	$168,300,000	$56,250,000	$1,987,200,000	…	…
						Total Present Value of Discounted Other Benefits (Sum of the values in Column (d))	$835,166,158

Table 11 – Annual Cost of South San Diego County Water Supply Strategy
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007	$0	$0	$0	$0	$0	$0	$0	$0	1.06	$0
2008	$169,926	$0	$0	$0	$0	$0	$0	$169,926	1.12	$151,234
2009	$339,853	$0	$0	$0	$0	$0	$0	$339,853	1.19	$285,347
2010	$339,853	$0	$0	$0	$0	$0	$0	$339,853	1.26	$269,195
2011	$339,853	$0	$0	$0	$0	$0	$0	$339,853	1.34	$253,958
2012	$169,926	$0	$0	$0	$0	$0	$0	$169,926	1.42	$119,791
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$1,079,524

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Table 11 – Annual Cost of El Monte Groundwater Recharge and Restoration Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008	$6,953,171							$6,953,171	1.12	$6,188,297
2009	$6,953,171							$6,953,171	1.19	$5,838,016
2010	$6,953,171							$6,953,171	1.26	$5,507,563
2011	$6,953,171							$6,953,171	1.34	$5,195,814
2012	$6,953,171							$6,953,171	1.42	$4,901,711
2013	$6,953,171							$6,953,171	1.50	$4,624,256
2014	$6,953,171							$6,953,171	1.59	$4,362,505
2015	$6,953,171							$6,953,171	1.69	$4,115,571
2016	$6,953,171		$200,000					$7,153,171	1.79	$3,994,293
2017			$400,000					$400,000	1.90	$210,715
2018			$400,000					$400,000	2.01	$198,788
2019			$400,000					$400,000	2.13	$187,536
2020			$400,000					$400,000	2.26	$176,920
2021			$400,000					$400,000	2.40	$166,906
2022			$400,000					$400,000	2.54	$157,459
2023			$400,000					$400,000	2.69	$148,546
2024			$400,000					$400,000	2.85	$140,138
2025			$400,000					$400,000	3.03	$132,205
2026			$400,000					$400,000	3.21	$124,722
2027			$400,000					$400,000	3.40	$117,662
2028			$400,000					$400,000	3.60	$111,002
2029			$400,000					$400,000	3.82	$104,719
2030			$400,000					$400,000	4.05	$98,791
2031			$400,000					$400,000	4.29	$93,199
2032			$400,000					$400,000	4.55	$87,924
2033			$400,000					$400,000	4.82	$82,947
2034			$400,000					$400,000	5.11	$78,252
2035			$400,000					$400,000	5.42	$73,823
2036			$400,000					$400,000	5.74	$69,644
2037			$400,000					$400,000	6.09	$65,702
2038			$400,000					$400,000	6.45	$61,983
2039			$400,000					$400,000	6.84	$58,474
2040			$400,000					$400,000	7.25	$55,165
2041			$400,000					$400,000	7.69	$52,042
2042			$400,000					$400,000	8.15	$49,096
2043			$400,000					$400,000	8.64	$46,317
2044			$400,000					$400,000	9.15	$43,696
2045			$400,000					$400,000	9.70	$41,222
2046			$400,000					$400,000	10.29	$38,889
2047			$400,000					$400,000	10.90	$36,688
2048			$400,000					$400,000	11.56	$34,611
2049			$400,000					$400,000	12.25	$32,652
2050			$400,000					$400,000	12.99	$30,804
2051			$400,000					$400,000	13.76	$29,060
2052			$400,000					$400,000	14.59	$27,415
2053			$400,000					$400,000	15.47	$25,863
2054			$400,000					$400,000	16.39	$24,399
2055			$400,000					$400,000	17.38	$23,018
2056			$400,000					$400,000	18.42	$21,715
2057			$400,000					$400,000	19.53	$20,486
2058			$400,000					$400,000	20.70	$19,327
2059			$400,000					$400,000	21.94	$18,233
2060			$400,000					$400,000	23.26	$17,201

Table 11 – Annual Cost of El Monte Groundwater Recharge and Restoration Project (All costs in 2006 Dollars)										
YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
Total Present Value of Discounted Costs (Sum of Column (j))										$48,163,983

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Capital costs spread evenly over construction period. Construction is expected to be complete in June, 2016, at which time O&M costs of $400,00/year begin; O&M for 2008 us assumed to be incurred for 6 months, for a total of $200,000.

Table 12 - Annual Water Supply and Water Quality Benefits of El Monte Groundwater Recharge and Restoration Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided purchase of additional imported water					Benefit: Financial incentives for using recycled water					Benefit: Reduced salt import to Region							
	Measure of Benefit: Acre-Feet					Measure of Benefit: Acre-Feet					Measure of Benefit: tons of TDS					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007																		
2008		0	0	$668.00	$0	0		0	$250.00	$0	0	0	0			$0	1.12	$0
2009		0	0	$703.00	$0	0		0	$250.00	$0	0	0	0			$0	1.19	$0
2010		0	0	$751.00	$0	0		0	$250.00	$0	0	0	0			$0	1.26	$0
2011	2240	0	2240	$786.00	$1,760,640	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,320,640	1.34	$1,734,117
2012	2240	0	2240	$829.00	$1,856,960	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,416,960	1.42	$1,703,861
2013	2240	0	2240	$855.00	$1,915,200	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,475,200	1.50	$1,646,149
2014	2240	0	2240	$886.00	$1,984,640	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,544,640	1.59	$1,596,539
2015	2240	0	2240	$908.00	$2,033,920	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,593,920	1.69	$1,535,337
2016	2240	0	2240	$930.70	$2,084,768	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,644,768	1.79	$1,476,825
2017	2240	0	2240	$953.97	$2,136,887	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,696,887	1.90	$1,420,687
2018	2240	0	2240	$977.82	$2,190,309	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,750,309	2.01	$1,366,820
2019	2240	0	2240	$1,002.26	$2,245,067	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,805,067	2.13	$1,315,125
2020	2240	0	2240	$1,027.32	$2,301,194	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,861,194	2.26	$1,265,509
2021	2240	0	2240	$1,053.00	$2,358,724	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,918,724	2.40	$1,217,881
2022	2240	0	2240	$1,079.33	$2,417,692	2240	0	2240	$250.00	$560,000	0	1354	1354			$2,977,692	2.54	$1,172,157
2023	2240	0	2240	$1,106.31	$2,478,134	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,038,134	2.69	$1,128,255
2024	2240	0	2240	$1,133.97	$2,540,087	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,100,087	2.85	$1,086,096
2025	2240	0	2240	$1,162.32	$2,603,590	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,163,590	3.03	$1,045,608
2026	2240	0	2240	$1,191.37	$2,668,679	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,228,679	3.21	$1,006,717
2027	2240	0	2240	$1,221.16	$2,735,396	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,295,396	3.40	$969,359
2028	2240	0	2240	$1,251.69	$2,803,781	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,363,781	3.60	$933,466
2029	2240	0	2240	$1,282.98	$2,873,876	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,433,876	3.82	$898,979
2030	2240	0	2240	$1,315.05	$2,945,723	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,505,723	4.05	$865,838
2031	2240	0	2240	$1,347.93	$3,019,366	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,579,366	4.29	$833,987
2032	2240	0	2240	$1,381.63	$3,094,850	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,654,850	4.55	$803,373
2033	2240	0	2240	$1,416.17	$3,172,221	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,732,221	4.82	$773,943
2034	2240	0	2240	$1,451.57	$3,251,527	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,811,527	5.11	$745,649
2035	2240	0	2240	$1,487.86	$3,332,815	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,892,815	5.42	$718,445
2036	2240	0	2240	$1,525.06	$3,416,135	2240	0	2240	$250.00	$560,000	0	1354	1354			$3,976,135	5.74	$692,285
2037	2240	0	2240	$1,563.19	$3,501,538	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,061,538	6.09	$667,127
2038	2240	0	2240	$1,602.27	$3,589,077	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,149,077	6.45	$642,930
2039	2240	0	2240	$1,642.32	$3,678,804	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,238,804	6.84	$619,655
2040	2240	0	2240	$1,683.38	$3,770,774	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,330,774	7.25	$597,264
2041	2240	0	2240	$1,725.47	$3,865,043	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,425,043	7.69	$575,721
2042	2240	0	2240	$1,768.60	$3,961,669	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,521,669	8.15	$554,993
2043	2240	0	2240	$1,812.82	$4,060,711	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,620,711	8.64	$535,047
2044	2240	0	2240	$1,858.14	$4,162,229	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,722,229	9.15	$515,851
2045	2240	0	2240	$1,904.59	$4,266,285	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,826,285	9.70	$497,375
2046	2240	0	2240	$1,952.21	$4,372,942	2240	0	2240	$250.00	$560,000	0	1354	1354			$4,932,942	10.29	$479,591
2047	2240	0	2240	$2,001.01	$4,482,265	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,042,265	10.90	$462,472
2048	2240	0	2240	$2,051.04	$4,594,322	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,154,322	11.56	$445,990
2049	2240	0	2240	$2,102.31	$4,709,180	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,269,180	12.25	$430,121
2050	2240	0	2240	$2,154.87	$4,826,909	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,386,909	12.99	$414,841
2051	2240	0	2240	$2,208.74	$4,947,582	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,507,582	13.76	$400,126
2052	2240	0	2240	$2,263.96	$5,071,272	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,631,272	14.59	$385,955
2053	2240	0	2240	$2,320.56	$5,198,054	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,758,054	15.47	$372,306
2054	2240	0	2240	$2,378.57	$5,328,005	2240	0	2240	$250.00	$560,000	0	1354	1354			$5,888,005	16.39	$359,159
2055	2240	0	2240	$2,438.04	$5,461,205	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,021,205	17.38	$346,494
2056	2240	0	2240	$2,498.99	$5,597,735	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,157,735	18.42	$334,293
2057	2240	0	2240	$2,561.46	$5,737,679	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,297,679	19.53	$322,538
2058	2240	0	2240	$2,625.50	$5,881,121	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,441,121	20.70	$311,212
2059	2240	0	2240	$2,691.14	$6,028,149	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,588,149	21.94	$300,298
2060	2240	0	2240	$2,758.42	$6,178,852	2240	0	2240	$250.00	$560,000	0	1354	1354			$6,738,852	23.26	$289,781
																	Total Present Value of Discounted Benefits	$40,814,150
																	% Benefit Cost Claimed by Proposal	57.2%
																	Total Present Value of Discounted Benefits Claimed by Proposal	$23,360,391

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Table 13 Annual Costs of Avoided Projects - El Monte Groundwater Recharge and Restoration Project
(All avoided costs should be in 2006 dollars)

	Costs				Costs				Costs				Discounting Calculations		
(a)	(b)	(c)	(d)	(e)	(b)	(c)	(d)	(e)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
	Alternative (Avoided Project Name): Avoided O&M and treatment costs for existing wells				Alternative (Avoided Project Name): Avoided Point Loma WWTP Upgrade				Alternative (Avoided Project Name): Avoided Santee WWTP Upgrade						
YEAR	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives (b) + (c) + (d)	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance Costs	Total Cost Avoided for Individual Alternatives	Total Cost Avoided for All Alternatives	Discount Factor	Discounted Costs
2007														1.06	
2008				$0									$0	1.12	$0
2009				$0									$0	1.19	$0
2010				$0									$0	1.26	$0
2011			$32,400	$32,400					$3,298,000		$370,540	$3,668,540	$3,700,940	1.34	$2,765,558
2012			$32,400	$32,400							$370,540	$370,540	$402,940	1.42	$284,057
2013			$32,400	$32,400							$370,540	$370,540	$402,940	1.50	$267,978
2014			$32,400	$32,400							$370,540	$370,540	$402,940	1.59	$252,810
2015			$32,400	$32,400							$370,540	$370,540	$402,940	1.69	$238,500
2016			$32,400	$32,400							$370,540	$370,540	$402,940	1.79	$225,000
2017			$32,400	$32,400							$370,540	$370,540	$402,940	1.90	$212,264
2018			$32,400	$32,400	$17,000,000	$0	$0	$17,000,000			$370,540	$370,540	$17,402,940	2.01	$8,648,728
2019			$32,400	$32,400							$370,540	$370,540	$402,940	2.13	$188,914
2020			$32,400	$32,400							$370,540	$370,540	$402,940	2.26	$178,221
2021			$32,400	$32,400							$370,540	$370,540	$402,940	2.40	$168,133
2022			$32,400	$32,400							$370,540	$370,540	$402,940	2.54	$158,616
2023			$32,400	$32,400							$370,540	$370,540	$402,940	2.69	$149,638
2024			$32,400	$32,400							$370,540	$370,540	$402,940	2.85	$141,168
2025			$32,400	$32,400							$370,540	$370,540	$402,940	3.03	$133,177
2026			$32,400	$32,400							$370,540	$370,540	$402,940	3.21	$125,639
2027			$32,400	$32,400							$370,540	$370,540	$402,940	3.40	$118,527
2028			$32,400	$32,400							$370,540	$370,540	$402,940	3.60	$111,818
2029			$32,400	$32,400							$370,540	$370,540	$402,940	3.82	$105,489
2030			$32,400	$32,400							$370,540	$370,540	$402,940	4.05	$99,518
2031			$32,400	$32,400							$370,540	$370,540	$402,940	4.29	$93,884
2032			$32,400	$32,400							$370,540	$370,540	$402,940	4.55	$88,570
2033			$32,400	$32,400							$370,540	$370,540	$402,940	4.82	$83,557
2034			$32,400	$32,400							$370,540	$370,540	$402,940	5.11	$78,827
2035			$32,400	$32,400							$370,540	$370,540	$402,940	5.42	$74,365
2036			$32,400	$32,400							$370,540	$370,540	$402,940	5.74	$70,156
2037			$32,400	$32,400							$370,540	$370,540	$402,940	6.09	$66,185
2038			$32,400	$32,400							$370,540	$370,540	$402,940	6.45	$62,439
2039			$32,400	$32,400							$370,540	$370,540	$402,940	6.84	$58,904
2040			$32,400	$32,400							$370,540	$370,540	$402,940	7.25	$55,570
2041			$32,400	$32,400							$370,540	$370,540	$402,940	7.69	$52,425
2042			$32,400	$32,400							$370,540	$370,540	$402,940	8.15	$49,457
2043			$32,400	$32,400							$370,540	$370,540	$402,940	8.64	$46,658
2044			$32,400	$32,400							$370,540	$370,540	$402,940	9.15	$44,017
2045			$32,400	$32,400							$370,540	$370,540	$402,940	9.70	$41,525
2046			$32,400	$32,400							$370,540	$370,540	$402,940	10.29	$39,175
2047			$32,400	$32,400							$370,540	$370,540	$402,940	10.90	$36,957
2048			$32,400	$32,400							$370,540	$370,540	$402,940	11.56	$34,865
2049			$32,400	$32,400							$370,540	$370,540	$402,940	12.25	$32,892
2050			$32,400	$32,400							$370,540	$370,540	$402,940	12.99	$31,030
2051			$32,400	$32,400							$370,540	$370,540	$402,940	13.76	$29,274
2052			$32,400	$32,400							$370,540	$370,540	$402,940	14.59	$27,617
2053			$32,400	$32,400							$370,540	$370,540	$402,940	15.47	$26,053
2054			$32,400	$32,400							$370,540	$370,540	$402,940	16.39	$24,579
2055			$32,400	$32,400							$370,540	$370,540	$402,940	17.38	$23,187
2056			$32,400	$32,400							$370,540	$370,540	$402,940	18.42	$21,875
2057			$32,400	$32,400							$370,540	$370,540	$402,940	19.53	$20,637
2058			$32,400	$32,400							$370,540	$370,540	$402,940	20.70	$19,469
2059			$32,400	$32,400							$370,540	$370,540	$402,940	21.94	$18,367
2060			$32,400	$32,400							$370,540	$370,540	$402,940	23.26	$17,327
														Total Present Value of Discounted Costs	$15,943,590
														% Avoided Cost Claimed by Proposal	57.2%
														Total Present Value of Discounted Avoided Project Costs Claimed by Proposal	$9,125,475

Table 11 – Annual Cost of San Diego Regional Pollution Prevention Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2008	$164,307							$164,307	1.12	$146,233
2009	$328,614							$328,614	1.19	$275,910
2010	$328,614							$328,614	1.26	$260,293
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$682,436

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Table 11 – Annual Cost of Biofiltration Wetlands Creation and Education Program
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2008	$258,824.85							$258,825	1.12	$230,353
2009	$603,924.64							$603,925	1.19	$507,067
2010			$35,000					$35,000	1.26	$27,723
2011			$35,000					$35,000	1.34	$26,154
2012			$35,000					$35,000	1.42	$24,674
2013			$35,000					$35,000	1.50	$23,277
2014			$35,000					$35,000	1.59	$21,959
2015			$35,000					$35,000	1.69	$20,716
2016			$35,000					$35,000	1.79	$19,544
2017			$35,000					$35,000	1.90	$18,438
2018			$35,000					$35,000	2.01	$17,394
2019			$35,000					$35,000	2.13	$16,409
2020			$35,000					$35,000	2.26	$15,481
2021			$35,000					$35,000	2.40	$14,604
2022			$35,000					$35,000	2.54	$13,778
2023			$35,000					$35,000	2.69	$12,998
2024			$35,000					$35,000	2.85	$12,262
2025			$35,000					$35,000	3.03	$11,568
2026			$35,000					$35,000	3.21	$10,913
2027			$35,000					$35,000	3.40	$10,295
2028			$35,000					$35,000	3.60	$9,713
2029			$35,000					$35,000	3.82	$9,163
2030			$35,000					$35,000	4.05	$8,644
2031			$35,000					$35,000	4.29	$8,155
2032			$35,000					$35,000	4.55	$7,693
2033			$35,000					$35,000	4.82	$7,258
2034			$35,000					$35,000	5.11	$6,847
2035			$35,000					$35,000	5.42	$6,459
2036			$35,000					$35,000	5.74	$6,094
2037			$35,000					$35,000	6.09	$5,749
2038			$35,000					$35,000	6.45	$5,424
2039			$35,000					$35,000	6.84	$5,117
2040			$35,000					$35,000	7.25	$4,827
2041			$35,000					$35,000	7.69	$4,554
2042			$35,000					$35,000	8.15	$4,296
2043			$35,000					$35,000	8.64	$4,053
2044			$35,000					$35,000	9.15	$3,823
2045			$35,000					$35,000	9.70	$3,607
2046			$35,000					$35,000	10.29	$3,403
2047			$35,000					$35,000	10.90	$3,210
2048			$35,000					$35,000	11.56	$3,028
2049			$35,000					$35,000	12.25	$2,857
2050			$35,000					$35,000	12.99	$2,695
2051			$35,000					$35,000	13.76	$2,543
2052			$35,000					$35,000	14.59	$2,399
2053			$35,000					$35,000	15.47	$2,263
2054			$35,000					$35,000	16.39	$2,135
2055			$35,000					$35,000	17.38	$2,014
2056			$35,000					$35,000	18.42	$1,900
2057			$35,000					$35,000	19.53	$1,793
2058			$35,000					$35,000	20.70	$1,691
2059			$35,000					$35,000	21.94	$1,595
									Total Present Value of Discounted Costs (Sum of Column (j))	$1,200,609

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Table 12 - Annual Water Supply and Water Quality Benefits of Biofiltration Wetlands Creation and Education Program
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided cost of Additional Supply					Benefit: Avoided cost of pump operation							
	Measure of Benefit: Acre-feet of Avoided Supply (AF of avoided overflow)					Measure of Benefit: Dollars per year					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Without Proposal	With Proposal	Change Resulting from Proposal	Unit Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2008	0		0	$ -	0	$70,400	$0	$70,400	1	$70,400	$70,400	1.12	$62,656
2009	0		0	$ 163.00	$0.00	$70,400	$0	$70,400	1	$70,400	$70,400	1.19	$59,109
2010	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.26	$61,573
2011	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.34	$58,088
2012	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.42	$54,800
2013	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.50	$51,698
2014	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.59	$48,772
2015	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.69	$46,011
2016	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.79	$43,407
2017	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	1.90	$40,950
2018	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.01	$38,632
2019	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.13	$36,445
2020	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.26	$34,382
2021	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.40	$32,436
2022	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.54	$30,600
2023	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.69	$28,868
2024	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	2.85	$27,234
2025	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	3.03	$25,692
2026	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	3.21	$24,238
2027	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	3.40	$22,866
2028	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	3.60	$21,572
2029	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	3.82	$20,351
2030	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	4.05	$19,199
2031	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	4.29	$18,112
2032	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	4.55	$17,087
2033	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	4.82	$16,120
2034	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	5.11	$15,207
2035	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	5.42	$14,347
2036	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	5.74	$13,534
2037	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	6.09	$12,768
2038	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	6.45	$12,046
2039	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	6.84	$11,364
2040	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	7.25	$10,721
2041	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	7.69	$10,114
2042	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	8.15	$9,541
2043	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	8.64	$9,001
2044	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	9.15	$8,492
2045	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	9.70	$8,011
2046	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	10.29	$7,558
2047	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	10.90	$7,130
2048	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	11.56	$6,726
2049	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	12.25	$6,345
2050	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	12.99	$5,986
2051	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	13.76	$5,647
2052	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	14.59	$5,328
2053	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	15.47	$5,026
2054	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	16.39	$4,742
2055	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	17.38	$4,473
2056	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	18.42	$4,220
2057	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	19.53	$3,981
2058	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	20.70	$3,756
2059	45	0	45	$ 163.00	$7,335.00	$70,400	$0	$70,400	1	$70,400	$77,735	21.94	$3,543
												Total Present Value of Discounted Benefits (Sum of the values in	$1,150,507

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Table 13 - Annual Costs of Avoided Projects of Biofiltration Wetlands Creation and Education Program
(All avoided costs should be in 2006 dollars)

	Costs				Costs				Discounting Calculations		
(a)	(b)	(c)	(d)	(e)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
YEAR	Alternative Project: Water Quality Improvement Project				Alternative Project: Water Supply Project				Total Cost Avoided for All Alternatives	Discount Factor	Discounted Costs
	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance	Total Cost Avoided for Individual Alternatives	Avoided Capital Costs	Avoided Replacement Costs	Avoided Operations and Maintenance	Total Cost Avoided for Individual Alternatives			
2008	$2,000,000			$2,000,000				$0	$2,000,000	1.12	$1,779,993
2009	$2,000,000			$2,000,000				$0	$2,000,000	1.19	$1,679,239
2010			$116,400	$116,400		$90,000		$90,000	$206,400	1.26	$163,488
2011			$116,400	$116,400				$0	$116,400	1.34	$86,981
2012			$116,400	$116,400				$0	$116,400	1.42	$82,057
2013			$116,400	$116,400				$0	$116,400	1.50	$77,413
2014			$116,400	$116,400				$0	$116,400	1.59	$73,031
2015			$116,400	$116,400				$0	$116,400	1.69	$68,897
2016			$116,400	$116,400				$0	$116,400	1.79	$64,997
2017			$116,400	$116,400				$0	$116,400	1.90	$61,318
2018			$116,400	$116,400				$0	$116,400	2.01	$57,847
2019			$116,400	$116,400				$0	$116,400	2.13	$54,573
2020			$116,400	$116,400				$0	$116,400	2.26	$51,484
2021			$116,400	$116,400				$0	$116,400	2.40	$48,570
2022			$116,400	$116,400				$0	$116,400	2.54	$45,820
2023			$116,400	$116,400				$0	$116,400	2.69	$43,227
2024			$116,400	$116,400				$0	$116,400	2.85	$40,780
2025			$116,400	$116,400				$0	$116,400	3.03	$38,472
2026			$116,400	$116,400				$0	$116,400	3.21	$36,294
2027			$116,400	$116,400				$0	$116,400	3.40	$34,240
2028			$116,400	$116,400				$0	$116,400	3.60	$32,302
2029			$116,400	$116,400				$0	$116,400	3.82	$30,473
2030			$116,400	$116,400				$0	$116,400	4.05	$28,748
2031			$116,400	$116,400				$0	$116,400	4.29	$27,121
2032			$116,400	$116,400				$0	$116,400	4.55	$25,586
2033			$116,400	$116,400				$0	$116,400	4.82	$24,138
2034			$116,400	$116,400				$0	$116,400	5.11	$22,771
2035			$116,400	$116,400				$0	$116,400	5.42	$21,482
2036			$116,400	$116,400				$0	$116,400	5.74	$20,266
2037			$116,400	$116,400				$0	$116,400	6.09	$19,119
2038			$116,400	$116,400				$0	$116,400	6.45	$18,037
2039			$116,400	$116,400				$0	$116,400	6.84	$17,016
2040			$116,400	$116,400				$0	$116,400	7.25	$16,053
2041			$116,400	$116,400				$0	$116,400	7.69	$15,144
2042			$116,400	$116,400				$0	$116,400	8.15	$14,287
2043			$116,400	$116,400				$0	$116,400	8.64	$13,478
2044			$116,400	$116,400				$0	$116,400	9.15	$12,715
2045			$116,400	$116,400				$0	$116,400	9.70	$11,996
2046			$116,400	$116,400				$0	$116,400	10.29	$11,317
2047			$116,400	$116,400				$0	$116,400	10.90	$10,676
2048			$116,400	$116,400				$0	$116,400	11.56	$10,072
2049			$116,400	$116,400				$0	$116,400	12.25	$9,502
2050			$116,400	$116,400				$0	$116,400	12.99	$8,964
2051			$116,400	$116,400				$0	$116,400	13.76	$8,456
2052			$116,400	$116,400				$0	$116,400	14.59	$7,978
2053			$116,400	$116,400				$0	$116,400	15.47	$7,526
2054			$116,400	$116,400				$0	$116,400	16.39	$7,100
2055			$116,400	$116,400				$0	$116,400	17.38	$6,698
2056			$116,400	$116,400				$0	$116,400	18.42	$6,319
2057			$116,400	$116,400				$0	$116,400	19.53	$5,961
2058			$116,400	$116,400				$0	$116,400	20.70	$5,624
2059			$116,400	$116,400				$0	$116,400	21.94	$5,306
										Total Present Value of	$5,070,953

Comment
Box

Table 11 – Annual Cost of San Dieguito Watershed Management Plan Implementation
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007									1.06	$0
2008	$34,088							$34,088	1.12	$30,338
2009	$34,088							$34,088	1.19	$28,621
2010	$34,088							$34,088	1.26	$27,001
2011									1.34	$0
2012									1.42	$0
2013									1.50	$0
2014									1.59	$0
2015									1.69	$0
2016									1.79	$0
2017									1.90	$0
2018									2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$85,960

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Table 11 – Annual Cost of San Diego River Watershed Management Plan Implementation
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008	$39,511							$39,511	1.12	$35,165
2009	$39,511							$39,511	1.19	$33,174
2010	$39,511							$39,511	1.26	$31,296
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$99,635

Comment Box:

Table 11 – Annual Cost of Green Mall Porous Paving and Infiltration
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008	$126,933			$15,000.00				$141,933	1.12	$126,320
2009	$380,799			$15,000.00				$395,799	1.19	$332,320
2010								$0	1.26	$0
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$458,640

Comment Box:

Table 11 – Annual Cost of Chollas Creek Runoff Reduction and Groundwater Recharge Project
(All costs in 2006 Dollars)

YEAR	Initial Costs		Operations and Maintenance Costs						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Capital and Other Initial Costs from Table 8	Capital and Other Initial Costs Not Included in Table 8	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2007								$0	1.06	$0
2008			$2,920.00				$10,600.00	$13,520	1.12	$12,033
2009	$582,845.36		$36,040.00				$5,000.00	$623,885	1.19	$523,826
2010	$145,711.34		$5,840.00				$5,000.00	$156,551	1.26	$124,003
2011								$0	1.34	$0
2012								$0	1.42	$0
2013								$0	1.50	$0
2014								$0	1.59	$0
2015								$0	1.69	$0
2016								$0	1.79	$0
2017								$0	1.90	$0
2018								$0	2.01	$0
Total Present Value of Discounted Costs (Sum of Column (j))										$659,862

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APPENDIX 8-22
ASSIGNING VALUE TO ENHANCED WATER SUPPLY RELIABILITY

Introduction

Many water projects can enhance the reliability of a local water supply system. There is some evidence (from empirical research, and from casual observation of political impacts) that water users place a fairly high value on having a water supply that reliably provides them the quantity and quality of water they desire, on an uninterrupted basis. The challenge is to interpret the existing evidence (using the guiding principles of "benefits transfer" as per Desvousges et al., 1992), so that one can reasonably deduce some monetary value that added reliability generates for water users.

This appendix provides a summary of the issues and literature related to valuing water supply reliability enhancements. It is intended to support the use of reliability-related water supply benefits as applied in the economic analyses for conservation, water reuse, and desalination projects, but apply as well as other efforts to enhance the reliability of a water supply. The material summarized in this manuscript is based in large measure on related prior work prepared for the Awwa Research Foundation (Raucher et al., 2005), the Water Reuse Foundation (Raucher et al., 2006), and the federal Bureau of Reclamation (Kasower et al., in peer review).

Types of Reliability

One of the complications in describing or monetizing the benefits of enhanced water supply reliability is that the term "reliability" can apply to a wide range of circumstances or sources of uncertainty in supply. For our purposes, we can think of at least three general types of reliability enhancement contexts that may apply to regional water supply projects:

1. ***Periodic adverse events, such as droughts*** *(moderate probability, moderate consequence risk).* Droughts are fairly common events, occurring periodically over the span of several decades. The frequency and severity of droughts may vary considerably over time and across locations, but most water customers (e.g., residential users) have some direct experience with drought years and associated impacts such as the imposition of water use restrictions in some drought periods. As described below, there is a reasonably extensive and consistent body of published empirical research on household willingness to pay (WTP) to avoid drought-type water use restrictions. These studies can be used to value the benefits of enhanced water supply reliability in the context of projects that reduce the likelihood of periodic drought-related impacts.

2. ***Episodic, catastrophic events, such as earthquakes*** *(low probability, high consequence risk).* Water supply reliability also can be enhanced in the context of what might happen in the aftermath of a somewhat extreme (low probability, high consequence) event such as a major earthquake, flood, levee failure, or terrorist attack. If and when such extreme events occur in the future, some local water projects may prove invaluable because they provide some level of water service when the usual imported supplies might be cut-off, perhaps for extended periods of time. For example, the earthquake-induced loss of a major feeder line from the Metropolitan Water District (MWD) of Southern California to a wholesale customer [or the loss of Central Valley Project (CVP) or State Water Project (SWP) waters in general, due to some event like levee failure in the Bay-Delta] might

mean the loss of up to 100% of the available imported water in a region for days, weeks, or even months or years (Harder, 2006). Under such extreme but plausible scenarios, having a local supply may mean the difference between having some water service available for basic human needs, fire suppression, etc.; as contrasted to having no water (or virtually no water) available locally at all. In such cases, the value of reliability to the region's residents would be extremely high since the local supply would be meeting the most highly valued, essential human needs. However, monetizing such values challenging empirically, given that existing research has focused on the lower consequence but more frequent event of periodic drought, rather than the value of water in a large-scale emergency situation.

3. ***Quasi-routine inconvenient events, such as infrastructure repair*** *(moderate probability, low consequence risks).* The infrastructure conveying water to customers, such as finished water transmission mains between a water treatment plant and the customer, are another source of reliability risk. Water main breaks create unscheduled disruptions in water service to some customers; and even scheduled efforts to replace or rehabilitate distribution lines disrupt service. Treatment plant shutdowns, as may be needed for periodic scheduled (or unanticipated) events, also may disrupt water deliveries. Most water users periodically experience these events, and the impacts typically are limited to temporary inconveniences associated with having no water on tap for several hours (or perhaps up to a few days), and street and parking disruption. These event are not frequent, but they also are not uncommon. There is some evidence that households have a positive WTP to having less frequent, shorter duration events and, in particular, value efforts to have scheduled events (e.g., announced, planned repairs) rather than unscheduled events (an emergency response to a main break) (Damodaran et al., 2004, 2005).

How Water Projects May Provide Benefits By Improving Reliability

Water projects can improve reliability (i.e., help manage the risk of water service disruption or water use restrictions) in different ways, depending on the type of project and local circumstances. The type(s) of reliability enhancement a project provides, and the extent to which it enhances reliability, will depend on site- and project-specific circumstances. Nonetheless, a few general observations often apply to various classes or types of water supply enhancement projects:

- **Projects that generate local water**, especially in regions that rely exclusively or predominantly on imported supplies, are likely to provide reliability benefits for both periodic risks such as droughts, as well as infrequent but catastrophic events such as earthquakes. Drought protection may arise because the additional local supplies diversify the water supply portfolio (e.g., the drought impacts may be more severe on the imported source than the newly developed local source), plus the added local source provides additional total capacity. Catastrophic risks are likely to be reduced because when the imported supply is cutoff or severely curtailed because of a seismic or other event (e.g., impacting the amount of water reaching MWD, or cutting off a major feed line from MWD to some of its wholesale and retail agency customers), then the local source remains available (and may be the only water available for local basic needs).

- **Projects that enable importation of water**, especially in regions that rely exclusively or predominantly on local supplies, also provide reliability benefits for both periodic drought and potential catastrophic events. As in the case above, the diversification and overall expansion of the water supply portfolio provides value across several circumstances.

- **Projects that include reclamation or desalination**, or otherwise make productive use out of waters previously considered unsuitable for use (e.g., by using advanced treatments to render low quality waters potable or fit for irrigation use) also tend to provide reliability benefits for both drought and catastrophic events. Drought protection arises because the new sources are not drought-sensitive, and thus their yields have low or zero covariance with yields from the traditional water supplies the area uses (see portfolio theory discussion, below). In addition, because reuse or desal projects provide added capacity, and are local sources, they provide reliability benefits in the event of catastrophic events.

- **Projects that replace or upgrade treatment or distribution infrastructure** tend to generate the third type of reliability value, described above (i.e., reduce the risk of unscheduled short-term service disruptions). They also may provide some drought protection insofar that infrastructure renewal probably reduces the volume of water lost to leaks, thereby enabling more end use from the existing supplies (in effect, increasing overall system capacity in terms of delivered water).

- **Projects that add water storage** also provide a buffer against seasonal or inter-annual fluctuations in the available yields from traditional water supply sources, as well as emergency interruptions of imported water supplies. That is why we are doing our Emergency Storage Project. This reason should be included in this bullet point. For example, Aquifer Storage and Retrieval (ASR) programs can make use of excess water in wet periods, and store that water for use in dry periods. These and other storage projects increase reliability from periodic drought events, and also can help improve intra-annual reliability by enabling more water availability in dry months (which also tend to be periods of high water demand).

Units of Measurement: How Reliability Values Are Applied in this Assessment

Values for reliability are often given in dollars per household per year for stated preference studies, and in dollars per acre-foot (or similar measure of water volume) for revealed preference studies. These values per specified unit of measurement should then be applied to the appropriate quantity. If values are cited in per household per year, then one needs to apply this value to the geographically appropriate total number of households.

In the economic evaluations (Attachment 8s) performed of the specific projects in this submittal, we apply values based on per household annual willingness to pay. As noted in the applicable Attachment 8s, we apply only the lower bound estimate shown in the literature ($80 per household per year, which when updated to 2006 dollars, is $88 per household annually).

We then apply only a percentage of this value to a given water supply project, where the percentage is based on the quantity of water developed by the project relative to a 20% shortfall in overall supply. For example, if a project provides 5000 AF per year, and a 20% shortfall for the region would be 100,000 AF, then we apply only 5% of the reliability value to this project (i.e., 5% of the $88 per household) to reflect the contribution that the project makes to overall reliability. The 20% benchmark is a common one in shortage assessments, and is well above the shortfall applied in the empirical study that generated the $88 per household estimate (under 9.2%, see Table 1, below).

Overall, we believe this approach results in a conservative estimate of the reliability value of new supplies. We use only the lower bound WTP value per household from the empirical literature, and then

we credit a project's contribution toward overall reliability by apportioning it relative to a large 20% shortfall of 20%. (i.e., a shortfall benchmark of 10% would double the $ per household value we would assign). .

Monetizing the Outcomes: Approaches and Evidence from the Literature

Although interest in water supply reliability is increasing, a limited studies have directly attempted to quantify its value. The studies that have attempted to quantify the value of reliability used "stated preference" and "revealed preference" methods to examine reliability values for residential customers. Stated preference methods determine estimates for reliability on the analysis of responses to hypothetical choices in surveys. Revealed preference infers the value of reliability from data obtained from choices and decisions made in the marketplace. For example, expenditures made to obtain higher levels of reliability (i.e., to avert potential shortages) sometimes can be used to infer the value of reliability.

Stated Preference Studies

Several studies have determined values of water supply reliability using the stated preference method. Values for reliability are usually defined as WTP to avoid a particular shortfall event. Water supply shortfall events are usually defined in different ways across studies. Factors that may be used to describe a shortfall event include the percent of water available compared to the amount fully demanded (the shortfall amount), the frequency with which this condition may occur (e.g., 1 in 10 years), and the probability of a single event. In other studies, respondents are questioned on their WTP to reduce the probability of an event, not avoid it.

- In 1987, a contingent valuation study was conducted for the MWD in an effort to determine the economic value for changes in the reliability of water supply among residents in Southern and Northern California. A reliable water supply is defined in the paper as "one without the threat of periodic shortages and mandatory rationing" (Carson and Mitchell, 1987, p. 1). In the study, four scenarios of reductions in reliability are investigated and households' WTP to alleviate the threat of those reductions in reliability is determined. Reductions in reliability are defined in terms of magnitude and frequency.

- In 1993, the California Urban Water Agencies (CUWA, 1994) retained Barakat and Chamberlin, Inc. to design, conduct, and analyze the results of a contingent valuation survey to estimate the value to residential users of water supply reliability in 10 California water districts. More specifically, they sought to estimate how much residents are willing to pay to avoid water shortages of varying magnitude and frequency. Shortage magnitudes ranged from 10 to 50% and frequencies ranged from once every 3 years to once every 30 years.

- Griffin and Mjelde (2000) conducted a stated preference study in seven Texas cities. Their first objective was to investigate the value of current water supply shortfalls (existing shortages of known strength and duration). Second, the study attempted to determine the value of future shortfalls, probabilistic shortages of differing strength duration and frequency.

- A study conducted by Howe and Smith (1994) attempts to formulate a framework for determining the optimal level of water supply reliability. The study uses contingent valuation survey methods to

measure customers' WTP for improved reliability and willingness to accept (WTA) lower water costs for reduced reliability.

- Michelsen et al. (1998) estimated the annual WTP for avoiding a 5% reduction in water consumption levels for several southwestern cities. WTP was $321 per household for Albuquerque, $330 per household for El Paso, and $257 per household for Las Cruces (reported here in 2003 $s).

Table 1 summarizes the results of these studies. The studies are unique to each location and situation, and it is probably ill-advised to use any single value for the transfer of benefits to other situations. However, it appears the majority of households value water supply reliability in excess of $100 per year, and the values given below may help to formulate a range of possible values that could be used to transfer benefits.

Limitations to Stated Preference Studies

While stated preference approaches have been applied to the valuation of nonmarket goods for many years, the method has limitations that need to be acknowledged and considered. For example, Griffen and Mjelde (2000) note that one difficulty with stated preference studies for water reliability is the notion of the "birthright" perspective. It is not uncommon for respondents to view water as an inalienable right. Consequently, while they highly value water reliability, the notion that water should be free can lead to a reduction in their stated WTP for reliability. However, if the limitations are acknowledged and efforts are made to perform the studies in an appropriate manner, stated preference studies can yield informative results.

Drawing Inferences about the Reliability Value for Residential Water

This text is based on work developed for and provided in an AwwaRF report on the value of water (Raucher et al., 2005). Despite the body of empirical research reviewed in the preceding section regarding water reliability values, there is a general lack of direct empirical evidence about how much residential customers of water utilities value the water they receive on a per acre foot (AF) (or per 1,000 gallon) basis. This leaves open the key question of "how much are households willing to pay for the water provided by their community water system?"

In this section, the research team applies a series of simple assumptions to interpret the available empirical evidence on reliability values, in a manner that provides some insight on the more basic issue of the WTP for reliable deliveries of residential water. In addition, the few studies that directly estimate WTP for residential water are reviewed. All monetary values below are stated in 2003 U.S. dollars, (USD) unless stated otherwise.

Griffin and Mjelde (2000) evaluated a "current shortfall" scenario of 20%, lasting for 3 weeks. To estimate how much water is at stake in this scenario, consider that the average U.S. household uses approximately 0.5 AF per year [172 gallons per capita per day (based on Mayer et al., 1999), times 2.6 persons per household, times 365 days per year, which equals over 163,000 gallons per household per year, or about 50% of the 325,850 gallons in an AF). The shortfall scenario used by Griffin and Mjelde thus may amount to about 0.0058 AF of water (3 weeks out of 52 weeks being 5.77% of the year, times a 20% shortfall, times 0.5 AF per year, which equals 0.0058 AF). Given the estimated WTP to avoid such a shortfall was $32.04 per household per year, the implied value per at risk AF is $5,553 ($32.04 divided by 0.00577 AF).

Table 1. Summary Table of Reliability Results from Stated Preference Studies (2003 USD).

Source	Shortfall Amount	Frequency	Probability	Annual WTP/ Household
Carson and Mitchell (1987)	10% to 15%	1 in 5 years	20%	$135
Carson and Mitchell (1987)	10% to 15%	2 in 5 years	10%	$248
CUWA (1994)	20%	1 in 30 years	3.3%	$143
Carson and Mitchell (1987)	30% to 35%	1 in 5 years	20%	$186
Carson and Mitchell (1987)	30% to 35%	2 in 5 years	10%	$421
CUWA (1994)	50%	1 in 10 years	5%	$253
Griffen and Mjelde (2000)	Na	Na	Na	$109
Griffen and Mjelde (2000)	Na	Na	Na	$125
Howe and Smith (1994)[a]	0.16% to 9.2%[b]	Na	Na	$80[c]
Howe and Smith (1994)	0.23% to 12.2%[b]	Na	Na	$92[d]

Na = not applicable.

a. Howe and Smith (1994) also estimated willingness to pay (WTP) values for decreases in reliability. Mean annual WTP results per household for approximately a 0.7% to 11% decrease in reliability, depending on the city, ranged from $68 to $166. Mean annual WTP results for approximately a 1.7% to 40% decrease in reliability, depending on the city, ranged from $81 to $241.

b. This percentage range does not represent the magnitude of the shortfall, as is the case in the other studies. Rather, this range represents the increased probability over the base probabilities of the Standard Annual Shortage Event (SASE). The actual percentage increase is dependent on the city. The associated dollar values are the annual WTP per respondent for an increase over their current reliability.

c. Value represents the average of the WTP range given in the study ($70 to $90 per year). If "no" respondents for this increased probability range are included into the data set (respondents' WTP = $0), the WTP range is from $16/year to $28/year per respondent.

d. Value represents the average of the WTP range given in the study ($64 to $119 per year). If "no" respondents for this increased probability range are included into the data set, the WTP range is from $15/year to $29/year per respondent.

Several caveats are required in evaluating a value estimate derived from this process. First, the assumptions applied to estimate the volume of water at stake might be in error. For example, if the water shortfall occurred in summer (which is likely), and the water use in summer is 2.4 times higher than in winter (the ratio of typical total use to indoor use only, as per Mayer et al., 1999), then the implied quantity of the water shortfall is understated. If the outdoor water use season in California (the study location) is assumed to be roughly one-half the year, then the 0.5 AF used per home per year comprises roughly 0.15 AF used in the winter months and 0.35 AF per household used in the six months in which outdoor irrigation occurs. The 3-week shortfall of 20% is thus equivalent to 0.008 AF (3 of 26 weeks of the outdoor watering season, times 20%, times 0.35 AF). Then, the implied residential customer WTP is $4,005 per AF ($32.04 divided by 0.008 AF).

Second, the reliability-based WTP values obtained by the original researchers reflect not just the value of the water per se, but also some degree of the residential customers' aversion to risk and uncertainty. In other words, the WTP values from the reliability studies undoubtedly embody some risk avoidance premium as well as the value held for the quantity of water at risk. This implies that the inferred WTP estimate would overstate the value of the water alone. This may be particularly true for the studies that value eliminating the risk of shortfalls, rather than reducing their likelihood or severity.

Third, the WTP estimates reflect values at the margin for the households' lowest valued current uses of the water (e.g., a portion of their outdoor irrigation). As more and more water is withheld from the households, the water uses that would be affected would be of increasing importance and value to the residential customers. Therefore, the WTP estimates inferred above might be understated compared to the WTP for water used for more highly valued purposes in the home (e.g., drinking, cleaning).

Finally, the reliability estimates we are interpreting are based on stated preference surveys of households. Given the hypothetical nature of some of the survey questions and the difficulty some respondents may have had with probability-based scenarios of water shortfalls and reliability, it may be the case that the results from the original research are skewed in one direction or the other.

Based on the above caveats, the values derived here need to be interpreted with considerable caution. There are reasons why the estimates may be under- or overstated relative to the true WTP of households for utility-supplied water. With these caveats in mind, by applying the general assumptions and procedures described above to the applicable reliability value estimates, the following illustrative WTP estimates for reliability of residential water are inferred:

- Griffin and Mjelde's (2000) current shortfall scenario implies a WTP for residential water on the order of $4,005 per AF.

- Carson and Mitchell's (1987) scenarios for the MWD imply a possible WTP for residential water of between $4,675 and $7,714 per AF.

- The Barakat and Chamberlin study for CUWA (1994) implies a possible WTP of over $14,500 per AF.

As noted, these value estimates may be overstated for water use at the margin (i.e., for modest cutbacks in current outdoor uses), for reasons described above. In particular, the results based on Carson and Mitchell (1987) and CUWA (1994) may be overstated because they are based on certainty equivalents of eliminating future shortfalls. However, these estimates may be on target, or possibly understated, for more essential water uses.

Revealed Preference and Cost-Based Studies

A few studies have used the revealed preference method to determine values for water supply reliability.

- Fisher et al. (1995) explored how price can be used as a tool to reduce demand during a drought. Using estimated price elasticities for residential customers, the loss of surplus was computed with a price-induced cutback of 25% in consumption in the East Bay Municipal Utility District (EBMUD, California) service area.

- In 2002, the California Recycled Water Task Force was established to investigate specific recycled water issues. The economic group of the task force was charged with identifying economic impediments to enhancing water recycling statewide. The report uses a case study of the Ground Water Replenishment System (GWRS) in Orange County as an illustration for the importance of economic feasibility analysis. The GWRS was designed to recycle an estimated 70,000 AF/year of effluent and inject it into the Orange County Aquifer.

- Varga (1991) investigated the role of local projects and programs in the City of San Diego to enhance imported water supply and improve reliability. The MWD provides water to San Diego from the Colorado River and Northern California, based on availability. To encourage the use of existing local reservoir capacities and improve the reliability and yield of the imported water system, the MWD and California introduced water rate credits for serviced cities.

- Thomas and Rodrigo (1996) measured the benefits of nontraditional water resource investments. The focus of the study was on the MWD and its member agencies. They investigated the benefits (expected yields and cost savings) of developing additional resources in the region through several alternatives: increased imported supplies (base case), the addition of significant conjunctive storage of local groundwater basins (groundwater case), and the implementation of recycled water and groundwater recovery projects (preferred case). To determine the value of recycled water and conjunctive use storage, the savings attributable to each of these resources were compared to the yield associated with the resource.

An overview of the value of reliability inferred from results of revealed preference and cost-based approaches is provided in Table 2. These results ($/AF) are considerably lower than those based on WTP from the stated preference studies, as summarized in Table 1 (where the results imply values of perhaps $4,000/AF and up). This may reflect the fact that many of the results shown in Table 2 reflect artificial measures such as rate structures applied by MWD. The stated preference results are designed to reflect the real *value* (i.e., WTP) of water supply reliability, whereas the *cost*-differential based results that make up most of Table 2 are simply reflective of agency pricing decisions that are not likely to reflect any value (WTP) considerations.

Portfolio Theory Implications

Water supply options that are drought-resistant (such as desalination or water reclamation) may provide a special type of reliability value-added, compared to other, more traditional (and drought-sensitive) water supply options. Recent work sponsored by the federal Bureau of Reclamation, and also explored elsewhere, has helped explain how the concept of “portfolio theory” – as originally devised and applied to financial assets by Nobel Prize winner Harry Markowitz – can be constructively applied to water supply portfolio choices.

Table 2. Water Supply Reliability Values Inferred from Revealed Preference or Cost and Price Differential Results (2003 USD/AF).

Source	Value ($/AF)	Basis
Fisher et al. (1995)	$51 to $230	Welfare loss per AF due to a price induced reduction in water consumption of 25%
Recycled Water Task Force (2002)	$179 to $256	The value (AF/year) of drought proofing based on drought penalties and rate increases for customer
NRC (1997)	$331	The difference in cost of local groundwater supplies versus the MWD non-interruptible rate (AF/year)
Varga (1991)	$60	The rate per AF that MWD credits local water retailers to store imported water in the local reservoir to increase reliability of imported supplies (AF/year)
Varga (1991)	$111	The rate per AF that MWD credits local water retailers to seasonally store imported water to increase capacity and yield of imported water system (AF/year)
Thomas and Rodrigo (1996)	$353	The benefit per AF of conjunctive use storage to ensure greater reliability

The central premise, long recognized and applied by financial managers, is to jointly maximize expected returns (water yields) while also reducing the overall variance in portfolio yield. This can be accomplished by minimizing the covariance in yield risks across the assets held in a portfolio (Markowitz, 1952). As shown in Kasower et al. (In peer review), a simple and plausible numeric illustration reveals that a manager should be willing to pay a considerable premium for drought-resistant supply options (perhaps justifying paying several hundreds of dollars per AF more for a reuse or desal option than to spend on expanding the reliance on a more traditional surface water supply).

Commercial Values for Reliability Also May be Significant

Note that the reliability values above pertain essentially to residential customers. Commercial, industrial, and institutional customers (CII) may also place a high value on reliable supplies. Businesses that rely on water as a key part of their production process do not want to have their production levels curtailed, disrupted, or subject to uncertainty because of potential limits on water use. While no empirical estimates are available at this time on CII reliability values for water supply, reuse may provide appreciable value in this manner to a utility's CII customers. This in turn can have associated beneficial impacts in terms of retaining or attracting businesses to the region, with attendant local economic impacts such as stability or growth in income, employment, and tax revenues.

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