Attachment 9

Other Expected Benefits

San Diego Integrated Regional Water Management Grant Application

PIN 13105

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SUMMARY OF OTHER BENEFITS PROVIDED BY PROPOSAL

The San Diego Region Implementation Grant Proposal provides a range of benefits in addition to those directly related to water supply and water quality (presented in Attachment 8). These benefits include: ecosystem restoration, preservation of habitat, protection of endangered species, steelhead recovery, public education, recreation and public access, reduced ocean discharges, reduced fire risk, infrastructure damage reduction, open space, energy savings, preservation of land, protection of endangered species, removal of harmful non-native plant species, power generation, and improved watershed management. Because of the proposal's emphasis on creation of new local water to replace imported water, the Proposal has significant benefits related to the avoided impacts of imported water such as energy savings and reduction of greenhouse gas emissions. The Bay-Delta ecosystem will also benefit from lowered demand for imported water.

The many quantitative benefits provided by this proposal include:

- Creation or conservation of new local water
- Avoided ocean discharges
- Restoration of habitat
- Conservation of land through acquisition
- Creation and enhancement of wetlands
- Preservation of water contact recreation areas
- Generation of available ocean front and lagoon front public access areas
- Provision of land for an expanded fish hatchery
- Preservation of trails
- Reductions in greenhouse gas emissions due to reduced imported water needs
- Reductions in nutrients applied through fertilizer requirements

Beneficiaries of the Proposal

The proposal will provide benefits to the following groups.

Local: Residents, businesses, agricultural operators, homeowners, recreational park users, commuters, local plant and animal species, steelhead, golf courses, schools. The proposal contains a large educational component across many projects directed to local residents and businesses.

Regional: Implementation of the Proposal will benefit the San Diego Region (Region) by preserving and restoring the rich natural resources for all who live in the Region to enjoy. The Proposal maintains a range of passive recreational opportunities through preservation of open space and habitat. It also provides expanded opportunities for active recreation through maintenance of green spaces, fishing opportunities and river access. Specifically, the Proposal provides benefits to recreational users of: the San Elijo Lagoon, Carlsbad Hydrologic Unit (HU), the Santee Lakes Recreation Preserve, parks, golf courses, beaches, San Vicente Reservoir, El Capitan Reservoir, Santa Margarita River, San Luis Rey River, San Dieguito River, Agua Hedionda Lagoon, Hubbs SeaWorld, El Monte Valley, San Diego Wild Animal Park, San Dieguito River Park, San Dieguito HU, San Diego River HU, Chollas Creek and San Diego Bay.

The Proposal also offers significant benefits to the Region in the form of flood protection, fire risk reduction and local power generation. The Point Loma Wastewater Treatment Plant (WWTP) will benefit from reduced ocean discharges that may allow it to delay expensive capacity expansion.

Statewide: The Bay-Delta ecosystem will benefit from the reduction in imported water demand. All citizens of California will benefit from the energy savings and reduced greenhouse gas emissions that will be realized from avoiding transportation of imported water. Visitors from outside the Region will benefit by improved public access and recreation opportunities at the lagoons, rivers, reservoirs, creeks, beaches and coastlines in the Region. The proposal will help to maintain the aesthetic values of open space and uncontaminated surface waters for visitors and tourists to enjoy.

The total monetized benefits for each work item and this Proposal as a whole are shown in **Table A**. The other expected benefits monetized in this attachment include energy cost savings for pumping offsets, avoided ocean discharge capacity charges, avoided fertilizer costs, avoided costs of local treatment, flood protection, increased sediment flows, reduced fire risk, energy management opportunities, and infrastructure damage reduction.

Table A. Monetized Proposal Benefits

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

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 #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 Conceptual Design	$782,948	$2,540,735	$2,254,949	$3,038,247	$5,293,195
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***

OTHER BENEFITS PROVIDED BY PROPOSAL WORK ITEMS

Attachment 9 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

In addition to a description of the other expected benefits and identification of beneficiaries, a discussion of benefits timing, adverse effects, and uncertainty of benefits is provided for each Work Item.

CONSERVATION PROGRAM

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

This project will target additional water conservation in the agricultural and landscape use sectors through a variety of services, device programs, and research. It also involves creation of a web-driven water budget program that will be available to San Diego County Water Authority (Water Authority) member agencies. The project has the potential to save over 3,000 AFY through the expansion of tested programs with proven and quantifiable water savings. If 17 % of all customers with dedicated meters (approximately 3,000) switched over to water budgets, it is estimated that an additional 2,400 AFY of water could be conserved. This project also contains a substantial outreach and education component, as well as efforts to develop effective branding messages to increase public awareness and action on water efficiency issues.

This project will achieve a significant reduction the need for imported water, which will help avoid the significant energy costs from transportation of the water. In addition, the water that is conserved also avoids local energy costs for treatment, pumping and disposal. Reduced pumping demands on the State Water Project (SWP) will also provide habitat benefits in the Bay Delta, including reducing risk to the endangered Delta smelt population.

An important water use efficiency strategy that will be emphasized by the project is the reduction of agricultural and landscape irrigation runoff, which will also contribute to water quality improvements and benefit local habitat and recreation. There are a number of reservoirs, lagoons and beaches in the Region which suffer impairments such as algal blooms from the effects of urban runoff. The reduction of runoff impacts through conservation will help ensure that suitable habitat will be maintained and that opportunities to partake in recreational activities such as fishing, swimming, and birdwatching etc. will be increased.

This project will significantly reduce imported water demand through additional conservation, which will provide both protection to the ecologically sensitive Bay-Delta system and provide energy savings. The project will lead to reductions in runoff, which will improve water quality; and associated riparian habitat, and increase the quality of recreational areas. Increasing public education and awareness will be both a benefit offered by the project and a means to achieve the desired level of water use efficiency. The benefits of this project are summarized in the table below. The other expected benefits of this project are summarized in the table below.

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 Carbon Emissions	+

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

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.

Expected Benefits of Project

This project will generate expected benefits related to reductions in imported water demand and a reduction in runoff associated with landscape and agricultural over irrigation.

Local Habitat Protection

By addressing the impacts of excessive irrigation and runoff, the project will lead to a reduction of pollutants with adverse effects on habitats in local reservoirs, lagoons and beaches. This will benefit local plant and animal species as well as residents and visitors from outside the Region who can view habitat in natural settings that have not been impacted adversely by human activities.

Water Use Efficiency Practices

The project will provide benefits to the public in terms of increased understanding and awareness of the context of water supply in the Region, as well as the importance of conservation. The project will develop the most effective messages to promote water conservation through a branding study, followed by dissemination of messages through a variety of public events, including landscape awards, County Fair exhibits and water conservation gardens. While not directly quantifiable, these significant, intangible benefits will lead to a more informed public, which will ideally lead to increased water conservation and an expansion of all of the associated benefits described herein. The major beneficiaries will be residents, businesses and agricultural operators throughout the Region.

Recreation and Public Access

Reduction in runoff helps maintain the quality and appearance of local water bodies which encourages recreational use. This project will provide benefits in terms of increased opportunities for recreation. Passive recreational opportunities such as hiking, picnicking and sightseeing will also be enhanced by avoiding the negative visual impacts of algal bloom events. Both residents of the Region and visitors from other areas in the state will benefit through improved recreational access.

Bay – Delta Habitat Protection

By reducing imported water, the project will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta smelt at the Harvey O. Banks (Banks) pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Reduction in Greenhouse Gas Emissions

By offsetting imported water demands with locally produced RW, the proposed project would reduce emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[1], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[2] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[3] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

[1] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[2] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[3] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[4], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[5], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water.

Conservation of imported water offsets 100% of the energy required to import water.[6] By reducing demand for approximately 3,618 AF of imported water per year (40% SWP and 60% CRA), the proposed project will reduce annual CO_2 emissions by approximately 2,600 metric tons of CO_2. Over the 5-year life of the project, that equates to avoiding emissions of over 11,500 metric tons of CO_2.

Table 1.2: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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

No adverse effects are anticipated from implementation of the project.

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.

[4] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)
[5] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf
[6] Per the Pacific Institute "Energy Down the Drain" report (Gleick, 2004), producing 1 AF of RW is requires approximately 1830 kWh/AF. If 40% imported water is SWP water and 60% is CRA water, then the average AF of imported water requires 2494 kWh/AF for conveyance; this implies that recycling water requires 73% as much energy (1830/2494) as importing water.

Table 1.3: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Bay – Delta Habitat Protection	U	The amount of water conserved is variable. Higher amounts of conservation would lead to reduced pumping from the Bay-Delta and improve conditions.
Energy Cost Savings	U	The power costs of imported water per AFY have been estimated. The actual amount of conservation achieved by this project is variable. Energy savings benefits would increase or decrease in relation to the amount of water conservation actually achieved.

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

This program will promote water conservation through a customized commercial landscape and residential survey program accompanied with the giveaway of state-of-the-art efficient irrigation hardware (including \residential and commercial weather-based irrigation controllers) free-of-charge to City of San Diego Water Department (SDWD) customers. An approximately 50 sites will demonstrate the link between the use of landscape conservation hardware and observable levels of urban runoff reduction. Generally, this project would share many of the benefits similar to Work Item #1, but on a smaller scale. The project is estimated to save at least 91 AFY of water. It also provides a localized education component by providing a demonstration of the benefits of runoff reduction at local sites.

The project would offer a number of expected benefits that would be gained from reducing the demand for imported water as well as local reductions in runoff from increased landscape irrigation efficiency. The benefits of this project are summarized in the table below.

Table 2.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits (described in Attachment 8)		
Reduced imported water use	Monetized	Local and Regional
Water Quality (described in Attachment 8)		
Reduced irrigation runoff	Qualitative	Local and Regional
Reduced import of salt (TDS) into the region	Physical Quantification	Local and Regional
Other Benefits		
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 Carbon Emissions	Physical Quantification	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.

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

Expected Benefits of Project

The expected benefits of the project are similar to Work Item #1, but on a smaller scale and more localized. These are described below.

Local Habitat Protection
By addressing the impacts of excessive irrigation and runoff, the project will lead to a reduction of pollutants with adverse effects on local water bodies, including the San Diego Bay. The beneficiaries would be local habitat and species as well as communities that are in the vicinity and downstream of the City of San Diego and adjacent to San Diego Bay and Harbor.

Public Education and Awareness of Water Use Efficiency Practices
The project will provide an example of the link between irrigation efficiency and dry weather impacts to storm drains. By implementing this project in the local context, other residents and businesses in the City of San Diego may be more inclined to explore the use of surveys and efficient irrigation equipment. Beneficiaries will be the residential and commercial participants as well as the broader general public.

Recreation and Public Access
Reduction in runoff helps maintain the quality and appearance of local water bodies which encourages recreational use. This project will provide benefits in terms of increased opportunities for water body recreation. Passive recreational opportunities such as hiking, picnicking and sightseeing will also be enhanced. Both residents of the Region and visitors from other areas in the state will benefit.

Bay – Delta Habitat Protection
By reducing imported water, the project will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta Smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Reductions in Greenhouse Gas Emissions
By offsetting imported water demands with locally produced RW, the proposed project would reduce emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[7], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[8] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[9] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce

[7] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf
[8] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).
[9] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[10], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[11], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water.

Conservation of imported water offsets 100% of the energy required to import water.[12] By reducing demand for approximately 91 AF of imported water per year (40% SWP and 60% CRA), the proposed project will reduce annual CO_2 emissions by approximately 143,200 pounds (65 metric tons) of CO_2 per year. Over the 10-year life of the project, that equates to avoiding emissions of approximately 650 tons of CO_2.

Table 2.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
Project participants, City of San Diego residents, businesses City of San Diego, Local Streets Division, Storm Water Pollution Prevention Division	Communities downstream and along coastline adjacent to the City of San Diego and San Diego Harbor and Bay	Bay-Delta Ecosystem, Visitors to Region, California Citizens

Project Benefits Timeline Description

This project will generate benefits for the conservative 10-year lifespan of the project. This 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

There would be no adverse impacts from implementation.

Uncertainty of Benefits

The benefits of increasing public awareness are uncertain. This depends on public interest and acceptance of the results of the demonstration.

[10] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)
[11] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf
[12] Per the Pacific Institute "Energy Down the Drain" report (Gleick, 2004), producing 1 AF of RW is requires approximately 1830 kWh/AF. If 40% imported water is SWP water and 60% is CRA water, then the average AF of imported water requires 2494 kWh/AF for conveyance; this implies that recycling water requires 73% as much energy (1830/2494) as importing water.

Table 2.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Public Education and Awareness	U	The impact of the study will depend on how receptive and open other City of San Diego residents and businesses are to the water conservation and dry weather runoff reduction messages.

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 #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 number of sites is much smaller, so the scope of quantified benefits will be lower; however, 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 would offer a number of expected benefits that would be gained from reducing runoff through increased irrigation efficiency. The benefits would be concentrated in the Carlsbad watershed, especially in the vicinity of San Elijo Lagoon (Lagoon). The project would improve the water quality of the Lagoon and educate local residents through outreach and by providing an example of the link between over-irrigation of landscape and water quality impacts to local resources such as the Lagoon. The project involves eight sites for implementation of water conservation programs, so there will be conservation of water and corresponding imported water reductions on a smaller scale. The other expected benefits of the project are summarized in the table below.

Table 3.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits (described in Attachment 8)		
Reduced imported water use	Monetized	Local and Regional
Improved water supply reliability	Qualitative	Local and Regional
Water Quality Benefits (described in Attachment 8)		
Reduced irrigation runoff	Qualitative	Local and Regional
Reduced import of salt (TDS) into the region	Physical Quantification	Local and Regional
Other Benefits		
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

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.

Without-Project Baseline

If the project were not implemented, then the eight sites chosen for the project would continue to use inefficient water methods, consume relatively high quantities of water and generate noticeable amounts of urban runoff that could impact San Elijo Lagoon. San Elijo Lagoon would receive increasing amounts of urban runoff and would experience the magnified effects of pollutant loading. This could likely lead to increased algal bloom events and a reduction in the quality of the Lagoon as a natural and aesthetic resource for the community, Region and visitors.

Expected Benefits of Project

The expected benefits of the project are similar to the other Conservation programs, but focused on eight sites that would provide a much smaller relative quantitative impact.

Ecosystem Restoration
By addressing the impacts of excessive irrigation and runoff, the project will lead to a reduction of pollutants with adverse effects on local water bodies, mostly concentrated on San Elijo Lagoon and the adjacent beaches. The benefits would be to local species and habitat.

Public Education and Awareness

This project is focused on the Carlsbad Hydrologic Unit. By demonstrating a very specific example of the benefit of over-irrigation reduction to a high visibility impaired water body within this watershed, the project can provide compelling educational benefits to local residents of the Cities of Encinitas, Escondido and Solana Beach about their impacts to a local resource and provide them with solutions.

Recreation and Public Access

Reduction in runoff will maintain the aesthetics of San Elijo Lagoon which will provide increased passive recreation benefits. The beneficiaries will be local residents of the Cities of Encinitas, Escondido and Solana Beach and recreational users from inside and outside the Region who have opportunities to view the Lagoon and other water bodies in the Carlsbad HU.

Bay – Delta Habitat Protection

By reducing imported water, the project will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta Smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Reduction in Greenhouse Gas Emissions

By offsetting imported water demands with locally produced RW, the proposed project would reduce emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[13], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[14] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[15] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[16], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[17], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

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[13] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[14] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[15] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[16] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[17] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water.

Conservation of imported water offsets 100% of the energy required to import water.[18] By reducing demand for approximately 535 AF of imported water per year (40% SWP and 60% CRA), the proposed project will reduce annual CO_2 emissions by approximately 252 metric tons of CO_2. Over the 25-year life of the project, that equates to avoiding emissions of over 6,300 tons of CO_2.

Table 3.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
Local Species and Habitat; Residents of the Cities of Escondido, Encinitas and Solana Beach City of San Diego, Local Streets Division, Storm Water Pollution Prevention Division	Recreational Users of San Elijo Lagoon and Carlsbad HU, Commuters	Recreational Users of San Elijo Lagoon and Carlsbad HU , Bay-Delta Ecosystem, California Citizens

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

There would be no adverse impacts from implementation.

Uncertainty of Benefits

The project is very focused, so the benefits of improved irrigation efficiency on water quality will be established with a strong degree of certainty.

Table 3.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Recreation and Public Access: San Elijo Lagoon	U	The actual link between over-irrigation reductions at the sites chosen and water quality improvements in San Elijo Lagoon is not yet established.

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 -

[18] Per the Pacific Institute "Energy Down the Drain" report (Gleick, 2004), producing 1 AF of RW is requires approximately 1830 kWh/AF. If 40% imported water is SWP water and 60% is CRA water, then the average AF of imported water requires 2494 kWh/AF for conveyance; this implies that recycling water requires 73% as much energy (1830/2494) as importing water.

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 a WRF expansion from 2 million gallons per day (mgd) to 4 mgd, with an additional future expansion to 10 mgd. This project is one component of an integrated project developed by Padre Dam Municipal Water District and Helix Water District (Helix). The second project component is Helix's recharge of the El Monte Valley groundwater basin. Up to 2,240 AFY of recycled water will be sent to the El Monte Valley for indirect potable reuse via groundwater recharge. Recycled water from the expansion in this project will also be available for replenishing the nearby Santee Lakes Recreation Preserve (Preserve), which relies on recycled water for its supply.

The additional recycled water created by this project will ensure the long term sustainability of the Preserve and its recreational and habitat benefits, as well as replacing imported water demands with a local supply, which will avoid energy costs and negative impacts to the Bay-Delta ecosystem. Utilization of the recycled water will reduce the quantity of wastewater that needs to be transported to and discharged into San Diego Bay. The other expected benefits of this project are shown in the table below.

Table 4.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits (described in Attachment 8)		
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 (described in Attachment 8)		
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		
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.

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.[19] 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.

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 ($35.9 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.

Expected Benefits of Project

This project, in conjunction with the El Monte Groundwater Recharge and Restoration Project would provide several qualitative benefits. These benefits are described in detail below.

Improved Flood and Stormwater Runoff Control
The linked El Monte Valley Project will decrease the potential for flood-related damage to property or life by managing groundwater levels in the San Diego River floodplain. This project includes strategies for managing stormwater runoff from adjacent catchment basins to the El Monte Valley.

Restoration of Natural Habitat
The recycled water produced from the Santee WRF Expansion Project will enable HWD to create a legacy 500-acre river restoration project. This restoration project will restore approximately 135 acres of river bottom and riparian habitat in the San Diego River; restore approximately 169 acres of upland and woodland habitat along the San Diego River; have approximately 40 acres of restored lake features; have approximately 8 acres of protected archeological sites; and have approximately 15 acres of public access roads and trails. The river restoration project would lead to several benefits, including:

- Long-term sustainability of Santee Lakes habitat, which supports 175 bird species, five fish species, and other wildlife.
- Environmental restoration of the El Monte Valley and 500 acres of the San Diego River watershed
- Restoration and new development of wildlife habitat in the El Monte Valley
- Restoration of areas previously used for agriculture to provide wetlands, land preserves, erosion control, and riparian buffers
- Assurance of an adequate, long-term water supply for Santee Lakes Recreation Preserve (which the recycled water from the Santee WRF would provide)

The revegetation will help remove several invasive plant species in the area including: Giant Reed (Arundo donax), Slender Wild Oat (Avena barbata), Compact Chess (Bromus madritensis), Pampas

[19] 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.

Grass (Cortaderia selloana), Jimson Weed (Datura werghtii), Fennel (Foeniculum vulgare), Horehound (Marribium vulgare), Tree Tobacco (Nicotiana glauca), Castor Bean (Ricinus communis), Peruvian Pepper Tree (Schinus molle) Tamarisk (tamarix parviflora), and various eucalyptus (Eucalyptus sp.). Currently, there are not threatened or endangered (T&E) species found at Santee Lakes or at El Monte Valley. However, once the revegetation project is complete, the new habitat could attract locally-know, species status species, including the Least Bells Viero, the California Gnatcatcher, and the Coastal Cactus Wren.

There have been a number of studies that have estimated the public's WTP for general protection of habitat systems. For example, a 1987 study estimated that California households would be willing to pay $158-$386 per household annually to protect Mono Lake from excessive water supply extractions in California to provide water for fish, birds, and other parts of the Mono Lake ecosystem.
Benefits transfer of these values to monetize the benefits of habitat improvements at Santee Lakes and El Monte Valley would be difficult and would be subject to considerable uncertainty. Therefore, we only go as far as to say that habitat quality improvement benefits from this project would probably be significant.

Promotion of Regional Collaboration
Both of Santee WRF Expansion Project and the El Monte Groundwater Recharge and Restoration Project are needed to achieve the full range of benefits. The Padre Dam MWD and HWD realized this and coordinated the timing and design of these two projects. The Santee WRF Project will provide a 100% increase in the availability of economical recycled water to Padre Dam's commercial, Home Owner's Associations, and large landscape customers. It will also provide recycled water to recharge the El Monte Valley, which will promote the El Monte Groundwater Recharge Project to encourage public interest in greater use of recycled water throughout San Diego County.

Enhanced Recreation and Public Access
The habitat restoration project will provide recreational opportunities for visitors to the area. The restoration area will include trails, interpretive signage, and walking tours at the Santee Lakes and El Monte Valley. Currently, the El Monte Property is owned by Helix Water District and is private property (with no trespassing signs posted); however, the river restoration component of the proposed project envisions hiking and horse riding trails with information kiosks and wildlife observation areas.

Bay – Delta Habitat Protection
By reducing imported water through creation of 2,240 AFY of local recycled water, the project will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta Smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Reduction in Greenhouse Gas Emissions
By offsetting imported water demands with locally produced RW, the proposed projects (Santee WRF Expansion Project and the El Monte Groundwater Recharge and Restoration Project) would reduce emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[20], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[21] is provided by DWR's hydroelectric plants; 16% is provided by

[20] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf
[21] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation."

DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[22] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[23], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[24], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water.

Producing recycled water in San Diego requires, approximately 27% less energy than importing water[25] By offsetting demand for approximately 2,240 AF of imported water per year (40% SWP and 60% CRA) with recycled water, the two proposed projects will reduce annual CO_2 emissions of approximately by 1,600 metric tons of CO_2. Over the 50-year life of the project, that equates to avoiding emissions of over 84,800 tons of CO_2.

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 PV costs of the combined projects attributed to the Santee WRF expansion (42.8%), then the Santee WRF expansion project will reduce CO2 emissions by more than 36,200 metric tons (89,300 tons * 42.87%).

<u>High Quality Sand Resources</u>
Much of the El Monte basin geology overlaying the rock boundaries is made up of good quality, well draining sand. According to the Final Feasibility Study for the El Monte Valley Recharge Project (Appendix 6), existing riverbed elevations range from about 410 feet on the west end to 470 feet on the east end. It is anticipated that portions of the basin will be graded to get ground surface elevations closer to the groundwater table. Grading the basin will generate high quality sand resources that will be sold to offset the cost of the project. The high quality sand resources would likely be used in San Diego County to provide sand for concrete and aggregate companies for use in building materials. Much of the sand is currently imported into the San Diego County to meet the demand for production of concrete. This is a critical benefit for the project because the current land use designation for the El Monte property is "extractive" and is indicated as a natural resource. With the project as a golf course, this valuable sand resource would not be utilized. With the Groundwater Recharge and River Restoration project, this sand

(http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[22] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[23] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[24] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

[25] Per the Pacific Institute "Energy Down the Drain" report (Gleick, 2004), producing 1 AF of RW is requires approximately 1830 kWh/AF. If 40% imported water is SWP water and 60% is CRA water, then the average AF of imported water requires 2494 kWh/AF for conveyance; this implies that recycling water requires 73% as much energy (1830/2494) as importing water.

resource could be used for the region and offset requirements for sand to be imported (and associated trucking impacts) to meet production demands.

The project developer estimates that approximately 10 million tons of sand will be removed, and can be sold for approximately $15 to $20 per ton. Extraction is expected to cost approximately $11 to $16 per ton, for a net profit of approximately $4 to $9 per ton. Assuming that 10 million tons of sand are removed for the conservative profit of $4 per ton, this will generate $4.4 million per year from 2008 through 2016 (the period of construction). The present value of this benefit is approximately $28.5 million, with $12.2 million ($28.5 million * 42.8%) attributed to the Santee WRF Expansion Project.

Disadvantaged Community Benefits
A disadvantaged community is one that has an annual median household income that is less than $43,206 (in 2006 U.S.$). Fishing, boating, hiking, tent camping, and other day-use recreation at Santee Lakes Recreation Preserve is accessible to the disadvantaged residents of these communities by public transportation. It is also accessible to minority residents, residents living below the poverty line, and disabled residents in San Diego County. For the 108,000 severely disabled residents of San Diego County, Santee Lakes offers a fishing pier, playground, and scenic wildlife observation trails specifically designed for wheelchair access and guests with limited mobility.

Of the 600,000 visitors to the Recreation Preserve in 2006, 40% live in Padre Dam's service area, which includes several disadvantaged communities: Santee, El Cajon, Alpine, Crest, and Harbison Canyon. The other 60% live in other San Diego communities.

Currently 1 mgd of recycled water from the Santee WRF sustains seven lakes within the Preserve and Padre Dam's regional park and campground, which serves multiple communities within San Diego. With the Santee WRF Expansion Project, the Santee Lakes Recreation Preserve would receive a more reliable source of water to sustain outdoor recreational opportunities for disadvantaged communities.

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 benefiting from increased flood protection, local well owners benefiting from high quality drinking water, the surrounding habitat benefiting from restoration (including species), and SDCWA benefiting by achieving over 80% of its 2020 goals for local groundwater production.

Table 4.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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)	Bay-Delta Ecosystem, Recreational Users of the Preserve, Visitors to Region, California Citizens

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

There will be short-term impacts such as noise, traffic, etc. from construction of the facilities.

Uncertainty of Benefits

The benefit of maintaining recreational opportunities at the Preserve is unknown, as the frequency and probability of water shortages are unknown. In addition, the probability of regulatory induced water shortages (e.g. for Delta smelt protection) is also unknown.

Table 4.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Recreation and Public Access	+	For recreation and public access benefits, the likelihood of actual future water shortages is unknown.

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 #5: Recycled Water Retrofit Assistance Program

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 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 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 presented by retrofitting a site 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 hook-up 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 (citation: "answers to Stratus' questions").

Grant amounts will be determined as $2,500 per irrigated acre, not to exceed $50,000 per retrofit site (i.e. 20 irrigated acres maximum 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 Table 5.1, which identifies the assessment level of each benefit (e.g., whether the benefit can be monetized or is described quantitatively or qualitatively). Those benefits best described qualitatively are summarized in Table 5.2, along with an overview of the monetized benefits and costs of the program.

This project will increase the number of customers that can use recycled water for landscape irrigation use. It will provide benefits of a local, reliable supply that will allow the maintenance of green areas during years when imported water availability is decreased. This will ensure that recreational benefits, both passive and active can be maintained. By replacing imported water supply with recycled water, the energy costs of imported water are avoided. Reusing water locally will help to delay costs for obtaining additional discharge capacity. The expected benefits of the project are shown in the table below.

Table 5.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 8)		
Avoided imported water costs	Monetized	Local, Regional
Improved water supply reliability	Qualitative	Local, Regional
Water Quality (described in Attachment 8)		
Avoided introduction of salts to the basin	Quantitative	Local, Regional
Other Benefits		
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
Other Benefits	Not monetized
Total Monetized Benefits	$16.1 M
Qualitative Benefits	**Qualitative indicator***
Improved water supply reliability	++
Avoided introduction of salts to the basin	++
Improved Dry Year Landscape Appearance	+
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.

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 recycled water 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 recycled water (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 State Water Project (SWP) and the Colorado River Aqueduct (CRA). Approximately 1,000 AFY of recycled water will be discharged to the ocean that would have been beneficially reused if the program were implemented.

Expected Benefits of Project

Improved Dry Year Landscape Appearance
The parks, schools, golf courses and large open spaces retrofitted will have access to a local, reliable recycled water supply that will ensure that the green space and recreational benefits of these areas are maintained even during drought conditions and/or mandatory cutbacks on imported water. This will benefit park users (both passive and active), schoolchildren, golf players and other recreational users.

Avoided Fertilizer Costs
By enabling customers to install the necessary retrofits, this program will allow customers to replace potable water with recycled water for landscape irrigation. Recycled water contains substantial amounts of nitrogen, phosphorus, and potassium (Kopec et al., 1993), and therefore offsets some of the fertilizer needs of recycled water users. Although the exact offset of fertilizer use from use of recycled water is difficult to predict due to daily and seasonal nutrient variations in recycled water, it is possible to estimate the potential fertilizer value of recycled water. This value could be used to calculate the potential benefit from offset of fertilizer use from the proposed project.

Calculating the value of offset fertilizer use requires utilizing a fertilizer price index for the United States from the Food and Agriculture Organization of the United Nations, and adjusting for the nutrient (nitrogen, potassium, and phosphorus) concentrations of the recycled water. Nitrogen and potassium concentrations in recycled water produced by the North City Water Reclamation Facility over the 2006 - 2007 time period averaged 34.7 mg/l and 15.2 mg/l, respectively. Phosphate data was unavailable at the time of this analysis; for the purposes of this analysis, phosphate concentrations were assumed to be negligible.

Literature estimates of the value of nitrogen, phosphorous and potassium in $/lb of nutrient in fertilizer were used as a basis for estimating the value of avoided fertilizer costs. The value of offset fertilizer use per acre foot of water applied is approximately $33.37 when updated to $2006 (updated from Asano, 1981). When multiplied by the amount of recycled water that is expected to be utilized by customers specifically as a result of the retrofit assistance program (1,000 AFY), the total avoided fertilizer cost is approximately $33,370 per year. Assuming a 6% real discount rate, the present value of this benefit over the 50-year life of the retrofits is $471,000.

Due to uncertainties associated with this estimate of the value of avoided fertilizer use, 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.

Reduced Stress on Bay – Delta
By providing recycled water for landscape irrigation, the proposed project offsets imported by approximately 2,000 AFY, much of which can be left as instream flows in the Bay-Delta. Maintaining the

Delta's environmental condition is vital to maintaining and improving the viability of the Delta region. The Delta provides drinking water to 23 million people, supports a $31 billion agricultural industry, and serves as a home to 750 plant and animal species. While salmon runs and wildlife habitat have been improved in recent years, significant problems still exist. The population of certain species of open-water fish, including the delta smelt, has declined dramatically over the past few years. The levee system is aging and concerns about its strength and reliability have escalated since Hurricane Katrina. In addition, water quality problems still exist, and there is little consensus on how to manage water resources through storage.

Reductions in Greenhouse Gas Emissions

By offsetting imported water demands with locally produced RW, the proposed project would avoid emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[26], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[27] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[28] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[29], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[30], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water. By offsetting demand for approximately 1,000 AF of imported water per year (40% SWP and 60% CRA), this program will avoid annual CO_2 emissions of nearly 1.6 million pounds (approximately 714 metric tons) of CO_2. Over the 50-year life of the project, that equates to avoiding emissions of 35,700 metric tons of CO_2.

[26] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[27] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[28] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[29] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[30] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

Since the recycled water involved in this supply offset is already produced (but currently unused), there are no additional CO_2 emissions associated with the expanded use of reclaimed water.

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. Table 5.3 presents a summary of project beneficiaries.

Table 5.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
Proposed RW customers, including: cities, school districts, homeowner's associations, a power plant, Caltrans, botanical gardens, University of San Diego and golf courses.	Water users region-wide SDCWA, MWD	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 2009, 70% in 2010 and the remaining 10% in 2011. 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.

Uncertainty of Benefits

The benefit of maintaining landscape during dry year conditions is not certain as weather patterns are very unpredictable. Also, the frequency and probability of regulatory induced water shortages are also unknown.

Table 5.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Avoided fertilizer costs	+	Avoided fertilizer cost estimates depend on nutrient (nitrogen, phosphorous and potassium) concentrations in the RW. Without data on the phosphorous concentrations of the RW that will be utilized in this project, the value of avoided fertilizer costs was estimated assuming phosphorous concentrations would be zero. If there is phosphorous in the RW, the value of this benefit could be higher.
Avoided carbon dioxide emissions	U	Avoided carbon dioxide emission estimates depend on:

Benefit or cost category	Likely impact on net benefits[1]	Comment
		▪ the total energy required to convey imported water (which is offset by the proposed project) to the San Diego region ▪ the portion of offset water that would have been imported from SWP and the portion that would have been imported from CRA (delivery of SWP water results in more carbon dioxide emissions than CRA water) ▪ the energy sources (coal-fired plant, hydroelectric plant, etc) that are utilized for the energy required to deliver that water. Estimates included in this analysis were based on the best available information from energy experts in California (e.g., Dr. Robert Wilkinson), the DWR, and the Department of Energy. Estimates from Poseidon (from the 2007 Climate Action Plan) suggest a higher carbon dioxide emission offset per AF of avoided imported water than those estimated using information from Wilkinson and DWR.
Recreation and Public Access	+	For recreation and public access benefits from improved dry weather appearance, the likelihood of actual future water shortages is unknown.

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 #6: City of San Diego Recycled Water Distribution System Expansion and Parklands Retrofit

The City of San Diego Recycled Water Distribution System Expansion and Parklands Retrofit has two 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.

The City of San Diego (City) treats its wastewater at the Point Loma Wastewater Treatment Plant (PLWWTP), 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 gallon per day (MGD) by 2010. With assistance of a

grant from the Environmental Protection Agency (EPA), the City constructed the 30 MGD[31] 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 recycled water, 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 two-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 Recycled Water 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 retrofit assistance program are presented in Table 6.1, which identifies the assessment level of each benefit (e.g., whether the benefit can be monetized or is described quantitatively or qualitatively). Those benefits best described qualitatively are summarized in Table 6.2, along with an overview of the monetized benefits and costs of the program.

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	Quantitative	Local, Regional
Other Benefits (described in Attachment 9)		
Avoided fertilizer costs	Qualitative	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	Physical Quantification	Statewide
Improved Dry Year Landscape Appearance	Monetized	Local, Regional

[31] 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
Other 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.

Without-Project Baseline

Without the proposed project, potable water supplied by the San Diego County Water Authority (SDCWA) would be used to irrigate the community open spaces, medians, slopes, 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%[32] 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.

Expected Benefits of Project

The proposed project would generate a few "non-water supply or water quality" benefits, including: increased likelihood of meeting EPA requirement to beneficially reuse 50% of flows from NCWRP by 2010, avoided fertilizer costs, reduced greenhouse gas emissions, and reduced stress on the Bay-Delta system. Each of these benefits is described in more detail below.

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.

Avoided Fertilizer Costs

By enabling customers to install the necessary retrofits, this program will allow customers to replace potable water with recycled water for landscape irrigation. Recycled water contains substantial amounts of nitrogen, phosphorus, and potassium (Kopec et al., 1993), and therefore offsets some of the fertilizer needs of recycled water users. Although the exact offset of fertilizer use from use of recycled water is difficult to predict due to daily and seasonal nutrient variations in recycled water, it is possible to estimate the potential fertilizer value of recycled water. This value could be used to calculate the potential benefit from offset of fertilizer use from the proposed project.

Calculating the value of offset fertilizer use requires utilizing a fertilizer price index for the United States from the Food and Agriculture Organization of the United Nations, and adjusting for the nutrient (nitrogen, potassium, and phosphorus) concentrations of the recycled water. Nitrogen and potassium concentrations in recycled water produced by the North City Water Reclamation Facility over the 2006 - 2007 time period averaged 34.7 mg/l and 15.2 mg/l, respectively. Phosphate data was unavailable at the time of this analysis; for the purposes of this analysis, phosphate concentrations were assumed to be negligible.

Literature estimates of the value of nitrogen, phosphorous and potassium in $/lb of nutrient in fertilizer were used as a basis for estimating the value of avoided fertilizer costs. The value of offset fertilizer use per acre foot of water applied is approximately $33.37 when updated to $2006 (updated from Asano, 1981). When multiplied by the amount of recycled water that is expected to be utilized by customers specifically as a result of the Recycled Water Distribution System Expansion and Parklands Retrofit Project (1,904 AFY), the total avoided fertilizer cost is approximately $63,540 per year. Assuming a 6% real discount rate, the present value of this benefit over the 50-year life of the retrofits is $793,000.

Due to uncertainties associated with this estimate of the value of avoided fertilizer use, 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.

Increased likelihood of meeting EPA requirement to beneficially reuse 50% of flows from NCWRP by 2010

The City's 30 MGD[33] NCWRP was constructed, with assistance of a grant from the EPA. 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. Currently, approximately 6 MGD of recycled water is beneficially reused and the existing "shortfall" of the 12 MGD goal is 6 MGD. The retrofits and expanded distribution system would enable the beneficial use of 1.7 MGD, which accounts for 28% of the existing "shortfall" (1.7 mgd out of 6 mgd).

Reduced stress on Bay-Delta

By providing RW for landscape irrigation, the proposed project offsets imports of State Water Project water by approximately 1,900 AFY which can be left as instream flows in the Bay-Delta. Maintaining the Delta's environmental condition is vital to maintaining and improving the viability of the Delta region. The Delta provides drinking water to 23 million people, supports a $31 billion agricultural industry, and serves as a home to 750 plant and animal species. While salmon runs and wildlife habitat have been improved in recent years, significant problems still exist. The population of ce rtain species of open-water fish, including the delta smelt, has declined dramatically over the past few years. The levee system is aging and concerns about its strength and reliability have escalated since Hurricane Katrina. In addition, water quality problems still exist, and there is little consensus on how to manage water resources through storage.

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

Avoided greenhouse gas emissions

By offsetting imported water demands with locally produced RW, the proposed project would avoid emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[34], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[35] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[36] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[37], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[38], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water. By offsetting demand for approximately 1,900 AF of imported water per year (40% SWP and 60% CRA), the proposed project will avoid annual CO_2 emissions of approximately 2.3 million pounds (1360 metric tons) of CO_2. Over the 50-year life of the project, that equates to avoiding emissions of approximately 68,900 tons of CO_2.

Improved Dry Year Landscape Appearance

The parks and large open spaces retrofitted will have access to a local, reliable recycled water supply that will ensure that the green space and recreational benefits of these areas are maintained even during drought conditions and/or mandatory cutbacks on imported water. Part of the project also provides recycled water to maintain landscape on freeway medians. Beneficiaries will be the recreational users of the parks (passive and active), homeowners, and commuters.

[34] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[35] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%)

[36] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[37] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[38] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

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 6.3 presents a summary of project beneficiaries.

Table 6.3: 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.

Uncertainty of Benefits

The "non water supply or water quality" benefits add value to the project, the cost of which is at least $5 million less than total monetized benefits (which include water supply benefits).

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 avoided costs. 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[1]	Comment
Recreation and Public Access	+	For recreation and public access benefits, actual potential future water shortages are unknown
Avoided fertilizer costs	+	Avoided fertilizer cost estimates depend on nutrient (nitrogen, phosphorous and

Benefit or cost category	Likely impact on net benefits[1]	Comment
		potassium) concentrations in the RW. Without data on the phosphorous concentrations of the RW that will be utilized in this project, the value of avoided fertilizer costs was estimated assuming phosphorous concentrations would be zero. If there is phosphorous in the RW, the value of this benefit could be higher.
Avoided carbon dioxide emissions	U	Avoided carbon dioxide emission estimates depend on: ▪ the total energy required to convey imported water (which is offset by the proposed project) to the San Diego region ▪ the portion of offset water that would have been imported from SWP and the portion that would have been imported from CRA (delivery of SWP water results in more carbon dioxide emissions than CRA water) ▪ the energy sources (coal-fired plant, hydroelectric plant, etc) that are utilized for the energy required to deliver that water. Estimates included in this analysis were based on the best available information from energy experts in California (e.g., Dr. Robert Wilkinson), the DWR, and the Department of Energy. Estimates from Poseidon (from the 2007 Climate Action Plan) suggest a higher carbon dioxide emission offset per AF of avoided imported water than those estimated using information from Wilkinson and DWR.

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 -

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.

Table 7.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 8)		
Supports San Diego Emergency Storage Project	Qualitative	Local, Regional
Water Quality (described in Attachment 8)		
Prevent NPS pollution	Qualitative	Local, Regional
Prevent impervious surfaces	Qualitative	Local, Regional
Other Benefits		
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 increase in 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.

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.

Expected Benefits of Project

Prevents Increase in Impervious Surfaces
Acquisition and restoration of these watershed lands will prevent their development, keeping them in their natural state and reducing the increase in impervious surfaces on these lands that would otherwise occur. Development typically includes the construction of streets, driveways, sidewalks and other structures comprised from impervious materials. When naturally vegetated pervious ground cover is converted to impervious surfaces through development, the water quality benefits associated with natural infiltration are lost, resulting in greater volume, velocity, and peak flow rate of runoff from these areas. The result is often a decline in the biological integrity and physical habitat of streams. Such impacts have been shown to occur with only a 10% conversion from natural to impervious surfaces. Reduction in impervious surfaces is an important element of the Region's joint stormwater permit.[39]

Preserves land for habitat
It should be noted that the existing holdings of the Water Department in the watershed are designated as Cornerstone Lands in accordance with the City of San Diego Multiple Species Conservation Plan (MSCP). Cornerstone Lands are areas of recognized high biological value from a regional perspective and constituted the building blocks upon which the City of San Diego preserve was assembled. There are six sensitive habitat types within the areas targeted for acquisition: Diegan Coastal Sage Scrub (a resource that has largely been lost to development along the coast), Chaparral, Coast Live Oak Woodland, Southern Coast Live Oak Riparian Forest, Southern Cottonwood-Willow Riparian Forest, and Non-Native Grassland.

Ecosystem restoration enabled
While removal of invasive species is not an explicit component of this project, the Water Department partners with non-governmental organizations to remove species such as *arundo donax* and tamarisk. The areas targeted for acquisition that currently harbor exotic species would be included in potential future invasive species removal projects.

Provides passive recreation opportunity
The improvement in the quality of runoff reaching the reservoir would lead to the protection and enhancement of water-dependent recreational activities. The project would also incorporate appropriate opportunities for linkages with other recreational opportunities in the area that are consistent with the water quality and habitat protection goal of the project as proposed.

There are no added recreational amenities specifically part of this project (no additional shoreline access). However, a portion of the County of San Diego's Trans County Trail, currently in planning stages, will be aligned across Water Department property at San Vicente Reservoir. The enlargement of the reservoir compressed the available corridor for the trail. Expanding the protective buffer around the

[39] California Regional Water Quality Control Board San Diego Region. (2007) Order No. R9-2007-0001. NPDES No. CAS0108758. Waste Discharge Requirements for Discharges of Urban Runoff from The Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of The County of San Diego, The Incorporated Cites of San Diego County, The San Diego Unified Port District, and the San Diego County Regional Airport Authority.
http://www.waterboards.ca.gov/sandiego/programs/stormwater/sd%20permit/r9-2007- 0001/Final%20Order%20R9-2007-0001.pdf

reservoir through acquisitions of this project expands the corridor back open allowing the Trans County Trail to located a safe distance from the reservoir [for source protection] while still entirely on public land.

Protection of special status species
It should be noted that the existing holdings of the Water Department in the watershed are designated as Cornerstone Lands in accordance with the City of San Diego Multiple Species Conservation Plan (Cornerstone Lands are areas of recognized high biological value from a regional perspective). Endangered and species of special concern in the project area include: California Adolphia, Delicate Clarkia, Engelmann Oak, Lakeside Ceanothus, Ocellated Humbolt Lily, San Diego Goldenstar, San Diego Sagewort, San Diego Sunflower, Hermes Copper Butterfly, Arroyo toad, Western Spacefoot, Orange-throated Whiptail, Red Diamond Rattlesnake, Coast Horned Lizard, Sothwestern Pnd Turtle, Two-striped Garter Snake, Bald Eagle, Bell's Sage Sparrow, Coastal California Gnatcatcher, Cooper's Hawk, Horned Lark, Least Bell's vireo, Loggerhead Shrike, Osprey, Northern Harrier, Rufous-crowned Sparrow, Sharp-shinned Hawk, White-tailed Kite, Yellow-breated Chat, Dulzura Pocket Mouse, San Diego Desert Woodrat, Southern Mule Deer, Western Mastiff Bat.

Distribution of Project Benefits and Identification of Beneficiaries

Water from San Vicente reservoir is treated at the Alvarado Water Treatment Plan 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. 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.

Table 7.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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 envisions an acquisition plan completed by 2008, appraisal of the properties and negotiations with the landowners throughout 2009, and acquisition 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 these parcels of land.

Uncertainty of Benefits

The uncertainty of ecosystem preservation benefits stems from the willingness of landowners to sell their property.

Table 7.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits*	Comment
Ecosystem Preservation	-	The success of ecosystem preservation will depend on the ability to make other acquisitions to form continuous buffer zones.

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 #8: El Capitan Reservoir Watershed Acquisition 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 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.

This project is will offer similar benefits as Work Item # 7. Through land acquisition, it will preserve land with habitat that is critical for a number of endangered species. By securing the land from development, benefits of maintaining open space, recreation and public access to the lands surrounding the El Capitan Reservoir can be gained. Protecting the source water quality of El Capitan reservoir will help avoid more expensive treatment. Preserving the pervious characteristics of the acquired land will contribute to decreased likelihood of hydromodification and flooding. The expected benefits are shown in the table below.

Table 8.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 8)		
Enable future increase in storage capacity	Qualitative	Local, Regional
Other Benefits		
Prevent 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	+
Prevent 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.

Without-Project Baseline

The parcels targeted for acquisition 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 on this water body.

Expected Benefits of Project

Prevents Increase in Impervious Surfaces
Acquisition and restoration of these watershed lands will prevent their development, keeping them in their natural state and reducing the increase in impervious surfaces on these lands that would otherwise occur. Development typically includes the construction of streets, driveways, sidewalks and other structures comprised from impervious materials. When naturally vegetated pervious ground cover is converted to impervious surfaces through development, the water quality benefits associated with natural infiltration are lost, resulting in greater volume, velocity, and peak flow rate of runoff from these areas. The result is often a decline in the biological integrity and physical habitat of streams. Such impacts have been shown to occur with only a 10% conversion from natural to impervious surfaces. Reduction in impervious surfaces is an important element of the Region's joint stormwater permit.[40]

Preserves Land for Habitat
The properties slated for acquisition contain several habitat types, including: chaparral, oak woodland, Diegan coastal sage scrub (a resource that has largely been lost to development along the coast), cottonwood-willow riparian, and native grassland habitats. Additionally, the El Capitan Management Area and the Upper San Diego River specifically is identified as a critical wildlife corridor and an area of unique biological value.

Ecosystem Restoration Enabled
Acquisition of this parcel enables future removal of invasive species such as tamarisk and arrundo donax. This will not be accomplished directly as part of this land acquisition project, but future efforts cannot be commenced until after the land is acquired.

Provides Passive Recreation Opportunity
All three parcels are adjacent to public lands under consideration for recreational trails. If these lands are not acquired, then potential alignments for trails across these properties would be eliminated. It is estimated that these lands would support 1.4 miles of trails. The reservoir is a popular boat and shore fishing destination, as well as supporting boating, water skiing, kayaking, and visiting the reservoir for birding and other activities. Tens of thousands of people enjoy the Cleveland National Forest and State Parks within the watershed.

Protection of Special-Status Species
Several species of concern are anticipated to use the properties slated for acquisition, including: arroyo toad (federally listed as an endangered species and a California species of concern), California gnatcatcher (federally listed as threatened and a California species of concern), golden eagle (a California species of concern), bald eagle (federally listed as threatened and by California as endangered), Bell's sage sparrow (a California species of concern), Cooper's hawk (a California species of concern), least Bell's vireo (listed federally and by California as an endangered species), osprey, rufous-crowned sparrow (a California species of concern), white-tailed kite, red diamond rattlesnake, orange-throated whiptail, coast horned lizard, two-striped garter snake (a California species of concern), Lakeside ceanothus, Englemann oak, San Diego sagewort, and San Diego goldenstar. Additionally, the El Capitan Management Area and the Upper San Diego River specifically is identified as a critical wildlife corridor and an area of unique biological value.

[40] California Regional Water Quality Control Board San Diego Region. (2007) Order No. R9-2007-0001. NPDES No. CAS0108758. Waste Discharge Requirements for Discharges of Urban Runoff from The Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of The County of San Diego, The Incorporated Cites of San Diego County, The San Diego Unified Port District, and the San Diego County Regional Airport Authority.
http://www.waterboards.ca.gov/sandiego/programs/stormwater/sd%20permit/r9-2007- 0001/Final%20Order%20R9-2007-0001.pdf

Provides Connectivity with Protected Lands
One 58 acre parcels under consideration for acquisition is the fourth and final planned phase of the San Diego River Park Foundation's Eagle Peak Preserve project. All three projects are adjacent to public lands.

Distribution of Project Benefits and Identification of Beneficiaries

These acquisitions 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, it serves customers throughout the Region.

Table 8.3: Beneficiaries Summary

Local	Regional	State
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	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 these parcels of land.

Uncertainty of Benefits

The uncertainty of benefits stem from the willingness of the landowners to sell their property.

Table 8.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits*	Comment
Ecosystem Preservation	-	The success of ecosystem preservation will depend on the ability to make other acquisitions to form continuous buffer zones.

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 #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.

Table 9.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits (described in Attachment 8)		
Increased water supply availability	Physical quantification	Local, Regional
Water Quality Benefits (described in Attachment 8)		
Decreased Salinity		
Other Benefits		
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 Benefits	**Qualitative indicator***
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.

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.

Expected Benefits of Project

Improved Habitat Benefit for Threatened and Endangered Species

Controlling the invasion of native plant species and restoring native habitats is a top priority for watershed restoration plans developed for the Region. This project will restore 373 acres of critical riparian habitat in the Santa Margarita, San Luis Rey, Carlsbad and San Dieguito HUs. Restoration of riparian habitat would

benefit endangered, threatened and sensitive species present in the removal areas. The main species of concern for this project include the federally endangered least Bell's vireo (Vireo bellii pusillus), California least tern (Sterna antillarum browni), light-footed clapper rail (Rallus longirostris levipes), and arroyo toad (Bufo californicus), and southwestern willow flycatcher (Empidonax traillii eximus) and the threatened coastal California gnatcatcher (Polioptila californica californica). Invasive plant species disrupt native riparian, coastal scrub and wetland communities critical to the survival of these species. Beneficiaries will be the local species and habitat.

In May 2007, a steelhead trout was found in lower San Luis Rey River. This is the furthest south this species has been found and removing invasive species will be essential to any recovery program for this species. This project will help enhance the prospects for steelhead recovery by assuring that flow regimes and habitat that are critical for steelhead are attained.

Improved Flood Protection and Erosion Mitigation

Removal of Arundo will provide enhanced benefits for flood protection. It is well documented that when Arundo is present, flooding is more severe and dynamic changing flows, sedimentation, and the entire hydrological and geomorphologic functioning of the system. Arundo biomass has caused numerous bridge failures resulting from biomass accumulating on pylons, which blocks and diverts flows. Overbank flows also occur as the flow capacity of the channel is reduced due to excessive biomass. Additionally, sedimentation caused by Arundo stands (which drop peak flow rates) further reduces flow capacity. All of these processes cause extensive damage to infrastructure, private property, and water delivery, storage, and treatment facilities. Emergency actions to 'repair' damage also results in additional impacts to water quality and habitat. This project will eliminate these potential occurrences. Beneficiaries will be downstream communities of the areas targeted for removal.

This project will help ensure the flow of sediment to coastal watersheds by removing stands of Arundo which can trap sediment on large rivers such as the San Luis Rey and Santa Margarita Rivers, preventing normal sediment flows. Coastal areas of the Region rely on sediment discharges from the rivers to replenish beaches and coastline areas. The San Luis Rey River generates over 90% of the sediment discharge for the entire County. Due to the prevention of normal sediment flow, coastal areas have become sediment starved and sand replenishment programs have been developed to remediate the decreased discharge of the region. Increasing sediment discharge, by restoring more natural flow patterns through invasives removal both on large and small water bodies will aid in flushing sediment out of coastal watersheds by increasing peak flow rates. This will help avoid the need for manual sand replenishment and sediment removal to restore flow capacity (as planned by the United States Army Corps of Engineers on the San Luis Rey River) which is extremely expensive and will continue indefinitely until the cause of the sedimentation is addressed. Beneficiaries will be agencies responsible for sediment removal, beachgoers and communities along the coast.

Increased Fire Hazard Mitigation

This project will help reduce the inherent high fire risk in the Region. The establishment of non-native invasive plant species such as Arundo and pampas grass, which are extremely flammable, increase both the probability and intensity of wildfires. Arundo recovers quickly from fires and the consequence of fire is to destroy slower recovering native habitat and convert the subsequent habitat composition into increasingly higher density stands of Arundo. The San Luis Rey River experiences frequent Arundo fires - over 30 acres burned in 2006-07. The San Dieguito River also has had large Arundo fires, such as occurred in 2001 which burned over 60 acres. This project will significantly decrease the likelihood of such fires occurring and spreading. The direct beneficiaries of this project will be residents and businesses within the HUs targeted for removal, however, since fire can quickly spread and have widespread effects, all residents of the Region will benefit. In addition, any reduction of fire risk will benefit all citizens of the state by avoiding the costs for emergency assistance and recovery.

Recreation and Public Access

This project will improve access to the rivers located in the targeted HUs by removing Arundo stands that can interfere with access and free movement along the river. Currently, there are extensive bike, hiking and horseback trail systems that exist and are being expanded in the vicinity of the rivers. The presence

of Arundo threatens and limits the use and maintenance of these recreational resources. In addition, Arundo is known to provide shelter for illegal encampments that can impact water quality stemming from E. coli contamination from human waste, which negatively impacts recreation use in riparian zones and beaches (swimming, fishing). Removal of Arundo will eliminate the presence of these encampments. The beneficiaries will be recreational users of the Santa Margarita, San Luis Rey, San Dieguito Rivers and other water bodies throughout the four HUs targeted by the project.

Table 9.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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.

Uncertainty of Benefits

The benefit associated with the return of steelhead migration is somewhat uncertain as it depends on many factors besides the improved riparian habitat provided by this project.

Table 9.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits[1]	Comment
Steelhead Recovery	-	The recovery of steelhead is dependent on a number of external factors that are not related to the removal of invasive non-native plant species. The project can increase the availability of suitable habitat, however, ultimate recovery is not certain

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 #10: Santa Margarita Conjunctive Use Project

The project will construct facilities to implement a conjunctive use project along the Santa Margarita River that will maximize the amount of new local water supply created by maximizing diversions from the river during high flow events. The project would create 6,800 AFY of local supply and will resolve a long-standing water rights dispute between Fallbrook Public Utilities District (FPUD) and Camp Pendleton. This project will also conserve as habitat approximately 1,383 acres as an open space management zone, including 264 riparian acres, currently owned by the FPUD for water supply purposes. Direct water

supply and water quality benefits include the diversification of water supply sources, construction of supply infrastructure, attainment of beneficial uses, and management of pollutant sources and stressors. Other expected benefits of the project are to protect, restore and maintain habitat and open space.

The project will provide other expected benefits in the form of preservation of 1,383 acres of riparian habitat that includes habitat that is critical for endangered species. This will also protect open space near the Santa Margarita River and allow for recreation and public access. Through conjunctive use, the project create 6,800 AFY of new local supply which will reduce imported water demand and the energy costs for transportation of that water, as well as potential carbon emission reductions. The expected benefits are shown in the table below.

Table 10.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (addressed in Attachment 8)		
Avoided Use of Imported Water	Monetized	Local, Regional and State
Improved Water Supply Reliability	Qualitative	Local and Regional
Water Quality (addressed in Attachment 8)		
Reduced import of salts (TDS) into the region	Physical Quantification	Local and Regional
Other Benefits		
Avoided carbon dioxide 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
Other Benefits	$113.2 M
Total Benefits	$182.0 M
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.

Without-Project Baseline

Without this project, the use of the groundwater basin would not be optimized. FPUD and Camp Pendleton would not perfect their water rights from the Santa Margarita River, which would lead to an increased demand for imported water. A surface water reservoir would need to be constructed instead of utilizing the storage capacity of the aquifer. Critical habitat dependent on adequate groundwater levels would be placed in jeopardy. Riparian habitat that would be encompassed by the project would not be preserved from future development.

Expected Benefits of Project

Reduction in Greenhouse Gas Emissions

By offsetting imported water demands with locally produced RW, the proposed project would avoid emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[41], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[42] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[43] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[44], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[45], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water. By offsetting demand for approximately 6,800 AF of imported water per year (assuming an average mix of 40% SWP

[41] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[42] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[43] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[44] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[45] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

and 60% CRA), this program will avoid annual emissions of approximately 4,600 metric tons of CO2 per year. Over the 50-year life of the project, that equates to avoiding emissions of over 232,000 metric tons of CO2. Since minimal pumping is involved with delivery of Santa Margarita River water, new CO2 emissions are assumed to be negligible.

Riparian Habitat Preservation
The project would preserve 1,380 acres of critical riparian habitat along the Santa Margarita River. This will include habitat for the following species: least bell's vireo, southwestern willow flycatcher, and the arroyo toad.

Santa Margarita River Recreation and Public Access
The project will preserve recreational opportunities along the Santa Margarita River in the form of access to 1,383 acres of critical riparian habitat. Beneficiaries include local species and habitat.

Bay – Delta Habitat Protection
This project will create 6,8500 AFY of local supply through conjunctive use, which will reduce imported water demand. This will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Table 10.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
City of Fallbrook, Camp Pendleton	Recreational Users of Santa Margarita River	Bay-Delta Ecosystem, Citizens of California

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.

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.
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Uncertainty of Benefits

There is some uncertainty about the exact species and critical habitat located in the 1,380 acres of riparian habitat. However, this will be investigated further during the preparation of an upcoming Environmental Impact Study/Environmental Impact Report (EIS/EIR).

Table 10.4: Omissions, Biases, and Uncertainties and their Effect on the Project

Benefit or cost category	Likely impact on net benefits*	Comment
Riparian Habitat Preservation	+	Currently, the entire extent of the species within the 1,383 open space management zone is not known, but will be defined during the EIS/EIR
Avoided carbon dioxide emissions	U	Avoided carbon dioxide emission estimates depend on: ▪ the total energy required to convey imported water (which is offset by the proposed project) to the San Diego region ▪ the portion of offset water that would have been imported from SWP and the portion that would have been imported from CRA (delivery of SWP water results in more carbon dioxide emissions than CRA water) ▪ the energy sources (coal-fired plant, hydroelectric plant, etc) that are utilized for the energy required to deliver that water. Estimates included in this analysis were based on the best available information from energy experts in California (e.g., Dr. Robert Wilkinson), the DWR, and the Department of Energy.

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 #11: Carlsbad Desalination Project 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.

Table 11.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 9)		
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		
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
Water Quality Benefits	
Other Benefits	
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.

Without-Project Baseline: Carlsbad Desalination Project Local Conveyance

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.

Expected Benefits of Project

Reduced Stress on Bay – Delta

This project will create 56,000 AFY of local supply through the delivery of desalinated water, which will significantly reduce imported water demand. This will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta Smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Reduction in Greenhouse Gas Emissions

By offsetting imported water demands with locally produced desalinated water, the proposed project would avoid emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[46], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[47] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[48] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[49], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[50], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water. By offsetting demand for approximately 56,000 AF of imported water per year (40% SWP and 60% CRA), the proposed project will avoid annual CO_2 emissions of over 88 million pounds (nearly 40,000 metric tons) of CO_2. Over the 30-year life of the project, that equates to avoiding emissions of over 1.2 million metric tons of CO2.

Poseidon has committed to run the Carlsbad Desalination Facility as a carbon neutral plant, by pursuing a mix of carbon emission reduction measures including: installation of premium energy efficient equipment, performance of LEED-type process for the facility, use of rooftop and/or locally produced solar energy, development of a 37-acre wetlands mitigation project, and purchases of carbon offset projects and/or renewable energy credits. Since the facility will be carbon neutral, there are no additional CO_2 emissions associated with the local production or delivery of desalinated water.

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[46] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[47] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[48] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[49] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[50] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

According to Poseidon's Climate Action Plan, desalinated water generated at the Carlsbad facility will offset a mix of 60% SWP water and 40% CRA water. Since the conveyance of SWP water is more energy intensive than CRA water, the CO_2 emissions are greater. As a result, Poseidon's estimates of the avoided CO_2 emissions are higher than those calculated for this analysis. Poseidon's estimates suggest the CO_2 emission offset would be over 47,000 metric tons per year, or 1.4 million metric tons of CO_2 over the 30-yr life of the facility (Poseidon, 2007).

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, the portion of avoided CO_2 emissions that should be attributed to the conveyance project is nearly 10,000 (25% of 40,000) metric tons of CO_2 per year (or nearly 300,000 metric tons over the life of the project).

Stewardship of Agua Hedionda Lagoon

This project will maintain, restore and enhance the marine environment through the stewardship of Agua Hedionda Lagoon. Approximately 388 acres of highly productive marine wetlands will be preserved. Hubbs SeaWorld White Sea Bass Research Institute produces and releases 150,000 White Sea Bass to the Pacific Ocean; Carlsbad Agua Farm produces one million pounds of mussels and oysters per year, thereby taking pressure off of natural stocks. The project will benefit local species in the lagoon as well as providing statewide benefits in the form of preservation of an important fishery.

San Dieguito Wetland Restoration Plan

This project will maintain, restore and enhance the marine environment through the restoration of 37 acres of marine habitat. The new coastal habitat will be created from what is now entirely disturbed land located within two miles of the coast. The land chosen for this project is a product of decades of fill, grading and/or agricultural use. It is rendered unsuitable for supporting native species that rely on freshwater/intertidal marsh or upland habitat. The proposed restoration projects will create 28.74 acres of wetlands and 8.52 acres of associated native grassland. A second component of this project is funding for enhanced water quality sampling, testing and monitoring of the proposed Water Quality Treatment Ponds. The project location was chosen to expand the number of acres of functional wetlands and associated habitat in the San Dieguito Lagoon area, by supplementing the 115-acre Wetlands Restoration Project, which is currently underway. The project includes maintenance and monitoring to ensure the successful re-establishment of planted species. Beneficiaries will include local wetland and marine species.

Dedication of Land for Expansion of Hubbs SeaWorld

Hubbs SeaWorld will be able to expand its marine restoration activities through the dedication of private property as a condition of approval of the desalination facility. Approximately 2.03 acres will be dedicated for the expansion of Hubbs SeaWorld Resources Enhancement and Hatchery Program that currently includes a 20,000 sq. ft. hatchery on Agua Hedionda Lagoon. To date, Hubbs SeaWorld has released over 1.5 million endangered white sea bass into the Pacific Ocean. Although the direct beneficiary would be Hubbs SeaWorld, statewide benefits will also occur through the preservation of fish stocks.

Water Contact Recreation

Approximately 300 acres of water contact recreation will be conserved in Agua Hedionda Lagoon. Beneficiares will be local, regional and state residents and visitors.

Ocean Front and Lagoon Front Property

The project includes the dedication of 15 acres of ocean front and lagoon front private property for improved public access and recreation in the coastal zone. The fishing beach along shore of Agua Hedionda Lagoon will be dedicated for public recreation and coastal access use. Ocean front bluff on the west side of Carlsbad Blvd. will be dedicated for recreational and coastal access uses. South power plant parking area will be dedicated for public parking. The project will advance the goals of the State of California to enhance public access and recreation in the coastal zone. This will benefit all recreational users of the dedicated facilities.

Table 11.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
Local Species in the Agua Hedionda Lagoon, Hubbs Seaworld, Recreational Users of Coastal and Lagoon Facilities	Recreational Users of Coastal and Lagoon Facilities	Recreational Users of Coastal and Lagoon Facilities , California Bay-Delta, Statewide Fisheries, California Citizens

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 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.

Ecosystem restoration benefits from the stewardship of the Agua Hedionda Lagoon will be received when the Encina Power Station is decommissioned. The ecosystem benefits from the San Dieguito Wetland Restoration Plan will be received within 24 months of the start of commercial operations of the desalination facility. Ecosystem restoration benefits from the Hubbs Sea World Enhancement and Hatchery Program will be received when the construction permit is issued. Recreation and public access benefits will be received when the construction permit is issued. Energy efficiency and elimination of greenhouse gas production benefits will be received when the Climate Action Plan is implemented, at the end of the first year of operation at the desalination facility.

Potential Adverse Effects from the Project

The desalination facility will have an unavoidable impingement losses of less than 2 pounds of fish per day. Unavoidable entrainment loss would potentially affect up to 12.2% of lagoon area. These impacts are more than fully mitigated by 37 acre marine wetlands restoration program described below.

Uncertainty of Benefits

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
Avoided carbon dioxide emissions	U	Avoided carbon dioxide emission estimates depend on: ▪ the total energy required to convey imported water (which is offset by the proposed project) to the San Diego region ▪ the portion of offset water that would have been imported from SWP and the portion that would have been imported from CRA (delivery of SWP water results in more carbon dioxide emissions than CRA water) ▪ the energy sources (coal-fired plant, hydroelectric plant, etc) that are utilized for the energy required to deliver that water. Estimates included in this analysis were based on the best available information from energy experts in California (e.g., Dr. Robert Wilkinson), the DWR, and the Department of Energy. Estimates from Poseidon (from the 2007 Climate

Benefit or cost category	Likely impact on net benefits*	Comment
		Action Plan) suggest a higher carbon dioxide emission offset per AF of avoided imported water than those estimated using information from Wilkinson and DWR.

*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 water systems fed by the San Vicente, El Capitan, Loveland, and Murray Reservoirs (with a combined storage capacity of approximately 233,000 AF) 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.

Table 12.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 8)		
Optimize existing storage capacity	Physical quantification	Local, Regional, State
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 (described in Attachment 8)		
None	N/A	N/A
Other Benefits		
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.

Without-Project Baseline

Because Loveland Reservoir is not connected to the imported water system and El Capitain Reservoir faces pipeline capacity limitations for receiving imported water, existing storage capacity is underutilized in this system. 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 and Murray and San Vicente reservoirs would provide approximately 100,000 acre feet of additional storage capacity every year. This increase in storage capacity would not occur by increasing the height of dams but would result from the ability to annually store imported water from the Colorado River and/or the California State Project when local runoff is insufficient.

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 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. 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.

Expected Benefits of Project

Expected benefits of the project are discussed below. Detailed information on monetized benefits is provided as Appendix 9-1.

Energy Management Opportunity
The project could potentially have a positive energy impact through the ability to add a facility for hydro-generation to the El Capitan to Loveland Reservoir pipeline link. Water could be pumped into Loveland during off-peak hours and released back through turbine generators into El Capitan generating electricity for peak and/or emergency use. The 1993 USACE study found that the 5.5 megawatts generated annually would have an average annual value of $3.79 million (adjusted to 2006 dollars). Using the USACE annualized energy benefit estimate, the present value total benefit over the lifetime of the project is $69.6 million. Note that the energy generation benefits were assumed to begin accruing in 2012.

This conceptual design represents 0.27% of the present value total costs for the Intertie Project. Therefore, the energy management benefits are apportioned to this project at 0.27% of the estimated monetized benefits of the combined benefits of studying and completing the project. The present value of energy management opportunities apportioned to this project is $188,000 ($69.6 million * 0.27%).

Reduce Environmental Impacts of Imports
Environmental considerations resulted in a reduction in the amount of water available from the Bay-Delta when a federal court ordered a cutback by roughly one-third in water extracted for consumptive use to protect the endangered Delta Smelt. The Intertie Project will enable the San Diego Region to make better use of its local and imported supplies, thereby reducing its demands on the Bay-Delta system (especially in dry years). In addition to reducing stress on oversubscribed Bay-Delta water, this will in turn help relieve the impacts of the Bay-Delta extraction restrictions on other MWD customers and other entities that rely on the Bay-Delta system as a key water source.

Increase Water Volumes for Water Dependent Recreation
The ability to receive and store imported water would increase the surface storage of El Capitan and Loveland Reservoirs. Potentially greater volumes of water in the reservoirs will protect and enhance the water dependent recreational opportunities already present there. The City of San Diego provides a variety of outdoor activities, such as boating, fishing, and hiking at El Capitan Reservoir. Public fishing access along a 5-mile portion of the shoreline is currently allowed at Loveland Reservoir.

Improved Flood Management Opportunities
The ability to transfer water into and out of El Capitan and Loveland Reservoirs will improve the ability to manage reservoir levels in years when local runoff is high, resulting in improved floodplain management as well as capture of local runoff. The Four Reservoir Intertie Project would decrease flood risk through the ability to move water from reservoirs in danger of spilling to reservoirs with available capacities. For example, when Lake Hodges spilled in 2005, the San Diego Region lost 98,000 AF of water. A significant portion of that water could have been utilized locally if the Intertie System had been in place. As the water level in Lake Hodges began to rise, water transfers to other reservoirs in a linked system could have been made.

The 1993 USACE study found that their slightly different Four Reservoir Intertie Project would reduce the average annual without-project flood damages of $76.4 million (adjusted to 2006 dollars) to $19.0 million (adjusted to 2006 dollars) annually for an average annual flood control benefit of $57.4 million (adjusted to 2006 dollars) in the San Diego River Basin. Using the USACE annualized benefit of $57.4 million, the present value total benefit over the lifetime of the project is $1.056 billion. Note that the flood benefits were assumed to begin accruing in 2012.

This conceptual design represents 0.27% of the present value total costs for the Intertie Project. Therefore, the flood management benefits are apportioned to this project at 0.27% of the estimated monetized benefits of the combined benefits of studying and completing the project. The present value of flood management opportunities apportioned to this project is $2.85 million ($1.056 billion * 0.27%).

Improve Climate Change Adaptation Capacity
Projections of climate change for the region include more intense, but less frequent precipitation events, a general drying of the southwest United States, increased evaporation, potential changes in the frequency and severity of drought, and other potential changes. The Four Reservoir Intertie Project can assist San Diego County in adapting to these projected changes by enhancing the ability to store and treat a large volume of water on an ongoing basis and lessen the impacts of significant changes in climate variability or baseline conditions.

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: Metropolitan Water District of Southern California, San Diego County Water Authority, Helix Water District, Otay Water District, and Padre Dam Municipal Water District. Exploring the conceptual design 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: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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 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 conveyance infrastructure linking 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 a potential 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.

Uncertainty of Benefits

The benefits of the Intertie Project will be better defined in the conceptual design envisioned by this project.

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

Benefit or cost category	Likely impact on net benefits[1]	Comment
All benefits	U	The portion of all benefits attributed to the conceptual design was estimated according to conceptual design's cost relative to the cost of a future Intertie Project. The cost of a future Intertie project was determined from the 1993 United States Army Corps of Engineers report (and updated to 2006 dollars). If the cost of an Intertie Project would be higher or lower than reported in that 1993 study, then cost of the conceptual design relative to the Intertie Project would be different and the portion of total benefits that should be attributed to the conceptual design would be different.
Energy management opportunity	U	The value of energy associated with this project was estimated from the 1993 United States Army Corps of Engineers report (and updated to 2006 dollars). If the value of this energy has changed in the past 15 years, then the value of this monetized benefit may be higher or lower than the estimate provided in our analysis.
Improved flood management opportunities	U	The value of improved flood management associated with this project was estimated from the 1993 United States Army Corps of Engineers report (and updated to 2006 dollars). If the value of improved flood management has changed in the past 15 years, then the value of this monetized benefit may be higher or lower than the estimate provided in our analysis.

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 #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.

Table 13.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 8)		
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 (described in Attachment 8)		
None	N/A	N/A
Other Benefits		
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 Benefits	**Qualitative indicator***
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.

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.

Expected Benefits of Project

Bay – Delta Habitat Protection
This project is designed to determine how the SDF can be utilized as a local supply resource. Local production of brackish groundwater obtained from the SDF will offset, gallon for gallon, imported water supplies, reducing the Region's dependence on imported water. This will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta Smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

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.

Uncertainty of Benefits

The certainty of the benefits listed for this project, which are all related to reduction of imported water supply, will be better defined once an improved estimate of the potential yield of the SDF is known. Obtaining this estimate will be a major outcome of this project.

Table 13.3: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
All benefits listed	U	Study must be completed to precisely identify potential benefits of future project, including yield, etc

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 #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 5,000 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;
- 5,000 AF reduction in San Diego County Water Authority demand for imported water from Metropolitan Water District;
- 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;
- 10 MGD decrease in capacity that must be built by the City of San Diego when it upgrades the Point Loma Wastewater Treatment Plant.

This integrated project will result in the water supply and quality benefits summarized below.

Table 14.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply Benefits (described in Attachment 8)		
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 (described in Attachment 8)		
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		
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 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.

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 $3.4 million.

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.[51] 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.

Without this project the El Monte Valley would have increasing non-native vegetation, limited habitat valuable and unmaintained trails. The opportunity to recharge the groundwater basin with another source of water would be limited and imported water would be needed to serve the residents of the area.

Expected Benefits of Project

Improved flood control and stormwater runoff control
Local runoff within the San Diego River floodplain would be captured through groundwater management. The groundwater basin would be controlled prior to periods of high runoff by extraction pumps to minimize flooding. Communities downstream of the El Monte Valley would benefit.

Restoration of natural habitat
The river restoration component of this project will restore 350 acres of impacted and impaired ecosystems through invasive species removal, revegetation, wetlands creation and enhancement and habitat project and improvement. Non-native vegetation will be removed and 135 acres of riparian and 169 acres of upland and woodland habitat will be restored. Beneficiaries will be local species and habitat and residents of the El Monte Valley.

A portion of the 500 acre habitat restoration project includes the restoration of 15 acres of public access roads and trails. Beneficiaries would include recreational users of the El Monte Valley from inside or outside the Region.

Promotion of Regional Collaboration
Both of Santee WRF Expansion Project and the El Monte Groundwater Recharge and Restoration Project are needed to achieve the full range of benefits. The Padre Dam MWD and HWD realized this and coordinated the timing and design of these two projects. The Santee WRF Project will provide a 100% increase in the availability of economical recycled water to Padre Dam's commercial, Home Owner's Associations, and large landscape customers. It will also provide recycled water to recharge the El Monte Valley, which will promote the El Monte Groundwater Recharge Project to encourage public interest in greater use of recycled water throughout San Diego County.

Bay – Delta Habitat Protection
This project will make the delivery of up to 5,000 AFY of local recycled water possible, which will reduce imported water demand. This will decrease pumping demands on the SWP, which will lead to reduced chances for entrainment of Delta Smelt at the Banks pumping plant. It will also reduce the general effects of pumping on the entire Bay-Delta system. This will benefit species in the Bay-Delta. As the Bay-Delta is a statewide resource, all citizens of California will benefit.

Reduction in Greenhouse Gas Emissions
By offsetting imported water demands with locally produced RW, the proposed projects (Santee WRF Expansion Project and the El Monte Groundwater Recharge and Restoration Project) would reduce emissions of CO_2 (a greenhouse gas) generated by transporting imported State Water Project (SWP) and Colorado River Aqueduct (CRA) water to San Diego County. The long-distance transport of water in

[51] 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.

conveyance systems, is a major element of California's total demand for electricity. The SWP, for example, is the largest consumer of electrical energy in the state, requiring an average of 5,000 GWh per year, and contributes 0.6% California's total GHG emissions (source: Perata letter[52], 2007).

The energy required to operate the SWP is provided by a combination of power sources, including a coal-fired plant and several hydroelectric power plants owed by the California Department of Water Resources (DWR). The approximate breakdown of the portion of the energy requirements for transport of SWP water provided by each energy source is: 51%[53] is provided by DWR's hydroelectric plants; 16% is provided by DWR's coal-fired plant; and 33% is provided by power purchased from other utilities[54] (Wilkison, 2005). Federal hydroelectric projects on the Colorado River (including Hoover and Park Dams) produce approximately 63% of the electricity required to pump CRA water; the balance is provided by power purchased from a number of utilities (CEC, 2005).

CO_2 emissions resulting from the production of electricity, measured as pounds of CO_2 per kilowatt-hour (kWh), vary by energy source. Hydroelectric power plants are assumed to generate relatively little CO_2 emissions, on the order of 0.01 to 0.04 lbs/kWh (van de Vate, 2002). For the Pacific region of the United States, CO_2 emissions from coal-fired plants and natural gas powered plants are estimated to be 2.152 pounds of CO_2 per kWh and 1.238 pounds of CO_2 per kWh, respectively (DOE/EPA[55], 2000). In California, electricity production relies on a range of energy sources that includes those listed above, as well as renewable and nuclear energy (Krebs[56], 2006). Therefore, the CO_2 emissions rate for *all* electricity sources in the Pacific region was estimated to be 0.435 lbs of CO2 per kWh (DOE/EPA, 2000).

On average , the electricity required for the conveyance of one acre-foot of imported SWP water to San Diego County is 3,240 kWh (Wilkinson, 2000 (pg 51)) and for one AF of imported CRA water is approximately 2,000 kWh (Wilkinson, 2005). Given the mix of energy sources utilized for the pumping and delivery of imported water, approximately 2500 pounds of CO_2 are emitted per AF of SWP water transported to southern California, and 960 pounds of CO_2 are emitted per AF of CRA water.

The conveyance of recycled water in San Diego requires, approximately 27% less energy than importing water[57]. By offsetting demand for approximately 2,240 AF of imported water per year (40% SWP and 60% CRA) with recycled water, the two proposed projects will reduce annual CO_2 emissions of approximately by 1,600 metric tons of CO_2. Over the 50-year life of the project, that equates to avoiding emissions of over 84,800 tons of CO_2.

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 PV costs of the combined projects attributed to the Santee WRF expansion (57.3%), then the El Monte Groundwater Recharge and Restoration Project will reduce CO+ emissions by approximately 49,000 metric tons (84,800 tons * 57.3%).

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[52] Letter available at: http://www.water.ca.gov/climatechange/docs/perata_letter.pdf

[53] "In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kwh. Of that total, 4.5 billion kwh come from hydroelectric generation." (http://www.publicaffairs.water.ca.gov/swp/benefits.cfm) (i.e., approximately 75% of the power generated by DWR's energy sources is hydroelectric power). And, "The SWP's eight hydroelectric power plants and a coal-fired plant produce enough electricity in a normal year to supply about two-thirds of the project's necessary power." (Wilkinson, 2005)… therefore, 33% is from "other" and 75% of the remaining 2/3 is provided by hydroelectric (50%), finally the other 25% of the remaining 2/3 is provided by coal-fired plant (16%).

[54] Assume that since 41% of energy produced in CA is from natural gas, "other" refers to natural gas.

[55] Carbon Dioxide Emissions from the Generation of Electric Power in the United States July 2000 Department of Energy Washington, DC 20585 Environmental Protection Agency Washington DC 20460 (http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf)

[56] Krebs: http://www.sandia.gov/energy-water/West/Krebs.pdf

[57] As shown in the Pacific Institute "Energy Down the Drain" report (Gleick, 2004), the conveyance of 1 AF of RW is requires approximately 1830 kWh/AF. If 40% imported water is SWP water and 60% is CRA water, then the average AF of imported water requires 2494 kWh/AF for conveyance; this implies that recycling water requires 73% as much energy (1830/2494) as importing water. The estimate may not fully reflect the amount of energy that would be required to treat and discharge the wastewater if it were not recycled.

High Quality Sand Resources

Much of the El Monte basin geology overlaying the rock boundaries is made up of good quality, well draining sand. According to the Final Feasibility Study for the El Monte Valley Recharge Project (Appendix 6), existing riverbed elevations range from about 410 feet on the west end to 470 feet on the east end. It is anticipated that portions of the basin will be graded to get ground surface elevations closer to the groundwater table. Grading the basin will generate high quality sand resources that will be sold to offset the cost of the project. The high quality sand resources would likely be used in San Diego county to provide sand for concrete and aggregate companies for use in building materials. Much of the sand is currently imported into the San Diego County to meet the demand for production of concrete. This is a critical benefit for the project because the current land use designation for the El Monte property is "extractive" and is indicated as a natural resource. With the project as a golf course, this valuable sand resource would not be utilized. With the Groundwater Recharge and River Restoration project, this sand resource could be used for the region and offset requirements for sand to be imported (and associated trucking impacts) to meet production demands.

The project developer estimates that approximately 10 million tons of sand will be removed, and can be sold for approximately $15 to $20 per ton. Extraction is expected to cost approximately $11 to $16 per ton, for a net profit of approximately $4 to $9 per ton. Assuming that 10 million tons of sand are removed for the conservative profit of $4 per ton, this will generate $4.4 million per year from 2008 through 2016 (the period of construction). The present value of this benefit is approximately $28.5 million, with $16.3 million ($28.5 million * 57.3%) attributed to the El Monte Project.

Disadvantaged Community Benefits

A disadvantaged community is one that has an annual median household income that is less than $43,206 (in 2006 U.S.$). Fishing, boating, hiking, tent camping, and other day-use recreation at Santee Lakes Recreation Preserve is accessible to the disadvantaged residents of these communities by public transportation. It is also accessible to minority residents, residents living below the poverty line, and disabled residents in San Diego County. For the 108,000 severely disabled residents of San Diego County, Santee Lakes offers a fishing pier, playground, and scenic wildlife observation trails specifically designed for wheelchair access and guests with limited mobility.

Of the 600,000 visitors to the Recreation Preserve in 2006, 40% live in Padre Dam's service area, which includes several disadvantaged communities: Santee, El Cajon, Alpine, Crest, and Harbison Canyon. The other 60% live in other San Diego communities.

Currently 1 mgd of recycled water from the Santee WRF sustains seven lakes within the Preserve and Padre Dam's regional park and campground, which serves multiple communities within San Diego. With the Santee WRF Expansion Project, the Santee Lakes Recreation Preserve would receive a more reliable source of water to sustain outdoor recreational opportunities for disadvantaged communities.

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 benefiting from increased flood protection, local well owners benefiting from high quality drinking water, the surrounding habitat benefiting from restoration (including species), and SDCWA benefiting by achieving over 80% of its 2020 goals for local groundwater production.

Table 14.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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)	Bay-Delta Ecosystem, Recreational Users of the Preserve, Visitors to Region, California Citizens

Project Benefits Timeline Description

The ecosystem restoration benefits would be received beginning in 2010. The flood control, recreation and public access, and power cost savings and production benefits would be received beginning in 2016.

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.

Uncertainty of Benefits

The uncertainty of benefits is minimal.

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.

Table 15.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality Benefits (described in Attachment 8)		
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		
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 and trash 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.

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 workshops 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.

Expected Benefits of Project

Public Education and Awareness

This project will create public education benefits and create awareness of water quality issues by directly involving citizens in monitoring efforts. By engaging citizens and involving them directly, they will be empowered and be more likely to sustain behaviors that will lead to improvements in water quality. Participants in the program will also be the ones likely to educate fellow citizens on water quality issues and to encourage them to follow similar practices. Thus, the benefit will extend to all residents of the Region.

Recreation and Public Access

Beneficial uses, including those related to recreation and public access, will be recorded in each watershed through this project. The database of the beneficial uses will be used in conjunction with the water quality data collected for the purpose of protecting the observed beneficial uses.

Table 15.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
Local Residents	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).

Potential Adverse Effects from the Project

As a result of this project, some areas may be disturbed by volunteers coming in to remove debris 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.

Uncertainty of Benefits

There is uncertainty in the effectiveness in of the public education and awareness benefit in producing actual desired behavior changes, however the project is utilizing community-based social marketing (CBSM) techniques to help improve the prospects of improved education and public awareness leading to improved behavioral outcomes.

Table 15.4: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
Public Education and Awareness	U	The impact of public education and awareness benefits is unknown and will depend on the receptiveness of the audiences to the CBSM approach implemented in the project.

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 #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.

Table 16.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply (described in Attachment 8)		
Avoided cost of additional imports	Monetized	Local and Regional
Avoided cost of pumping	Monetized	Local, Regional, and State
Avoided water supply project	Monetized	Local
Improved water supply reliability	Qualitative	Local and Regional
Water Quality (described in Attachment 8)		
Improved water quality	Physical Quantification	Local and Regional
Avoided water quality treatment project	Monetized	Local
Other Benefits		
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 imports	$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
Other Benefits	
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.

Without-Project Baseline

If this project were not implemented, opportunities for educating the public on the value of wetlands would not be realized and no further water quality or flood control benefits would be realized

Expected Benefits of Project

Improved habitat for threatened and endangered species
The constructed wetlands will produce natural bio-filtration through which the pond water can flow improve water quality. The Park guest experience will be enhanced. Beneficiaries would be the Park and visitors from inside and outside the Region.

Increased public education and environmental awareness

The demonstration wetland will serve as an "outdoor classroom" to educate individuals about water conservation. It will benefit approximately 1.5 million guests annually. These include Park visitors from all over the Region and the world.

Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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.

Uncertainty of Benefits

The project would serve as an educational tool for the millions of visitors to the Park. There is uncertainty in the effectiveness in of the public education and awareness component in producing actual desired behavior changes which are a major benefit that stems from increasing public education and awareness.

Table 16.3: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
Public Education and Awareness	U	The impact of public education and awareness benefits of the wetlands is unknown and will depend on the receptiveness of visitors to the Park

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 #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.

Table 17.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply/ Water Quality (discussed in Attachment 8)		
Increased coordination of watershed projects	Qualitative	Local, regional
Other Benefits		
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 Benefits	**Qualitative indicator***
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.

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.

Expected Benefits of Project

Public Education and Awareness
The Council will additionally disseminate information watershed-wide to increase public awareness and garner citizen support for habitat protection and restoration. The staff position supported by this project would manage these types of initiatives. The beneficiaries would be residents of the San Dieguito HU.

Table 17.3: of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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

Benefits will be received immediately with on-the-ground volunteer work and over the life of a project (e.g., invasives removal); benefits may be received well into the future with well-timed, consistent public involvement.

Potential Adverse Effects from the Project

No adverse effects are anticipated from this project.

Uncertainty of Benefits

Achieving the benefits of this project will depend on the ability of the Watershed Council to encourage entities that are necessary for successful implementation of the San Dieguito Watershed Management Plan to work together. The benefits of public education and awareness will also depend on the reception of watershed residents to outreach efforts.

Table 17.4: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
Ecosystem Restoration, Flood Control, Recreation and Public Access	-	Lack of coordination among entities will prevent projects from being carried out; the public's response to outreach efforts may be difficult to measure

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 #18: San Diego River Watershed Management Plan Implementation

This project will support implementation of the San Diego River Watershed Management Plan. Funding will allow for identification of long-term funding strategies and sources to continue implementation of the Watershed Management Plan 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 efforts of the watershed coordinator 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.

Table 18.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Supply/ Water Quality (discussed in Attachment 8)		
Increased coordination of watershed projects	Qualitative	Local, regional
Other Benefits		
Public Education and 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.

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.

Expected Benefits of Project

Public Education and Awareness
Public outreach and education conducted under this project will expand the Watershed's volunteer base for cleanups, exotic removals, native plantings and water quality monitoring and teach people how to minimize negative ecological impacts. The beneficiaries would be residents of the San Diego River HU.

Disadvantaged Communities
The project will focus on involving members of the public within seven identified disadvantaged communities: Bostonia, El Cajon, College Area, Normal Heights, Ocean Beach, Midway, and Old San Diego.

Table 18.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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 expected from the project

Uncertainty of Benefits

There is uncertainty in the public response to the public education and awareness component in how the public will respond.

Table 18.4: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
Public Education and Awareness	U	There is no certainty how the public will utilize the information provided to them and whether they decide to volunteer.

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 #19: City of San Diego Green Mall Porous Paving and Infiltration, Phase 1

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.

Table19.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality (described in Attachment 8)		
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

Type of Benefit	Assessment Level	Beneficiaries
Potential to decrease treatment costs	Qualitative	Local, regional
Other Benefits		
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 Benefits	**Qualitative indicator***
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 benefits	+
Outreach and education	+

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

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.

Expected Benefits of Project

Increased quality and abundance of riparian habitat in the Chollas Creek sub-watershed
By improving water quality between upstream wildlife corridor/habitat restoration efforts and San Diego bay, the project would improve the habitat for those species which are dependent upon improved water quality.

There have been a number of studies on the value to protect ecological systems and the public's willingness to pay (WTP) to protect riparian and aquatic habitats. Studies have estimated the value of instream flows to protect threatened and endangered (T&E) fish species. Values ranged from $7 to $112 per household per year to protect various specific aquatic T&E species (Raucher et al., 2006). A meta-analysis (Loomis and White, 1996) of studies covering 18 different T&E species resulted in similar annual WTP results ($6 to $95 per household annually).

There are also a number of species that will benefit from the project that are not T&E. There have been a number of studies that have estimated the public's WTP for general protection of habitat systems. Willingness to pay values are similar to those cited in Loomis and White (1996) to protect endangered species. For example, a 1987 study estimated that California households would be willing to pay $158-$386 per household annually to protect Mono Lake from excessive water supply extractions in California to provide water for fish, birds, and other parts of the Mono Lake ecosystem.

Benefits transfer of these values to monetize the benefits of habitat improvements from the Green Mall LID porous paving and infiltration pilot project is very difficult and would be subject to considerable uncertainty. Furthermore, the benefits from the pilot study along would likely be small; the real improvement would be from other projects following this lead. Therefore, we only go as far as to say that the long run habitat quality improvement benefits from this project (and the follow-on projects it should facilitate) might well be significant.

Potential to increase levels of recreational opportunities and enjoyment and aesthetics
The Green Mall LID porous paving and infiltration project will help protect the recreational use of the Chollas Creek and possibly the San Diego Bay by reducing urban runoff that carries pollutants into these water bodies. Although the pilot project alone will likely have little impact on San Diego Bay, there is much potential for water quality improvements from more large scale projects using this method. The San Diego Unified Port District's "Natural Resources Management Plan" indicates that the bay supports an estimated 35,000 to 40,000 angler-days per year (number of anglers times the number of days they fished per year), and that the bay includes 55 boatyards and 8,200 boat slips. Although the State Department of Environmental Health Hazard Assessment does not list a fish advisory for San Diego bay, signs warning the public about adverse health effects from eating bay-caught fish have been posted since 1990.

Several studies have been conducted on the economic value (willingness to pay) of fishing per user day. These values range from $2.06 to $251.49 and are highly dependent on species, water body and type, and angling technique (Raucher, 2006). Benefits transfer of these values to monetize the benefits of recreation from the Green Mall LID pilot study is very difficult and would be subject to considerable uncertainty. Again, the benefits from the pilot study alone would likely be small; the real improvement would be from other projects following this lead. Therefore, we only go as far as to say that the long run habitat quality improvement benefits from this project would probably be significant.

Enhanced Flood control
This pilot project would reduce flooding threats by removing water from flows in the storm water conveyance system. Although the capacity of the project to retain and/or infiltrate water from its seven acre drainage basin is not expected to measurably affect flooding potential, the real improvement would be from other projects following this lead.

Disadvantaged Community Benefits
This project will target the older, diverse, and densely urbanized neighborhoods of the Southcrest and Shelltown areas within the Pueblo HU. These areas tend to concentrate the City's low income families and are targeted for the majority of the City's anticipated redevelopment efforts. Urban runoff pollution prevention efforts in these areas will help support wildlife corridor/habitat restoration efforts upstream and downstream that will become community assets and increase community pride. The information gathered and project experience acquired by the City will facilitate the implementation of other projects similar in scope in other HUs with disadvantaged communities.
Outreach and Education
The outreach component of the project will consist of educating nearby residents on their role in preventing runoff pollution (e.g., sweeping instead of hosing driveways and picking up after pets), which will be tied to the opportunities that they will have to actively engage in preventing runoff pollution in connection with this project by, for example, agreeing to maintaining the bio retention planter boxes free of weeds and trash. Thus, the project will address urban runoff pollution through source control (i.e., pollution prevention through education and outreach), volume reduction, and treatment control.

Table 19.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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.

Uncertainty of Benefits

There is uncertainty in the effectiveness in of the public education and awareness benefit in producing actual desired behavior changes.

Table 19.4: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
Outreach and Education	U	The impacts of the educational component of the outreach may vary depending on the receptiveness of the audience.

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 #20: County of San Diego Chollas Creek Runoff Reduction and Groundwater Recharge

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 their use.

Table 20.1: Benefits Summary

Type of Benefit	Assessment Level	Beneficiaries
Water Quality (discussed in Attachment 8)		
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		
Disadvantaged community benefits	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 Benefits	**Qualitative indicator***
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.

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 such a project is not implemented to promote the installation of porous pavements and other LID measures 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.

Expected Benefits of Project

Infiltrate Stormwater and Reduce Runoff Pollution
The Chollas Creek Runoff Reduction and Groundwater Recharge Project will reduce runoff from three County of San Diego facilities in the Chollas Creek subwatershed of the Pueblo San Diego hydrological unit. The retrofit installations at the project sites will directly help to reduce urban runoff and the transport of pollutants to Chollas Creek, thereby contributing to water quality improvements in the Creek.

Guides Implementation of Other Runoff Reduction and Groundwater Infiltration Projects
Another benefit of the Project is as a practical demonstration of low impact development (LID) practices. County employees and contractors, as well as those from other agencies, will be able to visit the facilities, observe the Department of General Services' implementation of LID principles, and, potentially, apply some of those principles at other highly impervious facilities. The presence of these three public facilities retrofitted with stormwater BMPs will also provide an outreach benefit. Members of the public who visit the County facilities will be able to see how highly impervious sites can be retrofitted and improved to reduce runoff. Public awareness and education about the importance of runoff reduction to water quality is a key component in bringing about the changes necessary to affect long-term water quality improvements.

Disadvantaged Community Benefits
The project benefits the disadvantaged community in the portion of southeastern San Diego in which the three facilities included in the project are located. These facilities – the Central Regional Public Health facility, the Comprehensive Health Care Center, and the Probation - Dodson House (Work Furlough) – were located at these sites to provide services to low income, disadvantaged communities in the surrounding neighborhoods. The project will directly benefit those people from the community who visit these facilities, and will benefit the entire community by helping to reduce the transport of pollutants to Chollas Creek and San Diego Bay.

Reduced Erosion of Downstream Channels
Reduction in impervious surfaces is an important element of the Region's joint stormwater permit.[58] Reducing impervious surfaces will minimize runoff volume, velocity, rate, and duration of runoff, all of which accelerate the erosion of downstream natural channels. This project will demonstrate methods of reducing hydromodification and erosion of downstream channels through implementation of low impact development features.

Table 20.3: Distribution of Project Benefits and Identification of Beneficiaries

Local	Regional	State
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.

Uncertainty of Benefits

There is uncertainty in the effectiveness of the public education and awareness benefit in producing actual desired behavioral changes beyond the Department.

[58] California Regional Water Quality Control Board San Diego Region. (2007) Order No. R9-2007-0001. NPDES No. CAS0108758. Waste Discharge Requirements for Discharges of Urban Runoff from The Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds of The County of San Diego, The Incorporated Cites of San Diego County, The San Diego Unified Port District, and the San Diego County Regional Airport Authority. http://www.waterboards.ca.gov/sandiego/programs/stormwater/sd%20permit/r9-2007- 0001/Final%20Order%20R9-2007-0001.pdf

Table 20.4: Omissions, Biases, and Uncertainties and their Effect on the Project:

Benefit or cost category	Likely impact on net benefits*	Comment
Degree of Benefit	U	Because this is a pilot and demonstration project, it is intended to provide information and facilitate future projects. The scale of benefits accrued from projects facilitated by this project is currently unknown, but is expected to be significant.

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 -

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Appendix 9: Calculation of Costs and Benefits Presented in Attachment 9

Table 15 - Other Expected Benefits - Implementation of Integrated Landscape and Agriculture Efficiency Programs (All benefits should be in 2006 dollars)								
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Reduction in Greenhouse Gas Emissions							
	Measure of Benefit: tons CO2 per year					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0			$0	1.06	$0
2008	2227	0	2227			$0	1.12	$0
2009	2227	0	2227			$0	1.19	$0
2010	2227	0	2227			$0	1.26	$0
2011	2227	0	2227			$0	1.34	$0
2012	2576	0	2576			$0	1.42	$0
2013			0			$0	1.50	$0
2014			0			$0	1.59	$0
2015			0			$0	1.69	$0
2016			0			$0	1.79	$0
2017			0			$0	1.90	$0
2018			0			$0	2.01	$0
							Total Present Value of (Sum of the values in	$0
Comment Box:								

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Table 15 Other Expected Benefits of the of Over-Irrigation / Bacteria Reduction Project

(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Reduced Greenhouse Gas Emissions							
	Measure of Benefit: tons CO2					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0	0			$0	1.06	$0
2008	63	0	63			$0	1.12	$0
2009	126	0	126			$0	1.19	$0
2010	189	0	189			$0	1.26	$0
2011	252	0	252			$0	1.34	$0
2012	252	0	252			$0	1.42	$0
2013	252	0	252			$0	1.50	$0
2014	252	0	252			$0	1.59	$0
2015	252	0	252			$0	1.69	$0
2016	252	0	252			$0	1.79	$0
2017	252	0	252			$0	1.90	$0
2018	252	0	252			$0	2.01	$0
2019	252	0	252			$0	2.13	$0
2020	252	0	252			$0	2.26	$0
2021	252	0	252			$0	2.40	$0
2022	252	0	252			$0	2.54	$0
2023	252	0	252			$0	2.69	$0
2024	252	0	252			$0	2.85	$0
2025	252	0	252			$0	3.03	$0
2026	252	0	252			$0	3.21	$0
2027	252	0	252			$0	3.40	$0
2028	252	0	252			$0	3.60	$0
2029	252	0	252			$0	3.82	$0
2030	252	0	252			$0	4.05	$0
2031	252	0	252			$0	4.29	$0
2032	252	0	252			$0	4.55	$0
2033	189	0	189			$0	4.82	$0
2034	126	0	126			$0	5.11	$0
2035	63	0	63			$0	5.42	$0
2036								
							Total Present Value of Discounted Benefits (Sum of the values in	$0

Comment Box:

Table 15 Other Expected Benefits of the Santee Water Reclamation Facility Expansion Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Reduction in greenhouse gas emissions					Benefit: High Quality Sand Resources							
	Measure of Benefit: tons of CO2					Measure of Benefit: tons of sand					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	1.06	$0
2008	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.12	$3,968,254
2009	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.19	$3,734,827
2010	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.26	$3,520,416
2011	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.34	$3,321,147
2012	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.42	$3,133,158
2013	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.50	$2,955,809
2014	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.59	$2,788,499
2015	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.69	$2,630,660
2016	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.79	$2,481,755
2017	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	1.90	$0
2018	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.01	$0
2019	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.13	$0
2020	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.26	$0
2021	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.40	$0
2022	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.54	$0
2023	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.69	$0
2024	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.85	$0
2025	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.03	$0
2026	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.21	$0
2027	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.40	$0
2028	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.60	$0
2029	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.82	$0
2030	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.05	$0
2031	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.29	$0
2032	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.55	$0
2033	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.82	$0
2034	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	5.11	$0
2035	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	5.42	$0
2036	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2037	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2038	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2039	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2040	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2041	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2042	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2043	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2044	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2045	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2046	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2047	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2048	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2049	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2050	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2051	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2052	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2053	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2054	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2055	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2056	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2057	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2058	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2059	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2060	1,600	0	1600	$0	$0	0	0	0	$4	$0			
											Total Present Value of Discounted Benefits Based on % Avoided Cost Claimed by		$28,534,526 42.8% $12,202,502

Comment Box

Table 15 - Other Expected Benefits of Recycled Water Retrofit Assistance Program (All benefits should be in 2006 dollars)								
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided CO2 emissions							
	Measure of Benefit: metric tons of CO2							
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2007	0	0				$0.00	1.06	$0.00
2008	286	143	143			$0.00	1.12	$0.00
2009	1286	643	643			$0.00	1.19	$0.00
2010	1428	714	714			$0.00	1.26	$0.00
2011	1428	714	714			$0.00	1.34	$0.00
2012	1428	714	714			$0.00	1.42	$0.00
2013	1428	714	714			$0.00	1.50	$0.00
2014	1428	714	714			$0.00	1.59	$0.00
2015	1428	714	714			$0.00	1.69	$0.00
2016	1428	714	714			$0.00	1.79	$0.00
2017	1428	714	714			$0.00	1.90	$0.00
2018	1428	714	714			$0.00	2.01	$0.00
2019	1428	714	714			$0.00	2.13	$0.00
2020	1428	714	714			$0.00	2.26	$0.00
2021	1428	714	714			$0.00	2.40	$0.00
2022	1428	714	714			$0.00	2.54	$0.00
2023	1428	714	714			$0.00	2.69	$0.00
2024	1428	714	714			$0.00	2.85	$0.00
2025	1428	714	714			$0.00	3.03	$0.00
2026	1428	714	714			$0.00	3.21	$0.00
2027	1428	714	714			$0.00	3.40	$0.00
2028	1428	714	714			$0.00	3.60	$0.00
2029	1428	714	714			$0.00	3.82	$0.00
2030	1428	714	714			$0.00	4.05	$0.00
2031	1428	714	714			$0.00	4.29	$0.00
2032	1428	714	714			$0.00	4.55	$0.00
2033	1428	714	714			$0.00	4.82	$0.00
2034	1428	714	714			$0.00	5.11	$0.00
2035	1428	714	714			$0.00	5.42	$0.00
2036	1428	714	714			$0.00	5.74	$0.00
2037	1428	714	714			$0.00	6.09	$0.00
2038	1428	714	714			$0.00	6.45	$0.00
2039	1428	714	714			$0.00	6.84	$0.00
2040	1428	714	714			$0.00	7.25	$0.00
2041	1428	714	714			$0.00	7.69	$0.00
2042	1428	714	714			$0.00	8.15	$0.00
2043	1428	714	714			$0.00	8.64	$0.00
2044	1428	714	714			$0.00	9.15	$0.00
2045	1428	714	714			$0.00	9.70	$0.00
2046	1428	714	714			$0.00	10.29	$0.00
2047	1428	714	714			$0.00	10.90	$0.00
2048	1428	714	714			$0.00	11.56	$0.00
2049	1428	714	714			$0.00	12.25	$0.00

Table 15 - Other Expected Benefits of Recycled Water Retrofit Assistance Program
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided CO2 emissions							
	Measure of Benefit: metric tons of CO2							
	Without Proposal	With Proposal	Change Resulting from Proposal	Unit $ Value	Annual $ Value	Total Benefits	Discount Factor	Discounted Benefits
2050	1428	714	714			$0.00	12.99	$0.00
2051	1428	714	714			$0.00	13.76	$0.00
2052	1428	714	714			$0.00	14.59	$0.00
2053	1428	714	714			$0.00	15.47	$0.00
2054	1428	714	714			$0.00	16.39	$0.00
2055	1428	714	714			$0.00	17.38	$0.00
2056	1428	714	714			$0.00	18.42	$0.00
2057	1428	714	714			$0.00	19.53	$0.00
2058	1428	714	714			$0.00	20.70	$0.00
2059	1428	714	714			$0.00	21.94	$0.00
						Total Present Value of Discounted Benefits (Sum of the values in		$0.00

Comment Box:

Table 15 Other Expected Benefits of the 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)	(g)	(h)	(i)
YEAR	Benefit: Avoided CO2 Emissions							
	Measure of Benefit: metric tons of CO2					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal (c - b)	Unit $ Value	Annual $ Value	Total Benefits (Sum of Annual $ Value for each Benefit)	Discount Factor	Discounted Benefits
2007			0			$0.00	1.06	$0.00
2008			0			$0.00	1.12	$0.00
2009			0			$0.00	1.19	$0.00
2010			0			$0.00	1.26	$0.00
2011	1360	0	1360			$0.00	1.34	$0.00
2012	1360	0	1360			$0.00	1.42	$0.00
2013	1360	0	1360			$0.00	1.50	$0.00
2014	1360	0	1360			$0.00	1.59	$0.00
2015	1360	0	1360			$0.00	1.69	$0.00
2016	1360	0	1360			$0.00	1.79	$0.00
2017	1360	0	1360			$0.00	1.90	$0.00
2018	1360	0	1360			$0.00	2.01	$0.00
2019	1360	0	1360			$0.00	2.13	$0.00
2020	1360	0	1360			$0.00	2.26	$0.00
2021	1360	0	1360			$0.00	2.40	$0.00
2022	1360	0	1360			$0.00	2.54	$0.00
2023	1360	0	1360			$0.00	2.69	$0.00
2024	1360	0	1360			$0.00	2.85	$0.00
2025	1360	0	1360			$0.00	3.03	$0.00
2026	1360	0	1360			$0.00	3.21	$0.00
2027	1360	0	1360			$0.00	3.40	$0.00
2028	1360	0	1360			$0.00	3.60	$0.00
2029	1360	0	1360			$0.00	3.82	$0.00
2030	1360	0	1360			$0.00	4.05	$0.00
2031	1360	0	1360			$0.00	4.29	$0.00
2032	1360	0	1360			$0.00	4.55	$0.00
2033	1360	0	1360			$0.00	4.82	$0.00
2034	1360	0	1360			$0.00	5.11	$0.00
2035	1360	0	1360			$0.00	5.42	$0.00
2036	1360	0	1360			$0.00	5.74	$0.00
2037	1360	0	1360			$0.00	6.09	$0.00
2038	1360	0	1360			$0.00	6.45	$0.00
2039	1360	0	1360			$0.00	6.84	$0.00
2040	1360	0	1360			$0.00	7.25	$0.00
2041	1360	0	1360			$0.00	7.69	$0.00
2042	1360	0	1360			$0.00	8.15	$0.00
2043	1360	0	1360			$0.00	8.64	$0.00
2044	1360	0	1360			$0.00	9.15	$0.00
2045	1360	0	1360			$0.00	9.70	$0.00
2046	1360	0	1360			$0.00	10.29	$0.00
2047	1360	0	1360			$0.00	10.90	$0.00
2048	1360	0	1360			$0.00	11.56	$0.00
2049	1360	0	1360			$0.00	12.25	$0.00
2050	1360	0	1360			$0.00	12.99	$0.00
2051	1360	0	1360			$0.00	13.76	$0.00
2052	1360	0	1360			$0.00	14.59	$0.00
2053	1360	0	1360			$0.00	15.47	$0.00
2054	1360	0	1360			$0.00	16.39	$0.00
2055	1360	0	1360			$0.00	17.38	$0.00
2056	1360	0	1360			$0.00	18.42	$0.00
2057	1360	0	1360			$0.00	19.53	$0.00

Table 15 Other Expected Benefits of the 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)	(g)	(h)	(i)
YEAR	Benefit: Avoided CO2 Emissions							
	Measure of Benefit: metric tons of CO2					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal (c - b)	Unit $ Value	Annual $ Value	Total Benefits (Sum of Annual $ Value for each Benefit)	Discount Factor	Discounted Benefits
2058	1360	0	1360			$0.00	20.70	$0.00
2059	1360	0	1360			$0.00	21.94	$0.00
2060	1360	0	1360			$0.00	23.26	$0.00
						Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (i))		$0.00

Comment Box:

Table 15 Other Expected Benefits of Carlsbad Desalination Project Local Conveyance

(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Avoided CO2 Emissions							
	Measure of Benefit: metric tons of CO2					Discounting Calculations for Economic Benefits		
	Without Proposal	With Proposal	Change Resulting from Proposal (c - b)	Unit $ Value	Annual $ Value	Total Benefits (Sum of Annual $ Value for each Benefit)	Discount Factor	Discounted Benefits
2007						$0.00	1.06	$0.00
2008						$0.00	1.12	$0.00
2009						$0.00	1.19	$0.00
2010						$0.00	1.26	$0.00
2011						$0.00	1.34	$0.00
2012						$0.00	1.42	$0.00
2013	39991	0	39991			$0.00	1.50	$0.00
2014	39991	0	39991			$0.00	1.59	$0.00
2015	39991	0	39991			$0.00	1.69	$0.00
2016	39991	0	39991			$0.00	1.79	$0.00
2017	39991	0	39991			$0.00	1.90	$0.00
2018	39991	0	39991			$0.00	2.01	$0.00
2019	39991	0	39991			$0.00	2.13	$0.00
2020	39991	0	39991			$0.00	2.26	$0.00
2021	39991	0	39991			$0.00	2.40	$0.00
2022	39991	0	39991			$0.00	2.54	$0.00
2023	39991	0	39991			$0.00	2.69	$0.00
2024	39991	0	39991			$0.00	2.85	$0.00
2025	39991	0	39991			$0.00	3.03	$0.00
2026	39991	0	39991			$0.00	3.21	$0.00
2027	39991	0	39991			$0.00	3.40	$0.00
2028	39991	0	39991			$0.00	3.60	$0.00
2029	39991	0	39991			$0.00	3.82	$0.00
2030	39991	0	39991			$0.00	4.05	$0.00
2031	39991	0	39991			$0.00	4.29	$0.00
2032	39991	0	39991			$0.00	4.55	$0.00
2033	39991	0	39991			$0.00	4.82	$0.00
2034	39991	0	39991			$0.00	5.11	$0.00
2035	39991	0	39991			$0.00	5.42	$0.00
2036	39991	0	39991			$0.00	5.74	$0.00
2037	39991	0	39991			$0.00	6.09	$0.00
2038	39991	0	39991			$0.00	6.45	$0.00
2039	39991	0	39991			$0.00	6.84	$0.00
2040	39991	0	39991			$0.00	7.25	$0.00
						Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (i))		$0.00

Comment Box:

Table 15 Other Expected Benefits of thee San Diego Region Four Reservoir Intertie Project
(All benefits should be in 2006 dollars)

(a)	(b)	(c)	(d)	(e)	(f)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Benefit: Energy Management Opportunity					Benefit: Improved Flood Management							
	Measure of Benefit: megawatts per year (Identify units for each water supply or water quality benefit to be measured)					Measure of Benefit: $ in damages					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	$688,000	$0	0	0	0	$1.00	$0	$0	1.06	$0
2008	0	0	0	$688,000	$0	0	0	0	$1.00	$0	$0	1.12	$0
2009	0	0	0	$688,000	$0	0	0	0	$1.00	$0	$0	1.19	$0
2010	0	0	0	$688,000	$0	0	0	0	$1.00	$0	$0	1.25	$0
2011	0	0	0	$688,000	$0	0	0	0	$1.00	$0	$0	1.31	$0
2012	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.37	$44,659,854
2013	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.43	$42,786,014
2014	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.49	$41,063,087
2015	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.55	$39,473,548
2016	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.61	$38,002,484
2017	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.67	$36,637,126
2018	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.73	$35,366,474
2019	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.79	$34,181,006
2020	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.85	$33,072,432
2021	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.91	$32,033,508
2022	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	1.97	$31,057,868
2023	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.03	$30,139,901
2024	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.09	$29,274,641
2025	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.15	$28,457,674
2026	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.21	$27,685,068
2027	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.27	$26,953,304
2028	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.33	$26,259,227
2029	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.39	$25,600,000
2030	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.45	$24,973,061
2031	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.51	$24,376,096
2032	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.57	$23,807,004
2033	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.63	$23,263,878
2034	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.69	$22,744,981
2035	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.75	$22,248,727
2036	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.81	$21,773,665
2037	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.87	$21,318,467
2038	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.93	$20,881,911
2039	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	2.99	$20,462,876
2040	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.05	$20,060,328
2041	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.11	$19,673,312
2042	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.17	$19,300,946
2043	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.23	$18,942,415
2044	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.29	$18,596,960
2045	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.35	$18,263,881
2046	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.41	$17,942,522
2047	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.47	$17,632,277
2048	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.53	$17,332,578
2049	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.59	$17,042,897
2050	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.65	$16,762,740
2051	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.71	$16,491,644
2052	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.77	$16,229,178
2053	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.83	$15,974,935
2054	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.89	$15,728,535
2055	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	3.95	$15,489,620
2056	0	5.5	5.5	$688,000	$3,784,000	76400000	19000000	57400000	$1.00	$57,400,000	$61,184,000	4.01	$15,257,853
											Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (i))		$1,125,276,508

Comment Box:

Table 15 Other Expected Benefits of the 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)	(g)	(h)	(i)
YEAR	Benefit: Reduction in greenhouse gas emissions					Benefit: High Quality Sand Resources							
	Measure of Benefit: tons of CO2					Measure of Benefit: tons of sand					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	1.06	$0
2008	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.12	$3,968,254
2009	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.19	$3,734,827
2010	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.26	$3,520,416
2011	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.34	$3,321,147
2012	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.42	$3,133,158
2013	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.50	$2,955,809
2014	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.59	$2,788,499
2015	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.69	$2,630,660
2016	1,600	0	1600	$0	$0	0	1,111,111	1111111.11	$4	$4,444,444	$4,444,444	1.79	$2,481,755
2017	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	1.90	$0
2018	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.01	$0
2019	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.13	$0
2020	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.26	$0
2021	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.40	$0
2022	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.54	$0
2023	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.69	$0
2024	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	2.85	$0
2025	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.03	$0
2026	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.21	$0
2027	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.40	$0
2028	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.60	$0
2029	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	3.82	$0
2030	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.05	$0
2031	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.29	$0
2032	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.55	$0
2033	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	4.82	$0
2034	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	5.11	$0
2035	1,600	0	1600	$0	$0	0	0	0	$4	$0	$0	5.42	$0
2036	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2037	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2038	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2039	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2040	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2041	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2042	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2043	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2044	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2045	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2046	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2047	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2048	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2049	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2050	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2051	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2052	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2053	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2054	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2055	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2056	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2057	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2058	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2059	1,600	0	1600	$0	$0	0	0	0	$4	$0			
2060	1,600	0	1600	$0	$0	0	0	0	$4	$0			
											Total Present Value of Discounted Benefits Based on % Avoided Cost Claimed by Proposal		$28,534,526
													57.2%
											Total Present Value of Discounted Benefit		$16,332,024

Comment Box