San Francisco Bay Area Regional Priority Projects and Programs Attachment 8. Economic Analysis: Water Quality and Other Expected Benefits

Project 1. Regional Recycled Water Program

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1 Summary

The Bay Area Regional Recycled Water Program includes the implementation of 10 recycled water supply projects within the Bay Area Water region. Together, the projects will enable the use 3,210 acre-feet per year (AFY) of recycled water for landscape and agricultural irrigation, municipal, residential, and commercial and industrial purposes. In each case, the use of recycled water made available through the proposed projects will offset the use of potable water supplies, including water imported from the San Francisco Bay and Sacramento-San Joaquin Deltas, local surface water, and a limited amount of groundwater supplies.

The San Francisco Bay Area region has a long history of regional recycled water planning. In the early 1990s, Bay Area water and wastewater agencies formed a partnership with the US Bureau of Reclamation (USBR) and DWR to study the feasibility of a regional approach to water recycling in the Bay Area region. This partnership resulted in the formation of the Bay Area Regional Water Recycling Program (BARWRP), which produced the BARWRP Master Plan in 1999. BARWRP), demonstrated that large-scale implementation of recycled water would improve water supply reliability and water quality in the San Francisco Bay and Delta, and contribute to long-term restoration of the Bay-Delta environment. BARWRP continues to serve as the foundation of regional recycled water planning throughout the Bay Area today.

In addition, the South Bay Water Recycling Program (SBWR) was initiated in 1991 to provide a reliable, sustainable and drought-proof supply of recycled water to the South Bay area. The SBWR provide a case study of a complex partnership between local, state and federal agencies including entities such as San Jose, Santa Clara and Milpitas, five sanitation districts, the U.S. Bureau of Reclamation, Environmental Protection Agency, California Department of Water Resources, Department of Health Services, Regional Water Quality Control Board and Santa Clara Valley Water District.

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In 2003, water supply and clean water agencies throughout the North Bay counties of Marin, Sonoma and Napa began meeting to investigate opportunities to expand the use of recycled water for agricultural and other purposes. Co-sponsored by USBR, the North Bay Water Reuse Authority Program (NBWRA Program) was initiated to identify a regional recycled water program to increase water supply, reduce discharges to the North Bay and provide ecosystem enhancements. Finally, smaller scale collaboration efforts between water purveyors and sanitation districts have also multiplied in the recent years, as illustrated by some of the recycled water projects presented in this grant application. Generally, the recycled water projects included in this grant application are a direct product of BARWRP, SBWR, and NBWRP planning efforts.

Table 1 provides a summary of the Bay Area Regional Recycled Water Program included in this grant application. A summary of the project costs and water quality and other benefits of the Bay Area Regional Recycled Water Program are provided in Table 2. Total project costs and water quality and other benefits are discussed in the remainder of this attachment.

2 The "Without Project" Baseline

Water recycling within the Delta watershed may have minimal net water supply benefit to the Delta because water recycling reduces treated wastewater discharges that return flows to the Delta. However, on-going and new recycling activities are considered of statewide importance.

Without the project, 3,210 AFY of tertiary-treated effluent would not be put to beneficial use, and would be discharged directly to Bay Area surface water bodies, including Suisun Bay, North San Pablo Bay, San Francisco Bay, and the Sacramento-San Joaquin Delta. Many of these areas are already highly impaired and are home to sensitive habitat and endangered species. Fish and wildlife beneficial uses in these water bodies, such as cold freshwater habitat, estuarine habitat, fish migration, preservation of rare and endangered species, shellfish harvesting, fish spawning, riparian and wetland wildlife habitat are of statewide significance.

Generally, elevated salinity can be harmful to various species of fish and wildlife, agricultural production, and municipal and industrial uses of water throughout the Bay-Delta estuary. As a result, natural and abandoned flows are often inadequate to meet Bay-Delta water quality (2008 SWRCB). Therefore, the continued discharge of wastewater effluent to surface water would contribute to further surface water quality degradation.

Table 1. Bay Area Regional Recycled Water Program Projects Summary

Project Proponent	Project Name	Project Description	AFY
A.Central Contra Costa Sanitary District	Concord Recycled Water Project, Phase I	Construction of 2.5 miles of underground pipeline to provide recycled water to 34 sites in the City of Concord for landscape irrigation.	190
B. Dublin San Ramon Services District	Central Dublin Recycled Water Distribution and Retrofit Project	Construction of 14,000 linear feet of distribution pipeline to provide recycled water to 11 sites in Dublin for landscape irrigation.	240
C. East Bay Municipal Utilities District	East Bayshore Project, Phase IA (I-80 Pipeline)	Construction of a transmission pipeline from Emeryville to Albany, distribution pipelines in Emeryville, Berkeley, Albany, and customer retrofits to provide recycled water for irrigation purposes.	210
D. Marin Municipal Water District	Peacock Gap Recycled Water Extension	Construction of 8.5 miles of pipeline to existing MMWD recycled water distribution line, conversion of a 500,000-gallon potable water storage tank into recycled water storage, and installation of recycled water meters.	320
E. North Bay Water Reuse Authority (includes 4 sub-projects)			1,490
i. North Marin Water District/Novato Sanitary District	Novato North Service Area Project	Treatment capacity expansion at the Novato Sanitary District's Davidson WWTP to 1.7 MGD (peak day capacity), construction of distribution pump station, retrofit of the 0.5 MG Plum St. Tank for recycled water storage, and installation of 4.6 mi of pipeline.	*186*
ii. Las Gallinas Valley Sanitation District/North Marin Water District	Novato South Service Area Project	Implementation of 0.7 mgd treatment upgrade at the LGVSD WWTP or expansion of an existing tertiary treatment facility, construction of a booster pump station and 5.8 mile pipeline distribution system, and retrofit of the 0.5 MG Reservoir Hill Tank for recycled water storage.	*204*
iii. Napa Sanitation District	Napa State Hospital Pipeline Construction, Stage 1	Construct 24" recycled water pipeline along Napa College and through the Napa State Hospital (NSH) property.	*1,000*
iv. Sonoma Valley County Sanitation District	Sonoma Valley Recycled Water, Stage 1	Construction of distribution pipeline, improvements at SVCSD's treatment plant, and design and construction of a recycled water reservoir with capacity of between 60 – 100 AF.	*100*
F. San Francisco Public Utilities Commission	Harding Park Recycled Water Project	Construction of a pipeline along Lake Merced Boulevard to Harding Park, a 700,000 gal underground storage tank, and a pump station. Project will tie into existing recycled water system.	260
G. South Bay Water Recycling	Industrial Expansion and Reliability	Construction of 6,000 feet of pipeline to distribute recycled water to data centers in City of Santa Clara; construction of a potable backup system to ensure continuous supply of over 10,000 AFY of recycled water to SBWR customers in the event that water produced by the Advanced Water Treatment Facility becomes unavailable; construction of potable backup system to ensure the continuous supply of 100 AFY of recycled water for Mineta-San Jose International Airport; development of a regional message to promote the use of recycled water in the San Francisco Bay Area.	500
		Total Regional Bay Area Recycled Water Project	3,210

Table 2. Water Quality and Other Benefits Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$53,089,000
Monetizable Benefits	
Avoided Fertilizer Costs	$1,066,000
Qualitative Benefits or Costs	**Qualitative indicator***
Improved Surface Water Quality	++
Reduced CO2 Emissions	+
Reduced Stress on the Sacramento-San Joaquin River Delta – San Francisco Bay Estuary	+
Other Ecological Benefits	+
Increased Aesthetics and Recreational Opportunities	+

O&M = Operations and Maintenance
* 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 –.

3 Water Quality and Other Benefits

The proposed project will provide a range of water quality and other benefits. This section provides discussion and details on benefit estimation for benefits including: (1) Avoided fertilizer costs; (2) Reduced CO2 emissions; (3) Improved surface water quality; and, (4) Other ecological, aesthetic, and recreational benefits.

Avoided Fertilizer Costs

Fertilizing compounds commonly contained in recycled water are typically not found in potable water (e.g., nitrogen, phosphorous, potassium). Thus, the use of recycled water for irrigation will reduce fertilizer costs associated with lands that will be serviced by the various projects.

Approximately 2,710 AF of recycled water will be made available for irrigation as a result of the Bay Area Regional Recycled Water Projects (all projects will provide irrigation water except Project G, which will provide 500 AFY for industrial purposes). On average (across all projects), this recycled water is expected to contain about 27.2 lbs of nitrogen per AF, 13.6 lbs of phosphorous per AF, and 27.2 lbs of potassium per AF. The commercial value of these concentrations of fertilizing nutrients amounts to $11.8,

$9.87, and $8.24 per AF of recycled water (2009 USD).[1] Thus, for every AF of recycled water used in lieu of potable supplies, irrigators will avoid a total of $29.92 in fertilizer costs. Over the lifetime of all projects (through 2062), 126,773 AF of recycled will be used for irrigation in-lieu of potable water, and total present value avoided fertilizer costs will amount to $1,066,000 (2009 USD)[2].

Reduced CO_2 Emissions

Water recycling may serve to reduce green house gas emissions in comparison to alternate water supplies, and they serve as adaptive responses to climate change because they increase local water supplies and water reliability (2008 SWRCB[3]). Although water recycling may actually increase CO2 emissions in SFPUC and EBMUD service areas -since water supplies from both agencies are mostly gravity fed- it is likely overall energy consumption and CO2 emissions will be reduced after implementation of the Regional Recycled Water Project. By offsetting imported water demands with locally produced water, the project will avoid emissions of CO_2 (a greenhouse gas) generated by the production of energy required to transport water from the San Francisco Bay and Sacramento-San Joaquin River Delta or from other surface water sources.

In California, electricity production relies on a range of energy sources, including those located within California and those located outside of the state. PG&E estimates that the average CO2 emissions rate for the mix of electricity sources in the Bay Area is 0.238 MT/MWh. The California Energy Commission estimates that in Northern California, 1.29 MWh of electricity are required to treat and deliver 1 AF of surface water for potable use[4] [5](CEC 2005). This includes energy required for conveyance, treatment, distribution, and wastewater treatment.

Given the carbon dioxide emissions of 0.238 tons of CO_2 emitted per MWh, 0.307 tons of CO_2 are produced for every AF of surface water delivered and treated within Bay Area (1.29 MWh/AF multiplied by 0.238 MT CO2/MWh). By eliminating use of 152,273 AF of surface water supplies over the assumed project life, the project will avoid emission of 46,751 MT of CO2. Avoided CO2 emissions will be offset to some extent by the energy (and associated CO2 emissions) used to pump and distribute recycled water in the region. It is estimated that on average, 0.652 MWh are required to produce and distribute 1 AF of recycled water within the project service area. Using the same emissions rate of 0.238 of CO2 per MWh, CO2 emissions associated with recycled water use through 2062 will amount to 23,629 MT. Thus, with the project, net avoided carbon emissions will be 23,122 MT.
Table 3 shows the quantified avoided fertilizer costs and reduced CO2 emissions associated with

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[1] Source: Asano, 1981, updated to 2006 using the national fertilizer price index. Updated from 2006 to 2009 based on the Consumer Price Index (CPI).

[2] 2,710 AFY will be available at full project implementation. In earlier years, before all projects are fully online, less will be available. In later years, the two projects with 25-year project lives are assumed to be taken offline. The calculation of recycled water over the life of the project takes the phasing of the different projects into account.

[3] Source: Strategic Workplan for Activities in the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, SWRCB, Central Valley RWQCB & San Francisco RWQCB

[4] California Energy Commission. 2005. California's Water-Energy Relationship, November 2005. Final Staff Report. Prepared in Support of the 2005 Integrated Energy Policy Proceeding (04-IEPR-01E).

[5] Although the NBWRP will offset the use of some groundwater, it is expected to be a very small amount. Because surface water (especially imported water) is the marginal source of water in the Bay Area, it is assumed that the majority of avoided potable water will come from surface water. Thus, avoided emissions will be a result of reduced surface water reliance.

the proposed project.

Improved Surface Water Quality

If the recycled water projects are not implemented, wastewater effluent will not be put to beneficial use, and will be discharged to surface water bodies within the Bay Area. Affected water bodies include Suisun Bay, North San Pablo Bay, San Francisco Bay, and the Sacramento-San Joaquin Delta. Fish and wildlife beneficial uses in these water bodies, such as cold freshwater habitat, estuarine habitat, fish migration, preservation of rare and endangered species, shellfish harvesting, fish spawning, riparian and wetland wildlife habitat are of statewide significance. Many of these areas are already highly impaired and are home to sensitive habitat and endangered species. In addition, reducing wastewater discharges into the San Francisco Bay and San Joaquin-Sacramento River Delta will result in reduction of total pollutants loading into surface waters.

Reduced Stress on the Sacramento-San Joaquin River Delta – San Francisco Bay Estuary

In addition to improving water quality, the Bay Area Regional Recycled Water projects will augment in-stream flows in the Bay-Delta, or will offset other diversions that may otherwise reduce flows. Reduced demands on Delta supplies will also help to reduce the overall salinity of the Delta and improve Delta habitat. For example, approximately 95% of EBMUD's water supply comes from the Mokelumne River, an eastside tributary to the Delta. EBMUD's project (Project C) will reduce the amount of water that must otherwise be delivered from the Mokelumne River to EBMUD's East Bay service area. Reducing deliveries can result in higher reservoir storage levels in EBMUD reservoirs in the Sierra Nevada foothills and increased reservoir releases to the lower Mokelumne River. Under a legally enforceable Settlement Agreement involving state and federal resource agencies, releases and flows in the lower Mokelumne River during the fall and early winter are based on storage levels so increased storage may result in some portion being released for fishery purposes. Once that water reaches the Delta, it provides additional benefits for Delta resources and water users.

Maintaining the Delta's environmental condition is vital to maintaining and improving the viability of the region. The Delta provides drinking water to 25 million people, supports irrigation of 4.5 million acres of agricultural land, and serves as home to 750 plant and animal species. The Delta's 1,600 square miles of marshes, islands, and sloughs support at least half of migratory water birds on the Pacific Flyway, 80% of California's commercial fisheries, and recreational uses including boating, fishing, and windsurfing. Delta resources are in a state of crisis. Fish populations, including salmon and Delta smelt, have declined dramatically in recent years. The levee system is aging, and vulnerability of the Delta to flooding, sea level rise, or a major earthquake has contributed concerns about possible levee collapse. In addition, water quality problems continue, and there is little consensus on how to manage water resources through storage.

Other Ecological Benefits

Implementation of Bay Area Recycled Water Program will also increase the amount of water available for environmental uses in areas outside of the Bay Delta. For example, reduced reliance on local surface water will improve in-stream flows for riparian habitat and fisheries recovery. Implementation of the Regional Recycled Water Program will also reduce wastewater discharges to the Pacific Ocean thereby reducing total pollutants loading into the Pacific Ocean.

Increased Aesthetics and Recreational Opportunities

Much of the recycled water made available by the proposed projects will be used to irrigate municipal parks, sports fields, golf courses and other public areas. Because recycled water is a drought resistant source of supply, these areas will not be subject to water supply shortages during dry years. Thus, lands serviced by the various projects will be able to remain green throughout the year. This will result in increased aesthetics and increased recreational opportunities at sports fields, parks, and golf courses relative to areas irrigated with potable supplies.

4 Distribution of Project Benefits, and Identification of Beneficiaries

The proposed project includes the full range of beneficiaries. At the local level, there will be increased recreational opportunities and aesthetics, and recycled water customers will benefit from avoided fertilizer costs. Regional and statewide benefits include reduced GHG emissions, improved water quality and ecological benefits in water bodies of regional and state-wide significance.

5 Project Benefits Timeline

With the exception of the Novato North Service Area Project (Project E.i) and Novato South Service Area Project (Project E.ii) (NBWRA Program), all projects are assumed to have a useful project life of 50-years. The majority of these projects will be fully online by 2013 (with most beginning to provide benefits at some point in 2012). Thus, benefits are calculated through 2062 for these projects (50-years after the projects come online).

Both Projects E.i and E.ii include treatment components, which typically have a shorter lifetime than pipeline/distribution projects. The useful life of these two projects is assumed to be 25 years. Benefits for these projects are therefore calculated through 2037 and 2038 (25 years after they are fully online in 2013 and 2014, respectively).

6 Potential Adverse Effects from the Project

Potential impacts from implementation of the Regional Recycled Water Program include temporary construction-related impacts. Additional impacts can include potential water quality impacts from nutrient and salinity loading and emerging contaminants, potentially increased energy usage and costs (compared to potable supplies) from the treatment process (while overall energy usage and costs are anticipated to be lower as discussed in the *Reduced CO_2 Emissions* section), and potential growth-inducing impacts resulting from improved water supply reliability.

Table 3 - Water Quality and Other Expected Benefits
(All benefits in 2009 dollars)
Project: REGIONAL RECYCLED WATER PROGRAM

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project	(g) Unit $ Value (1)	(h) Annual $ Value (1)	(i) Discount Factor (1)	(j) Discounted Benefits (1)
2012	Avoided fertilizer use	lbs of fertilizer	0	60,336	60,336	$0.44	$26,549	0.840	$22,301
	Avoided CO2 emissions	MT of CO_2	0	211	211				
2013	Avoided fertilizer use	lbs of fertilizer	0	179,648	179,648	$0.44	$79,048	0.792	$62,606
	Avoided CO2 emissions	MT of CO_2	0	477	477				$0
2014	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.747	$60,568
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2015	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.705	$57,163
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2016	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.665	$53,920
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2017	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.627	$50,839
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2018	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.592	$48,001
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2019	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.558	$45,244
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2020	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.527	$42,730
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2021	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.497	$40,298
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2022	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.469	$38,028
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2023	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.442	$35,838
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2024	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.417	$33,811
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2025	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.394	$31,946
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2026	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.371	$30,082
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2027	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.350	$28,379
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2028	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.331	$26,838
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2029	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.312	$25,298
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2030	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.294	$23,838
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2031	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.278	$22,541
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2032	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.262	$21,244
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2033	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.247	$20,027
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2034	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.233	$18,892
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2035	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.220	$17,838
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2036	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.207	$16,784
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2037	Avoided fertilizer use	lbs of fertilizer	0	184,271	184,271	$0.44	$81,082	0.196	$15,892
	Avoided CO2 emissions	MT of CO_2	0	487	487				$0
2038	Avoided fertilizer use	lbs of fertilizer	0	171,624	171,624	$0.44	$75,517	0.185	$13,971
	Avoided CO2 emissions	MT of CO_2	0	459	459				$0
2039	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.174	$12,078
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2040	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.164	$11,384
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2041	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.155	$10,759
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2042	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.146	$10,134
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2043	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.138	$9,579
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2044	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.130	$9,024
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2045	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.123	$8,538
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2046	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.116	$8,052
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2047	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.109	$7,566
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2048	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.103	$7,150
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2049	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.097	$6,733
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2050	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.092	$6,386
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2051	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.087	$6,039
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2052	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.082	$5,692
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2053	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.077	$5,345
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2054	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.073	$5,067
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2055	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.069	$4,790
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2056	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.065	$4,512
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2057	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.061	$4,234
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2058	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.058	$4,026
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2059	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.054	$3,748
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2060	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.051	$3,540
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2061	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.048	$3,332
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
2062	Avoided fertilizer use	lbs of fertilizer	0	157,753	157,753	$0.44	$69,414	0.046	$3,193
	Avoided CO2 emissions	MT of CO_2	0	428	428				$0
Project life	**Avoided fertilizer use**	**lbs of fertilizer**	**0**	**8,620,180**	**8,620,180**		$ 3,766,467		$ 1,065,817
Project life	**Avoided CO2 emissions**	**MT of CO_2**	**0**	**23,122**	**23,122**		-		
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries		$1,066,000

7 Summary of Findings

The proposed recycled water projects will provide water quality and other benefits. As a result of the project, recycled water customers will save $1,066,000 in fertilizer costs. By reducing reliance on imported water and local surface water, the projects will also avoid 23,122 MT of CO2 emissions over their useful life. The projects will also result in improved surface water quality due to reduced wastewater discharges and reduced total contaminant loading. In addition, the project will provide ecological benefits resulting from the increased availability of surface flows for environmental uses, as well as recreational and aesthetic benefits resulting from the availability of a year-round supply for irrigation of public parks and spaces throughout the Bay Area.

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. Potential issues are listed in Table 4.

Table 4. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Avoided Fertilizer Costs	U	The analysis of avoided fertilizer costs is based on average concentrations from the literature. Project-specific data is not available. If nutrient concentrations are higher than assumed, avoided fertilizer costs would be greater than shown.
Reduced CO2 Emissions	U	The analysis of avoided CO2 emissions is expected to result in real emissions reductions. However, energy and emission data for each project is unavailable. This analysis therefore relies on averages for Northern California as a whole.

*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 -.

Appendix A

		Initial Costs (Not Discounted)	Operations and Maintenance Costs (Discounted)						
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(i)
No.	Project Name		Admin	Operation	Maintenance	Replacement	Other	Total Cost	Total Present Value of Discounted Cost
A	CCCSD/Concord Recycled Water Project	$ 3,945,000	$ -	$ -	$ -	$ -	$ -	$ 3,945,000	$ 3,414,000
B	DSRSD Central Dublin Recycled Water Distribution and Retrofit Project	$ 3,542,000	$ -	$ -	$ -	$ -	$ -	$ 3,542,000	$ 3,077,000
C	EBMUD East Bayshore Phase IA – I-80 Pipeline	$ 1,639,000	$ -	$ -	$ -	$ -	$ -	$ 1,640,000	$ 1,378,000
D	MMWD Peacock Gap Recycled Water Extension	$ 7,601,000	$ -	$ -	$ -	$ -	$ -	$ 7,602,000	$ 6,390,000
E	North Bay Water Reuse Authority Program								
i.	Novato SD/NMWD Novato North Service Area Project	$ 10,425,000	$ 254,000	$ 1,966,000	$ 3,111,000	$ -	$ -	$ 15,755,000	$ 11,515,000
ii.	LGVSD/NMWD Novato South Service Area Project	$ 9,968,000	$ 309,000	$ 2,567,000	$ 2,417,000	$ 436,000	$ -	$ 15,696,000	$ 11,071,000
iii.	Napa SD NSH Pipeline Construction Stage 1 Project	$ 2,218,000	$ -	$ 186,000	$ 180,000	$ 2,957,000	$ -	$ 5,540,000	$ 2,741,000
iv.	SVCSD Recycled Water Stage 1 Project	$ 4,875,000	$ 81,000	$ 250,000	$ 250,000	$ 2,200,000	$ -	$ 7,656,000	$ 4,861,000
F	SFPUC Harding Park Recycled Water Project	$ 5,879,000	$ -	$ -	$ -	$ -	$ -	$ 5,879,000	$ 5,173,000
G	SBWR Industrial Expansion and Reliability	$ 4,127,000	$ -	$ -	$ -	$ -	$ -	$ 4,127,000	$ 3,469,000
	TOTAL FOR REGIONAL RECYCLED WATER PROGRAM	**$ 54,219,000**	**$ 644,000**	**$ 4,969,000**	**$ 5,958,000**	**$ 5,593,000**	**$ -**	**$ 71,382,000**	**$ 53,089,000**

Table 11- Annual Cost of Project

(All costs should be in 2009 Dollars)

Project: CCSD Concord Recycled Water Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost	Admin	Operation	Maintenance	Replacement	Other	Total Costs	Discount Factor	Discounted Costs
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$1,990,000						$1,990,000	0.890	$1,771,100
2012	$1,955,000						$1,955,000	0.840	$1,642,200
2013							$0	0.792	$0
2014							$0	0.747	$0
2015							$0	0.705	$0
2016							$0	0.665	$0
2017							$0	0.627	$0
2018							$0	0.592	$0
2019							$0	0.558	$0
2020							$0	0.527	$0
2021							$0	0.497	$0
2022							$0	0.469	$0
2023							$0	0.442	$0
2024							$0	0.417	$0
2025							$0	0.394	$0
2026							$0	0.371	$0
2027							$0	0.350	$0
2028							$0	0.331	$0
2029							$0	0.312	$0
2030							$0	0.294	$0
2031							$0	0.278	$0
2032							$0	0.262	$0
2033							$0	0.247	$0
2034							$0	0.233	$0
2035							$0	0.220	$0
2036							$0	0.207	$0
2037							$0	0.196	$0
2038							$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$3,945,000	$0	$0	$0	$0	$0	$3,945,000	$0	$3,414,000
								Total Present Value of Discounted Costs (Sum of Column (i))	$3,414,000
								Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries	

Comments: There are no incremental O&M costs for this project.
Numbers have been rounded to the nearest $1,000.

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: DSRSD Central Dublin Recycled Water Distribution and Retrofit Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$2,030,000						$2,030,000	0.890	$1,806,700
2012	$1,512,000						$1,512,000	0.840	$1,270,080
2013							$0	0.792	$0
2014							$0	0.747	$0
2015							$0	0.705	$0
2016							$0	0.665	$0
2017							$0	0.627	$0
2018							$0	0.592	$0
2019							$0	0.558	$0
2020							$0	0.527	$0
2021							$0	0.497	$0
2022							$0	0.469	$0
2023							$0	0.442	$0
2024							$0	0.417	$0
2025							$0	0.394	$0
2026							$0	0.371	$0
2027							$0	0.350	$0
2028							$0	0.331	$0
2029							$0	0.312	$0
2030							$0	0.294	$0
2031							$0	0.278	$0
2032							$0	0.262	$0
2033							$0	0.247	$0
2034							$0	0.233	$0
2035							$0	0.220	$0
2036							$0	0.207	$0
2037							$0	0.196	$0
2038							$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$3,542,000	$0	$0	$0	$0	$0	$3,542,000	$0	$3,077,000
Total Present Value of Discounted Costs (Sum of Column (i))									$3,077,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: There are no incremental O&M costs for this project. Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: EBMUD East Bayshore Phase IA – I-80 Pipeline									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$546,500						$546,500	0.890	$486,385
2012	$546,500						$546,500	0.840	$459,060
2013	$546,500						$546,500	0.792	$432,828
2014							$0	0.747	$0
2015							$0	0.705	$0
2016							$0	0.665	$0
2017							$0	0.627	$0
2018							$0	0.592	$0
2019							$0	0.558	$0
2020							$0	0.527	$0
2021							$0	0.497	$0
2022							$0	0.469	$0
2023							$0	0.442	$0
2024							$0	0.417	$0
2025							$0	0.394	$0
2026							$0	0.371	$0
2027							$0	0.350	$0
2028							$0	0.331	$0
2029							$0	0.312	$0
2030							$0	0.294	$0
2031							$0	0.278	$0
2032							$0	0.262	$0
2033							$0	0.247	$0
2034							$0	0.233	$0
2035							$0	0.220	$0
2036							$0	0.207	$0
2037							$0	0.196	$0
2038							$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$1,639,000	$0	$0	$0	$0	$0	$1,640,000	$0	$1,378,000
Total Present Value of Discounted Costs (Sum of Column (i))									$1,378,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: There are no incremental O&M costs for this project. Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: MMWD Peacock Gap Recycled Water Extension									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$2,533,875						$2,533,875	0.890	$2,255,149
2012	$2,533,875						$2,533,875	0.840	$2,128,455
2013	$2,533,875						$2,533,875	0.792	$2,006,829
2014							$0	0.747	$0
2015							$0	0.705	$0
2016							$0	0.665	$0
2017							$0	0.627	$0
2018							$0	0.592	$0
2019							$0	0.558	$0
2020							$0	0.527	$0
2021							$0	0.497	$0
2022							$0	0.469	$0
2023							$0	0.442	$0
2024							$0	0.417	$0
2025							$0	0.394	$0
2026							$0	0.371	$0
2027							$0	0.350	$0
2028							$0	0.331	$0
2029							$0	0.312	$0
2030							$0	0.294	$0
2031							$0	0.278	$0
2032							$0	0.262	$0
2033							$0	0.247	$0
2034							$0	0.233	$0
2035							$0	0.220	$0
2036							$0	0.207	$0
2037							$0	0.196	$0
2038							$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$7,601,000	$0	$0	$0	$0	$0	$7,602,000	$0	$6,390,000
Total Present Value of Discounted Costs (Sum of Column (i))									$6,390,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: There are no incremental O&M costs for this project. Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: Novato SD/NMWD Novato North Service Area Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	$0	$0	$0	$0	$0	$0	$0	1.000	$0
2010		$0	$0	$0	$0	$0	$0	0.943	$0
2011	$8,500,849	$0	$0	$0	$0	$0	$8,500,849	0.890	$7,565,756
2012	$1,923,959	$9,750	$38,550	$61,000	$0	$0	$2,033,259	0.840	$1,707,938
2013	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.792	$165,409
2014	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.747	$156,011
2015	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.705	$147,239
2016	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.665	$138,885
2017	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.627	$130,949
2018	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.592	$123,639
2019	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.558	$116,538
2020	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.527	$110,064
2021	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.497	$103,798
2022	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.469	$97,951
2023	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.442	$92,312
2024	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.417	$87,090
2025	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.394	$82,287
2026	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.371	$77,483
2027	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.350	$73,098
2028	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.331	$69,129
2029	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.312	$65,161
2030	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.294	$61,402
2031	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.278	$58,060
2032	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.262	$54,719
2033	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.247	$51,586
2034	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.233	$48,662
2035	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.220	$45,947
2036	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.207	$43,232
2037	$0	$9,750	$77,100	$122,000	$0	$0	$208,850	0.196	$40,935
2038					$0	$0	$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$10,425,000	$254,000	$1,966,000	$3,111,000	$0	$0	$15,755,000	$0	$11,515,000
Total Present Value of Discounted Costs (Sum of Column (i))									$11,515,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project

(All costs should be in 2009 Dollars)

Project: LGVSD/NMWD Novato South Service Area Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	$0	$0	$0	$0			$0	1.000	$0
2010		$5,000	$0	$0			$5,000	0.943	$4,715
2011	$4,911,672	$5,000	$0	$0			$4,916,672	0.890	$4,375,838
2012	$5,055,924	$5,000	$90,750	$51,000			$5,202,674	0.840	$4,370,246
2013	$0	$11,500	$95,250	$91,000			$197,750	0.792	$156,618
2014	$0	$11,500	$95,250	$91,000			$197,750	0.747	$147,719
2015	$0	$11,500	$95,250	$91,000			$197,750	0.705	$139,414
2016	$0	$11,500	$95,250	$91,000			$197,750	0.665	$131,504
2017	$0	$11,500	$95,250	$91,000			$197,750	0.627	$123,989
2018	$0	$11,500	$95,250	$91,000			$197,750	0.592	$117,068
2019	$0	$11,500	$95,250	$91,000			$197,750	0.558	$110,345
2020	$0	$11,500	$95,250	$91,000	$57,600		$255,350	0.527	$134,569
2021	$0	$11,500	$95,250	$91,000	$57,600		$255,350	0.497	$126,909
2022	$0	$11,500	$95,250	$91,000	$57,600		$255,350	0.469	$119,759
2023	$0	$11,500	$95,250	$91,000			$197,750	0.442	$87,406
2024	$0	$11,500	$95,250	$91,000			$197,750	0.417	$82,462
2025	$0	$11,500	$95,250	$91,000			$197,750	0.394	$77,914
2026	$0	$11,500	$95,250	$91,000			$197,750	0.371	$73,365
2027	$0	$11,500	$95,250	$91,000	$90,000		$287,750	0.350	$100,713
2028	$0	$11,500	$95,250	$91,000			$197,750	0.331	$65,455
2029	$0	$11,500	$95,250	$91,000			$197,750	0.312	$61,698
2030	$0	$11,500	$95,250	$91,000	$57,600		$255,350	0.294	$75,073
2031	$0	$11,500	$95,250	$91,000	$57,600		$255,350	0.278	$70,987
2032	$0	$11,500	$95,250	$91,000	$57,600		$255,350	0.262	$66,902
2033	$0	$11,500	$95,250	$91,000			$197,750	0.247	$48,844
2034	$0	$11,500	$95,250	$91,000			$197,750	0.233	$46,076
2035	$0	$11,500	$95,250	$91,000			$197,750	0.220	$43,505
2036	$0	$11,500	$95,250	$91,000			$197,750	0.207	$40,934
2037	$0	$11,500	$95,250	$91,000			$197,750	0.196	$38,759
2038	$0	$11,500	$95,250	$91,000			$197,750	0.185	$36,584
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$9,968,000	$309,000	$2,567,000	$2,417,000	$436,000	$0	$15,696,000	$0	$11,071,000
								Total Present Value of Discounted Costs (Sum of Column (i))	$11,071,000
								Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries	

Comments: Numbers have been rounded to the nearest $1,000.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: Napa SD Napa State Hospital Pipeline Construction Stage 1 Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009				$0	$0		$0	1.000	$0
2010				$0	$0		$0	0.943	$0
2011	$739,201			$0	$0		$739,201	0.890	$657,889
2012	$739,201			$0	$0		$739,201	0.840	$620,929
2013	$739,201		$2,250	$0	$59,136		$800,587	0.792	$634,065
2014			$3,750	$0	$59,136		$62,886	0.747	$46,976
2015			$3,750	$0	$59,136		$62,886	0.705	$44,335
2016			$3,750	$15,000	$59,136		$77,886	0.665	$51,794
2017			$3,750	$0	$59,136		$62,886	0.627	$39,430
2018			$3,750	$0	$59,136		$62,886	0.592	$37,229
2019			$3,750	$0	$59,136		$62,886	0.558	$35,090
2020			$3,750	$15,000	$59,136		$77,886	0.527	$41,046
2021			$3,750	$0	$59,136		$62,886	0.497	$31,254
2022			$3,750	$0	$59,136		$62,886	0.469	$29,494
2023			$3,750	$0	$59,136		$62,886	0.442	$27,796
2024			$3,750	$15,000	$59,136		$77,886	0.417	$32,478
2025			$3,750	$0	$59,136		$62,886	0.394	$24,777
2026			$3,750	$0	$59,136		$62,886	0.371	$23,331
2027			$3,750	$0	$59,136		$62,886	0.350	$22,010
2028			$3,750	$15,000	$59,136		$77,886	0.331	$25,780
2029			$3,750	$0	$59,136		$62,886	0.312	$19,620
2030			$3,750	$0	$59,136		$62,886	0.294	$18,488
2031			$3,750	$0	$59,136		$62,886	0.278	$17,482
2032			$3,750	$15,000	$59,136		$77,886	0.262	$20,406
2033			$3,750	$0	$59,136		$62,886	0.247	$15,533
2034			$3,750	$0	$59,136		$62,886	0.233	$14,652
2035			$3,750	$0	$59,136		$62,886	0.220	$13,835
2036			$3,750	$15,000	$59,136		$77,886	0.207	$16,122
2037			$3,750	$0	$59,136		$62,886	0.196	$12,326
2038			$3,750	$0	$59,136		$62,886	0.185	$11,634
2039			$3,750	$0	$59,136		$62,886	0.174	$10,942
2040			$3,750	$15,000	$59,136		$77,886	0.164	$12,773
2041			$3,750	$0	$59,136		$62,886	0.155	$9,747
2042			$3,750	$0	$59,136		$62,886	0.146	$9,181
2043			$3,750	$0	$59,136		$62,886	0.138	$8,678
2044			$3,750	$15,000	$59,136		$77,886	0.130	$10,125
2045			$3,750	$0	$59,136		$62,886	0.123	$7,735
2046			$3,750	$0	$59,136		$62,886	0.116	$7,295
2047			$3,750	$0	$59,136		$62,886	0.109	$6,855
2048			$3,750	$15,000	$59,136		$77,886	0.103	$8,022
2049			$3,750	$0	$59,136		$62,886	0.097	$6,100
2050			$3,750	$0	$59,136		$62,886	0.092	$5,786
2051			$3,750	$0	$59,136		$62,886	0.087	$5,471
2052			$3,750	$15,000	$59,136		$77,886	0.082	$6,387
2053			$3,750	$0	$59,136		$62,886	0.077	$4,842
2054			$3,750	$0	$59,136		$62,886	0.073	$4,591
2055			$3,750	$0	$59,136		$62,886	0.069	$4,339
2056			$3,750	$15,000	$59,136		$77,886	0.065	$5,063
2057			$3,750	$0	$59,136		$62,886	0.061	$3,836
2058			$3,750	$0	$59,136		$62,886	0.058	$3,647
2059			$3,750	$0	$59,136		$62,886	0.055	$3,429
2060			$3,750	$15,000	$59,136		$77,886	0.051	$3,992
2061			$3,750	$0	$59,136		$62,886	0.048	$3,029
2062			$3,750	$0	$59,136		$62,886	0.045	$2,848
TOTAL	$2,218,000	$0	$186,000	$180,000	$2,957,000	$0	$5,540,000	$0	$2,741,000
Total Present Value of Discounted Costs (Sum of Column (i))									$2,741,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project

(All costs should be in 2009 Dollars)

Project: SVCSD Recycled Water Stage 1 Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010					Liner & Pumps		$0	0.943	$0
2011	$2,937,500						$2,937,500	0.890	$2,614,375
2012	$1,937,500						$1,937,500	0.840	$1,627,500
2013		$300	$5,000	$5,000			$10,300	0.792	$8,158
2014		$300	$5,000	$5,000			$10,300	0.747	$7,694
2015		$300	$5,000	$5,000			$10,300	0.705	$7,262
2016		$300	$5,000	$5,000			$10,300	0.665	$6,850
2017		$3,900	$5,000	$5,000	$120,000		$133,900	0.627	$83,955
2018		$300	$5,000	$5,000			$10,300	0.592	$6,098
2019		$300	$5,000	$5,000			$10,300	0.558	$5,747
2020		$300	$5,000	$5,000			$10,300	0.527	$5,428
2021		$300	$5,000	$5,000			$10,300	0.497	$5,119
2022		$3,900	$5,000	$5,000	$120,000		$133,900	0.469	$62,799
2023		$300	$5,000	$5,000			$10,300	0.442	$4,553
2024		$300	$5,000	$5,000			$10,300	0.417	$4,295
2025		$300	$5,000	$5,000			$10,300	0.394	$4,058
2026		$300	$5,000	$5,000			$10,300	0.371	$3,821
2027		$3,900	$5,000	$5,000	$120,000		$133,900	0.350	$46,865
2028		$300	$5,000	$5,000			$10,300	0.331	$3,409
2029		$300	$5,000	$5,000			$10,300	0.312	$3,214
2030		$300	$5,000	$5,000			$10,300	0.294	$3,028
2031		$300	$5,000	$5,000			$10,300	0.278	$2,863
2032		$20,700	$5,000	$5,000	$680,000		$710,700	0.262	$186,203
2033		$300	$5,000	$5,000			$10,300	0.247	$2,544
2034		$300	$5,000	$5,000			$10,300	0.233	$2,400
2035		$300	$5,000	$5,000			$10,300	0.220	$2,266
2036		$300	$5,000	$5,000			$10,300	0.207	$2,132
2037		$3,900	$5,000	$5,000	$120,000		$133,900	0.196	$26,244
2038		$300	$5,000	$5,000			$10,300	0.185	$1,906
2039		$300	$5,000	$5,000			$10,300	0.174	$1,792
2040		$300	$5,000	$5,000			$10,300	0.164	$1,689
2041		$300	$5,000	$5,000			$10,300	0.155	$1,597
2042		$3,900	$5,000	$5,000	$120,000		$133,900	0.146	$19,549
2043		$300	$5,000	$5,000			$10,300	0.138	$1,421
2044		$300	$5,000	$5,000			$10,300	0.130	$1,339
2045		$300	$5,000	$5,000			$10,300	0.123	$1,267
2046		$300	$5,000	$5,000			$10,300	0.116	$1,195
2047		$3,900	$5,000	$5,000	$120,000		$133,900	0.109	$14,595
2048		$300	$5,000	$5,000			$10,300	0.103	$1,061
2049		$300	$5,000	$5,000			$10,300	0.097	$999
2050		$300	$5,000	$5,000			$10,300	0.092	$948
2051		$300	$5,000	$5,000			$10,300	0.087	$896
2052		$20,700	$5,000	$5,000	$680,000		$710,700	0.082	$58,277
2053		$300	$5,000	$5,000			$10,300	0.077	$793
2054		$300	$5,000	$5,000			$10,300	0.073	$752
2055		$300	$5,000	$5,000			$10,300	0.069	$711
2056		$300	$5,000	$5,000			$10,300	0.065	$670
2057		$3,900	$5,000	$5,000	$120,000		$133,900	0.061	$8,168
2058		$300	$5,000	$5,000			$10,300	0.058	$597
2059		$300	$5,000	$5,000			$10,300	0.055	$562
2060		$300	$5,000	$5,000			$10,300	0.051	$528
2061		$300	$5,000	$5,000			$10,300	0.048	$496
2062		$300	$5,000	$5,000			$10,300	0.045	$466
TOTAL	$4,875,000	$81,000	$250,000	$250,000	$2,200,000	$0	$7,656,000	$0	$4,861,000
								Total Present Value of Discounted Costs (Sum of Column (i))	$4,861,000
								Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries	

Comments: Numbers have been rounded to the nearest $1,000.

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: SFPUC Harding Park Recycled Water Project									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$4,703,101						$4,703,101	0.890	$4,185,760
2012	$1,175,775						$1,175,775	0.840	$987,651
2013							$0	0.792	$0
2014							$0	0.747	$0
2015							$0	0.705	$0
2016							$0	0.665	$0
2017							$0	0.627	$0
2018							$0	0.592	$0
2019							$0	0.558	$0
2020							$0	0.527	$0
2021							$0	0.497	$0
2022							$0	0.469	$0
2023							$0	0.442	$0
2024							$0	0.417	$0
2025							$0	0.394	$0
2026							$0	0.371	$0
2027							$0	0.350	$0
2028							$0	0.331	$0
2029							$0	0.312	$0
2030							$0	0.294	$0
2031							$0	0.278	$0
2032							$0	0.262	$0
2033							$0	0.247	$0
2034							$0	0.233	$0
2035							$0	0.220	$0
2036							$0	0.207	$0
2037							$0	0.196	$0
2038							$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$5,879,000	$0	$0	$0	$0	$0	$5,879,000	$0	$5,173,000
Total Present Value of Discounted Costs (Sum of Column (i))									$5,173,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

Table 11- Annual Cost of Project (All costs should be in 2009 Dollars) Project: SBWR Industrial Expansion and Reliability									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.000	$0
2010							$0	0.943	$0
2011	$1,375,500						$1,375,500	0.890	$1,224,195
2012	$1,375,500						$1,375,500	0.840	$1,155,420
2013	$1,375,500						$1,375,500	0.792	$1,089,396
2014							$0	0.747	$0
2015							$0	0.705	$0
2016							$0	0.665	$0
2017							$0	0.627	$0
2018							$0	0.592	$0
2019							$0	0.558	$0
2020							$0	0.527	$0
2021							$0	0.497	$0
2022							$0	0.469	$0
2023							$0	0.442	$0
2024							$0	0.417	$0
2025							$0	0.394	$0
2026							$0	0.371	$0
2027							$0	0.350	$0
2028							$0	0.331	$0
2029							$0	0.312	$0
2030							$0	0.294	$0
2031							$0	0.278	$0
2032							$0	0.262	$0
2033							$0	0.247	$0
2034							$0	0.233	$0
2035							$0	0.220	$0
2036							$0	0.207	$0
2037							$0	0.196	$0
2038							$0	0.185	$0
2039							$0	0.174	$0
2040							$0	0.164	$0
2041							$0	0.155	$0
2042							$0	0.146	$0
2043							$0	0.138	$0
2044							$0	0.130	$0
2045							$0	0.123	$0
2046							$0	0.116	$0
2047							$0	0.109	$0
2048							$0	0.103	$0
2049							$0	0.097	$0
2050							$0	0.092	$0
2051							$0	0.087	$0
2052							$0	0.082	$0
2053							$0	0.077	$0
2054							$0	0.073	$0
2055							$0	0.069	$0
2056							$0	0.065	$0
2057							$0	0.061	$0
2058							$0	0.058	$0
2059							$0	0.055	$0
2060							$0	0.051	$0
2061							$0	0.048	$0
2062							$0	0.045	$0
TOTAL	$4,127,000	$0	$0	$0	$0	$0	$4,127,000	$0	$3,469,000
Total Present Value of Discounted Costs (Sum of Column (i))									$3,469,000
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									
Comments: Numbers have been rounded to the nearest $1,000.									

(1) The incremental change in O&M costs attributable to the project.

San Francisco Bay Area Regional Priority Projects and Programs Attachment 8 – Economic Analysis: Water Quality and Other Expected Benefits

Project 2. Regional Water Conservation Program

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1 Summary

This program offers drought relief and long-term water savings in the form of a package of water conservation programs to improve water use efficiency throughout the San Francisco Bay Region. This project was developed in response to recent dry years and other strains on Bay Area water supplies and the Delta.

The participating water agencies developed the following three specific programs that were determined to provide the most quantifiable and sustainable water savings:

(1) *Landscape Water Conservation Programs:*

a. The *Water-Efficient Landscape Education Program* will provide outreach, education and trainings to convert traditional urban landscaping to water-efficient and sustainable landscaping and support the water-efficient landscape and weather-based irrigation controller rebates. This program will save 47 acre-feet per year (AFY).

b. The *Water Efficient Landscape Rebate Program* will focus on replacing existing water intensive lawns with water efficient landscapes. Region wide, the program will replace more than 3 million square feet of lawn with water efficient landscaping and efficient irrigation, saving 282 AFY

c. The *Weather-Based Irrigation Controllers (WBICs) Rebate Program* will replace standard automatic landscape timers with self-adjusting irrigation controllers that schedule irrigation events based on actual site conditions and weather data. The program will install 2,000 WBICs controlling more than 33,000 residential, commercial, and institutional sprinkler sites stations, saving 266 AFY.

(2) *High-Efficiency Toilet (HET)/High-Efficiency Urinal (HEU) Rebates and Direct Install Program:* This program will enable water agencies to implement a combination of rebates and direct installation programs. The program would include residential, commercial, industrial and institutional (CII) customer classes. Rebates for HETs and HEUs will offer incentives for the replacement of existing high-volume toilets and urinals with high efficiency models, saving 697 AFY

(3) *Regional High-Efficiency Washer Program:* This program will extend the current Bay Area Regional Rebate Program. Installation of a high efficiency washer will save households more than 8,000 gallons of water per year. Savings from this program will be 1,254 AFY This program offers a dual benefit by reducing energy consumption and therefore carbon emissions.

The Regional Water Conservation Program will reduce water demand, preserving current potable supplies and reducing stress on the San Francisco Bay and Sacramento San Joaquin Delta. **Table 1** provides an overview of the costs and benefits presented in Attachment 7 and 8. The remainder of this attachment discusses Water Quality and Other Benefits, as directed for Attachment 8.

Table 1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$12,721,554
Monetized Benefits	
Water Supply Benefits	
Avoided Purchased Water Costs	$24,670,740
Total Monetized Benefits	$24,670,740
Quantified Benefits	
Other Benefits	
Reduced CO_2 Emissions	7,816 Metric Tons
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved Water Supply Reliability	+
Improved Operational Flexibility	+
Water Quality Benefits and Other Benefits	
Reduced Pollution from Dry Weather Runoff	++
Reduced Stress on the Bay Delta	+
Reduced Street Maintenance Costs	+
Avoided Wastewater Treatment Costs	+

O&M = Operations and Maintenance
* 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 –.

2 The "Without Project" Baseline

The proposed program will significantly improve indoor and outdoor water use efficiency. As a result the program will reduce the amount of imported and local surface water used. Use of this water contributes to significant energy use and carbon emissions, which will continue unabated without this program.

Without the Water-Efficient Landscape Education and Water-Efficient Landscape Rebate Programs, municipalities will continue to provide a mix of local surface water and the delta water to meet the irrigation demands for 3.8 million square feet of lawns and 33,000 sites proposed for irrigation system efficiency improvements. Without these improvements, landscape irrigation systems will use 50 million gallons more water annually. This additional water use will increase the amount irrigation-based runoff.

Runoff from over-watering landscapes currently ponds in streets and gutters and runs to local retention basins. The runoff contains fertilizers and pesticides that have been applied to the landscapes, along with other pollutants including salts, pathogens, and fecal coliforms. The runoff eventually drains to the San Francisco Bay-Delta.

Without the High Efficiency Toilet/Urinal Rebates and Direct Install Program the municipalities will continue to draw on local water supplies or supplies from the Delta to meet customer water demand. There will be a continuing demand placed on local water suppliers and the Delta from 35,261 older, high water using non-efficient toilets and urinals. The old inefficient toilets currently use between 2.22 and 3.72 gallons per flush (gpf) more than high efficiency toilers (HET). The old urinals use between 1.0 and 4.5 gpf more than high efficiency urinals (HEU). The increased use of water for flushing toilets and urinals generates more wastewater flows to the wastewater treatment plants (WWTP). Without the program, Bay Area WWTPs will continue to receive and treat higher volumes of wastewater, and result in more discharges to the Bay-Delta.

Without the Regional High-Efficiency Washer Program, the municipalities will continue to draw on local water supplies or supplies from the Delta to meet customer water demand for 51,000 regular washing machines. These regular washers require nearly double the volume of water per load compared to high efficiency washers (41 gallons per load compared with 23 gallons per load).

Without the Program, Bay Area residents will continue to rely on imported potable water supplies for non-potable uses. This will further decrease flows in the Delta and local creeks and rivers that could otherwise be used for other beneficial uses, including protection of sensitive habitat and endangered species.

3 Water Quality and Other Benefits

The proposed project will provide a range of water quality and other benefits. This section provides discussion and details on benefit estimation for benefits including: avoided CO2 emissions, improved surface water quality, and other ecological, aesthetic, and recreational benefits.

Reduced CO2 Emissions

By offsetting imported water demands with locally produced water, the project will avoid emissions of CO_2 (a greenhouse gas) generated by the production of energy required to transport water from the San Francisco Bay and Sacramento – San Joaquin Delta or from other water surface water sources.

In California, electricity production relies on a range of energy sources, including those located within California and those located outside of the state. PG&E estimates that the average CO2 emissions rate for the mix of electricity sources in the Bay Area is 0.238 MT/MWh. The California Energy Commission

estimates that in Northern California, 1.29 MWh of electricity are required to treat and deliver 1 AF of surface water for potable use[1](CEC 2005). This includes energy required for conveyance, treatment, distribution, and wastewater treatment.

Given the carbon dioxide emissions of 0.238 tons of CO_2 emitted per MWh, 0.307 tons of CO_2 are produced for every AF of surface water delivered and treated within Bay Area (1.29 MWh/AF multiplied by 0.238 MT CO2/MWh). By eliminating use of 25,456 AF of surface water supplies over the assumed project life, the program will avoid emission of 7,816 MT of CO_2. This result is shown in Table 2.

Table 2 - Water Quality and Other Expected Benefits
(All benefits should be in 2009 dollars)
Project: Regional Water Conservation Program

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (f) x (g) (1)	(i) Discount Factor (1)	(j) Discounted Benefits (h) x (i) (1)
2009	Avoided C02	Metric Tons	0	0	0				
2010	Avoided C02	Metric Tons	0	0	0				
2011	Avoided C02	Metric Tons	0	97.7	97.7				
2012	Avoided C02	Metric Tons	0	488.51	488.51				
2013	Avoided C02	Metric Tons	0	781.62	781.62				
2014	Avoided C02	Metric Tons	0	781.62	781.62				
2015	Avoided C02	Metric Tons	0	781.62	781.62				
2016	Avoided C02	Metric Tons	0	781.62	781.62				
2017	Avoided C02	Metric Tons	0	781.62	781.62				
2018	Avoided C02	Metric Tons	0	781.62	781.62				
2019	Avoided C02	Metric Tons	0	781.62	781.62				
2020	Avoided C02	Metric Tons	0	781.62	781.62				
2021	Avoided C02	Metric Tons	0	683.92	683.92				
2022	Avoided C02	Metric Tons	0	293.11	293.11				
2023	Avoided C02	Metric Tons		0	0				
Project Life	Avoided C02	Metric Tons			7,816			…	
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table) Transfer to Table 20, column (f), Exhibit F: Proposal Costs and Benefits Summaries									

Comments: Dollar value is not being claimed for the benefit.

[1] California Energy Commission. 2005. California's Water-Energy Relationship, November 2005. Final Staff Report. Prepared in Support of the 2005 Integrated Energy Policy Proceeding (04-IEPR-01E).

Reduced Street Maintenance Costs

The Landscape Water Conservation programs will also reduce street maintenance costs by reducing the amount of dry-weather runoff to streets in the participating agencies' service areas. The program will reduce ponding on streets and minimize the effect of moisture in creating potholes and cracks, which make up a significant portion of street maintenance costs.

Avoided Wastewater Treatment Costs

Over the two-year implementation period, the High Efficiency Toilet/Urinal Direct Install/Rebate Program will replace 35,000 toilets and urinals. The high-efficiency toilet fixtures will reduce indoor water use, and therefore lower the volume of wastewater discharges to WWTPs and the Bay. This volumetric reduction will result in avoided wastewater treatment costs.

4 Distribution of Project Benefits, and Identification of Beneficiaries

The proposed project includes the full range of beneficiaries, as summarized in Table 3. At the local level, Bay Area cities and counties will benefit from a reduction in dry-weather irrigation runoff and the associated reduction in street maintenance costs. Local sanitation districts will benefit from reduction in wastewater attributed to the high efficiency toilet and urinal installations. Regional and statewide ecological and air quality benefits include reduced stress on the San Francisco Bay and Sacramento San-Joaquin Delta, and reduced GHG emissions due to decreased reliance on imported water.

Table 3. Project Beneficiaries Summary

Local	Regional	Statewide
Bay area cities and sanitation districts	Reduced CO2 emissions	San Francisco Bay and Sacramento – San Joaquin Deltas

5 Project Benefits Timeline Description

This program will be implemented over a two-year period, beginning on October 1, 2011 and be completed on September 30, 2013. A water savings lifespan of ten-years has been identified for all water savings equipment and education in this program. Program benefits are expected to extend over 12 – years, which allows for phase-in implementation over the first two years and a phase-out of benefits at the end of the program.

To calculate water savings by year, it was assumed that the program will be implemented across the timeframe from October 2011 to September 2013. This results in a ramp-up period where approximately 12.5% of program benefits are realized in 2011, 62.5% of program benefits are realized in 2012, and all the benefits are realized in 2013. Full benefits are sustained through 2020. Due to the 10-year lifetime assumed for the program, benefits phase out between 2021 and 2022.

6 Potential Adverse Effects from the Project

There are no adverse effects anticipated from the implementation of this program. Temporary disruptions may occur during project construction (e.g. replacement of landscaping), but will be less-than-significant.

7 Summary of Findings

The proposed program will provide a range of both water quality and other benefits. By reducing reliance on imported water, the program will avoid 7,816 MT of CO2 emissions over the ten-year life of the program. Additionally, the reduced reliance on imported water will provide ecological benefits to the San Francisco Bay-Delta.

Additional qualitative benefits from the proposed program include avoided wastewater treatment costs associated with high efficiency toilet and urinal installation. Reductions in dry weather runoff pollution and street maintenance costs will result from water efficient landscaping, and irrigation equipment installation. These are summarized in Table 4.

Table 4. Qualitative Benefits Summary – Water Quality and Other Benefits

Benefit	Qualitative Indicator
Reduced Pollution from Dry Weather Runoff	++
Reduced Stress on the Bay Delta	+
Reduced Street Maintenance Costs	+
Avoided Wastewater Treatment Costs	+

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. These issues are listed in table 5.

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

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
Avoided CO2 emissions	U	The analysis of avoided CO2 emissions is expected to result in real emissions reductions. However, energy and emission data for each project is unavailable. This analysis therefore relies on averages for Northern California as a whole.
Project lifetime for Conservation Equipment	++	Lifetime of conservation equipment is assumed to be 10 years. A review of the marketplace showed that high efficiency toilet and urinals have 25 years and 33 years respectively (Haasz, 2010).

*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 -.

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San Francisco Bay Area Regional Priority Projects and Programs Attachment 8 – Economic Analysis: Water Quality and Other Expected Benefits

Project 3. Wetland Ecosystem Restoration Program

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1 Summary

The Bay Area Wetland Ecosystem Restoration Program (WERP) consists of a suite of restoration construction projects located on the bay shoreline of 3 counties. Each of the projects will carry out ecosystem restoration of degraded tidal wetlands and also address climate change response, flood management, and protection and improvement of surface water quality and will provide public recreation opportunities. Individually and collectively, the WERP projects will implement regional goals and objectives of the Bay Area IRWM Plan, the San Francisco Bay Comprehensive Conservation and Management Strategy, the Basin Plan, the Baylands Ecosystem Habitat Goals, the Tidal Wetland Recovery Plan of the U.S. Fish and Wildlife Service (USFWS), the San Francisco Bay Joint Venture Implementation Strategy and BCDC's Sea Level Rise Strategy for the San Francisco Bay Region. The proposed projects are at Sears Point in Sonoma County, Bair Island in San Mateo County, and South Bay Salt Pond A-16/17 in Santa Clara County. Overall, the project will create or significantly restore 2300 acres of coastal wetlands – increasing the number of Bay area coastal wetlands by almost 6%.

1.1 Costs and Benefits Summary

Total discounted costs for this project equal about $25.6 million and are illustrated and discussed in detail in the next section. Monetized water quality and other benefits for this project of about $250 million are summarized in Table 1 below.

Using conservative assessments this project has a positive benefit to cost ratio. To ensure benefits are not double counted as well as to provide a conservative benefit estimate, total benefits are estimated to be $165.2 million.

The significant qualitative benefits associated with this project include shoreline stabilization, global climate impacts and groundwater recharge.

Table 1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$25.6 million
Monetized Benefits	
Value to the State of California	$157 million
Water Quality and Other Benefits	
Habitat Restoration	$114.9 million
Comparative Cost of Treatment Plants	$3.3 million
Storm Protection	$21 million
Recreation	$16 million
Commercial Fisheries	$10 million
Total Monetized Benefits	$165.2 million
Qualitative Benefit or Cost	*Qualitative indicator**
Shoreline Stabilization	++
Global Climate Change	+
Groundwater Recharge	+

1.2 Project Costs

Total present value (PV) costs for the sum of all tasks is $25,667,511 million dollars. The present value for the Sears Point site is $14,796,310. The present value for the Bair Island site is $2,939,084, and the present value of the Pond A16/17 site is $7,932,117. A state Table 11 was prepared for each individual site – Sears Point, - Table11a, Blair Island – Table 11b, and Pond A16/17 – Table 11c. Adding up the present value figure for each site derives the present value for the total project. The tables are attached at the end of this document.

The costs associated with each project are discussed below.

Sears Point

Total PV costs for the Sears Point site are $14,796,310 dollars over the 50-year project life. Construction costs total $16,448,621, including Construction, Construction Administration and the Construction Contingency. Operation costs of $55,000 and maintenance costs of $19,000 begin at the end of the construction period and continue for the 50 year project life.

Note that the Table 11 initial costs for Sears Point do not equal the total seen in Table 7 due to the sunk cost of $873,340 for design work completed in 2010.

Bair Island

Total PV costs for the Bair Island site are $2,939,084 dollars over the 50-year project life. Construction related expenses of $2,387,280 dollars begin in June 2011 and continue for 3 years ending in June of 2014. O&M Administration costs of $1,500 begin in 2015 after construction is completed. Monitoring costs of $3,500 per year begin in June 2011 as the program begins and continue for 15 years. Additional maintenance costs of $10,000 occur every 10 years throughout the projects 50-year lifespan.

Pond A16/17

Total PV costs for the Pond A16/17 Task equal $7,932,117 dollars over the 50 year project life. Construction related costs, including construction administration, construction, and construction contingency, equal $8.3 million. O & M Administration costs equal $1000 a year with an additional $2000 cost occurring every 10 years. Maintenance costs equal $10,000 per year with an additional $200,000 cost every 10 years.

2 The "Without Project" Baseline

Today only about 40,000 acres of the original 190,000 acres of tidal marsh remain in the San Francisco Bay. What is left is largely a narrow strip of marshes or diked marshes with limited habitat value due to fragmentation. Adverse effects of this loss include radical reductions in: protection of the shoreline from erosion and flooding, flood protection for up-stream areas, habitats for many plants and both resident and migratory animal species (including protected and endangered species); carbon sequestration, filtering of pollutants from both fresh and salt waters including the contribution of nutrients to the Bay, and the ability to respond to fluctuations in sea level. In addition, recreation and open space access is vital for quality of life in the areas crowded urban areas.

Without this project the amount of tidal marsh available to provide the benefits outlined above, and discussed in more detail below, will remain limited; and will most likely continue to decline.

3 Water Quality and Other Benefits

3.1 Quantitative Benefits

The significance of the potential benefits of this project can be analyzed in terms of the contribution to wildlife habitat, water quality, recreation, storm protection, and commercial fisheries. Each of these benefits is discussed in more detail below. The potential benefits can also be viewed by examining the contribution of the San Francisco Bay to the State of California economy. Although this value, discussed below, is not added into the total monetized benefit estimate, to prevent double counting, it does provide an interesting and useful benefits perspective.

Value to State of California

The San Francisco Bay-Delta Estuary was designated an estuary of national significance and entered the U.S. Environmental Protection Agency's National Estuary Program (NEP) in 1987. Although only five percent of the Bay's original wetlands remain, they account for 90 percent of California's total remaining tidal wetlands (Allen, 1992).

A 1992 case study performed at the University of California Berkeley Graduate School of Public Policy reviewed the wetlands literature and estimated that California's wetlands provide between $6.9 and $22.9 billion ($10.5 billion and $35 billion in 2009 dollars) in flood control, water supply, water quality, recreation, commercial fisheries and habitat benefits to the state annually, not including the incalculable value to wildlife (Allen et.al. 1992). Although the literature review found no studies conducted for California it is reasonable to assume the value of wetlands in the San Francisco Bay-Delta are roughly comparable to those found in other regions of the country.

Although the study looked at values to the state as a whole, and was not designed to look at the value of any one individual acre, the study found that the average acre of wetland provides benefits equal to $5,472 per year, in 2009 dollars. Assuming the wetlands being created have value equal to or greater than the average California wetland acre (in most cases coastal wetlands have the highest value per acre), this project represents an annual value of roughly 12.6 million per year (2300 acres x $5472). The present value increase in value to the State of California, discounted at 6% over the life of the project amounts to about $157 million. Although this figure is clearly a very rough and incompletely documented estimate due to the number of assumptions and unknowns (e.g. are values linear and/or transferable?) it does provide an empirical insight into the potential magnitude of the benefits associated with this project. In the remainder of this attachment we review in more detail the individual benefits from this wetlands restoration project.

Fish and Wildlife Habitat Restoration/Creation

The largest estuary on the West Coast, the San Francisco Bay is home to 500 species of wildlife, 128 of them threatened or endangered, like the California clapper rail and salt marsh harvest mouse. The Bay is a crucial resting spot for millions of migrating birds, and its sheltered waters provide critical nurseries for fish. (www.savesfbay.org/greening-bay).

Populations of over 300 fish and wildlife species breed, raise young, feed and rest in Estuary wetlands. Countless clams, worms, and other invertebrates thrive in mudflats; migratory birds winter in marshes; and fish and crabs use shallow waters as nursery grounds. Wetlands support a food web in which detritus provides food for invertebrates, which in turn are eaten by shorebirds, fish, crabs, and human clam diggers. As wetlands become rare, so do some of the species that live in them. Estuary wetlands sustain over 60 plant and animal species that are listed as rare, threatened or endangered or are candidates for such listing. Of the animal species, the California clapper rail, California least tern, and salt marsh harvest mouse are best known due to their presence on several bayshore properties proposed for

development. Of the plant species, palmatebracted bird's beak and Solano grass, found in vernal pools, are the most endangered (Wetlands, SF Estuary Partnership, 2010).
Healthy wetlands provide food resources and protection from predators for fish, birds and mammals that use them to nurse and raise their young. Without these sheltered habitats, young salmon, water birds, seals and raptors might not survive.

Species of concern being addressed by this project include- endangered salt marsh harvest mouse, California clapper rail, least terns, western snowy plovers, CA black rail, salt marsh common yellowthroat, San Pablo song sparrow, steelhead rearing, Sacramento splitail, saline clover, calipee silverspot butterfly, tricolored blackbird, western burrowing owl and the CA red-legged frog.

A well regarded technique for assigning value to habitat for wetlands is Willingness to Pay. In the peer reviewed papers published by Hanemann, Loomis and Kanninen (1991), the authors surveyed California residents and, using a voter type value elicitation, asked residents how much they would be willing to pay each year for wetlands improvements. (Although the study was asking residents to value all wetlands benefits the authors noted that for almost all respondents the only value they recognize for wetlands is habitat. It is therefore reasonable to attribute this willingness to pay estimate equal to respondents willingness to pay for wetlands habitat) Using a statistical efficiency of double bounded dichotomous choice contingent valuation methodology the study found that California households in 1989 were willing to pay between $235 and $268 per year to improve wetlands. Given the increase in awareness of the value of wetlands, and the decrease in the number of wetlands, it is conservative to apply this value to the potential restoration of wetlands from this project. The Hanemann et al. study was performed for both a local project in the San Joaquin valley, the state of California as a whole, and two other sites in the Pacific northwest. The authors found that the values were similar for both local issues and statewide. It is therefore reasonable to apply this value to either the total number of households in California or just to the number of households in the Bay Area. Again, to provide an extremely conservative estimate, the value is applied here only to San Francisco Bay area households. Utilizing US Census data from 2008 the Bay area is identified as having over 6.6 million households. Multiplying the 6.6 million households by the low end of the range of their willingness to pay ($406 in 2009 dollars) for wetlands habitat improvements results in an annual value of over $2.6 billion dollars.

The $2.6 billion dollar value represents Bay Area residents' willingness to pay for improvements in all wetlands – not just project acres – so we cannot assign all of this value to this project. One way to estimate how much they are willing to pay to improve the acres represented by this project is to identify the total number of wetland acres in the area and determine the percentage of those acres represented by this project. A satellite imagery study performed by the State Department of Fish and Game (DFG) and Ducks Unlimited showed that the Central Valley, Bay Area and Delta contain about 325,000 acres of estuarine, palustrine, tidal and riparian wetlands. This analysis assumed that these local wetlands represent 50% of the WTP of Bay Area residents for wetlands. Taking half (50%) of the $2.6 billion dollar willingness to pay value ($1.3 billion) and allocating it over the local wetlands acres (325,000 acres), we arrive at a per acre willingness to pay for improvements in local wetlands by Bay Area residents of $4,000 per acre annually. By applying this per acre value to the 2300 acres represented by this project, we arrive at an annual habitat benefit value for this project of $9.2 million. Discounted at 6% over the 50 year life of the project results in a present value for habitat protection of $114.9 million.

Water Quality

Mayer, et.al, 1995, estimated that in1995 up to 70% of toxics in the San Francisco Bay come from polluted runoff. Wetlands absorb and filter out many pollutants found in runoff, such as pesticides and fertilizers from farms and gardens and motor oil from cars. Wetlands trap some natural pollutants, and some wastewater and stormwater contaminants, and either retain them or convert them by biochemical processes to less harmful forms. Wetlands also trap and stabilize sediment that, suspended in the water, can interfere with fish and plant growth, as well as fishing. (Wetlands, SF Estuary Partnership, 2010).

Because wetlands purify water so well, they are often used for tertiary treatment by municipal sewage plants. (Greening the Bay, Savesfbay.org/greening-bay) However, because the majority of the water quality contaminants entering the Bay are from non-point sources – agricultural and household runoff and stormwater collection of motor oil on roadways - it is difficult to economically capture and treat these loadings. In order to physically treat these loadings in a water treatment facility it would be necessary to first create a catchment infrastructure. No estimates of the costs of this type of catchment infrastructure are available. However, by comparing the cost of the treatment facility alone we can develop a conservative estimate of a comparative type of water quality improvement. This analysis provides a value for comparative levels of treatment and is illustrative of the value of wetlands water quality benefits.

A rough calculation of the decrease in nutrient loadings to the Bay as a result of restoring about 2,300 acres of wetlands shows that over 1 million acre feet of water will be treated as a result of the wetlands created and restored in this project, every year. A simple water treatment facility designed to treat storm water runoff, (with comparable or less effective water quality improvements) with a 320,000 acre feet per year capacity, has a present value cost over 50 years of about $1.1 million (Riley et.al. 2009). By conservatively assuming the need for 3 SMURFF type water quality treatment plants (with no water collection infrastructure costs) to achieve the same (or lower) improvements in water quality as the marsh wetlands, we arrive at an extremely conservative present value cost estimate of $3.3 million for a comparative level of water treatment.

Storm Protection and Flood Control

Wetlands depressions prevent floods by detaining excess flow. Their vegetation and root systems obstruct floodwaters, thereby reducing their velocity and damage potential. In this way, wetlands provide an invaluable first line of defense, by reducing both the size and destructive power of floods. Importantly, the flood control benefits of wetlands are realized both downstream and upstream. (Allen, 1992). Wetlands also provide valuable protection from storm surge by buffering mainland properties from storm tides and rising sea levels. Coastal wetlands function as valuable, self maintaining 'horizontal levees' for storm protection, and also provide a host of other ecosystem services that vertical levees do not (Mayer, et.al. 1995).

A literature review of the benefits due to the existence of wetlands in reducing storm damages, including both flood control and storm surge damage, illustrates a wide range of per acre values. Table 2 illustrates the values range and includes: a 1987 study in Virginia showing a value of $110 (2009 dollars) to $1,378 per acre in Louisiana; a 1976 Army Corps of Engineers Study showing that for the Charles River near Boston, Massachusetts, coastal wetlands provided $4,650 per acre of flood control benefits, and a modeling effort by Costanza, 2008. The Costanza model was developed in an effort to take the values found in the literature reviews and, using actual damages avoided due to hurricanes from wetlands, and, utilizing an econometric model, predicted the actual avoided cost of storm damage on the east coast due to the existence of wetlands. This model found that a loss of 1 acre of wetland corresponded to an increase in actual storm damage of over $13,000 per year.

Table 2: Economic Values for Wetlands Storm Protection

Study Location	Avoided Cost for Storm Damage per Acre
Virginia	$110 - $1278
Charles River, Mass.	$4650
Literature Review, basis for Costanza Model	$13,000

Although the Costanza study provides a more rigorous analysis by looking at actual avoided costs of storm damage resulting from wetlands, in an effort to be conservative the lower value developed by Army Corp in 1976, is applied. Utilizing the $4650 per ace ($7626 in 2009 dollars) the annual potential storm protection benefits of this project are about $215 million.

To provide an even more conservative estimate the midpoint of the lowest value found in the literature review $744, is used to provide a total potential present value benefit for flood control of $21 million.

This represents an extremely conservative estimate of storm protection as this project represents a buffer between Highway 37 and the SMART rail lines.

Recreation

Wetlands provide opportunities for fishing, hunting, walking, environmental education, wildlife observation, photography, and picnicking. The San Francisco Estuary supports the largest sport fisheries on the west coast as well as popular duck hunting grounds (EDF/WWF 1992).

In addition to the overall recreation benefits associated with wetland creation, the Bair Island project includes the construction of a bridge to provide access to the extremely popular Bay Trail.

The literature review by Allen identified a study by Stoll, 1989, using survey methodology that is particularly applicable to the Bay area wetlands. This study placed a lower bound of per acre wetlands recreation value of $569 in 2009 dollars. Applying this value to the 2300 acres of proposed wetlands creation/restoration for this project results in a potential discounted PV for recreation of about $16 million.

Commercial Fisheries

Seventy-one percent of fish caught in California waters depend on wetland habitat, making San Francisco Bay a major contributor to the estimated $890 million in retail value of fish sold each year across the state (Allen, J., Cunningham, M., Greenwood, A., and Rosenthal, L., 1992). Over 6,000 people were directly employed in wholesale and processing operations, and many more in retail, transportation, and equipment industries (NMFS, 1990). Wetlands serve as a vital link in maintaining the productivity of fisheries providing rearing grounds, food supply, habitat, and maintaining water quality for dependent fish species.

A review of the literature of the contribution of wetlands to commercial fisheries finds a lower bound estimate of $356 per acre. (USDOC, 1987/EDF). Discounted at 6% over the 50-year life of the proposed project results in a potential contribution of this project to the commercial fisheries industry in California of over $10 million dollars.

3.2 Summary of Monetized Benefits

Table 3 below provides a summary of the monetized benefits attributable to this project. It should be noted that although every effort was made to provide conservative estimates these values were arrived at by utilizing data and information where it was not always possible to ascertain all the omissions**,** biases, and uncertainties, and their possible effect on the project.

Of particular concern are assumptions used in comparing the value of marsh treatment to a water treatment facility, the effect of extrapolating national flood control values and the validity/reliability of the willingness to pay calculations.

Given these concerns and the possible effect they may have on the development of monetized benefits – the total monetized benefits are reduced to provide conservative estimate of $250 million in present value terms.

Table 3: Monetized Benefits & Omissions, Biases, and Uncertainties, and Their Effect on the Project

Type of Benefit	Total Benefit	Likely Impact on Net Benefits*
Habitat Restoration	$114.9 million	++
Comparative Cost of Treatment Plants	$3.3 million	+
Storm Protection	$21 million	++
Recreation	$16 million	+
Commercial Fisheries	$10 million	+
Total Monetized Benefits	$165.2 million	

Direction and magnitude of effect on net benefits:
+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.
– = Likely to decrease benefits.
– – = Likely to decrease net benefits significantly

3.3 Qualitative Benefits

Table 4 below, created by the California Coastal Commission, provides an overview of the benefits found in wetlands/marshes. A brief overview of substantial benefits for this project is discussed following Table 4.

Table 4: Benefits of Wetlands (California Coastal Commission)

Commercial factors
Support of commercial fisheries: Coastal wetlands are important spawning and nursery areas and provide sources of nutrients for commercial fish such as flounder, perch, and English sole, and shellfish such as clams and shrimp.
Provision of commercially harvested organisms: Because of their high natural productivity, both tidal and inland wetlands have food production potential for aquaculture enterprises.
Water supply and storage: Wetlands are potential sites for groundwater recharge and surface water storage.
Damage prevention factors
Pollution assimilation/water purification: Wetlands contribute to improving water quality by removing excess nutrients and excess chemical contaminants; some wetlands are used in the tertiary treatment of wastewater.
Flood control: Riverine wetlands and adjacent floodplain lands often form natural floodways that convey floodwaters from upstream to downstream areas; wetlands can also store water during floods and slow the movement to downstream areas, thereby lowering flood peaks.
Erosion control: Wetlands reduced flood flows and the velocity of floodwaters, reducing erosion causing floodwaters to release sediment.

Ecological factors
Provision of critical habitat for threatened and endangered species: In California numerous threatened or endangered species such as the Santa Cruz long-toed salamander, the clapper rail, the salt marsh harvest mouse, and the soft-haired bird's beak all rely on wetlands for their existence.
Provision of habitat for native wildlife: Wetlands provide essential breeding, feeding, and refuge habitats for many native plants (e.g., cord grass, salt grass, and pickleweed) and animals (e.g., great blue heron, garter snake, and the tiger salamander); this directly contributes to the maintenance of biodiversity.
Provision of resting and feeding habitat for migratory waterfowl: California's wetlands provide essential nesting, feeding, and refuge habitats for migratory birds along the Pacific flyway; this directly contributes to the maintenance of biodiversity.
Food chain support to resident and non-resident species: Wetlands have the ability to support nutrient transformations (both microbial and chemical processes); wetlands act as sources and sinks of nutrients and food and provide a medium for the transfer of these materials.
Other factors
Consumptive recreation: Wetlands serve as recreation sites for fishing and hunting.
Nonconsumptive recreation: Wetlands serve as recreation sites for hiking, boating, and bird watching.
Source of open space and contribution to aesthetic values: Wetlands are areas of great diversity and beauty, and provide open space for human enjoyment.
Education and research: Wetlands provide educational opportunities for nature observation and scientific study.

Shoreline Stabilization

Vegetated wetlands reduce bank and shoreline erosion caused by stream runoff, tidal waters and wave action. Wetlands absorb and dissipate wave energy that would otherwise erode shores and banks. This allows suspended sediment to settle and build up, encouraging more wetland vegetation to take root and further stabilizing the shore. (Wetlands, SF Estuary Partnership, pg.2).

Global Warming

Scientists have found that tidal salt marshes capture carbon from greenhouse gases in the air efficiently and effectively, helping to counter global warming. Every acre of restored, healthy salt marsh captures and converts at least 870 kilograms of carbon dioxide into plant material annually – equivalent to global warming emissions from driving 2,280 miles. Unlike some other plants, tidal salt marsh plants release only negligible amounts of methane (a powerful greenhouse gas) when they decay. These findings have led scientists from the United Nations and the White House to recommend wetland restoration as a strategy to fight global warming.(U.S. Climate Change Technology Program: Technology Options for the Near and Long Term (2005), para 3.2.1.6, available at www.climatetechnology.gov/library/2005/tech-options/tor2005-3216.pdf)

Groundwater Recharge

Wetlands play an important role in replenishing groundwater supplies by allowing transport of ponded surface water into underground basins. In the Delta, for example, surface water flows downward through the permeable peat soil that underlies wetlands. In the South Bay, water from streams and creeks percolates into the underground aquifer, which supplies many drinking water wells. (Wetlands, SF Estuary Partnership, pg 2)

4 Distribution of Benefits, and Identification of Beneficiaries

Table 6 provides an overview of beneficiaries.

Table 6. Project Beneficiaries Summary

Local	Regional	Statewide
Local residents, Local Agricultural producers Caltrans	Santa Clara County San Mateo County San Jose County	Bay-Delta Shipping Industry Commercial fisheries State residents Tourism industry natural resources/wildlife

5 Project Benefits Timeline

Project benefits will begin to accrue in 2012 and will continue indefinitely. It is likely that benefits will increase over time; protected wetlands are likely to increase in both productivity and size due to biological processes over time. For purposes of this study benefits will continue for 50 years.

6 Potential Adverse Effects from the Project

There are no adverse effects anticipated from the implementation of this program.

7 Summary of Findings

Table 5 provides a summary of the program's qualitative benefits and an indicator of the significance of these benefits.

Table 5: Qualitative Benefits Summary – Water Quality and Other Benefits

Benefit	Qualitative Indicator*
Shoreline Stabilization	++
Global Climate Change	+
Groundwater Recharge	+

* 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 –.

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Table 11- Annual Cost of Project

Wetland Ecosystem Restoration Program - Sears Point

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.00	$0
2010							$0	0.94	$0
2011	$811,908						$811,908	0.89	$722,595
2012	$5,695,512						$5,695,512	0.84	$4,782,062
2013	$5,695,512						$5,695,512	0.79	$4,511,379
2014	$5,230,708						$5,230,708	0.75	$3,908,689
2015			$55,000	$19,000			$74,000	0.70	$52,167
2016			$55,000	$19,000			$74,000	0.67	$49,214
2017			$55,000	$19,000			$74,000	0.63	$46,429
2018			$55,000	$19,000			$74,000	0.59	$43,800
2019			$55,000	$19,000			$74,000	0.56	$41,321
2020			$55,000	$19,000			$74,000	0.53	$38,982
2021			$55,000	$19,000			$74,000	0.50	$36,776
2022			$55,000	$19,000			$74,000	0.47	$34,694
2023			$55,000	$19,000			$74,000	0.44	$32,730
2024			$55,000	$19,000			$74,000	0.42	$30,878
2025			$55,000	$19,000			$74,000	0.39	$29,130
2026			$55,000	$19,000			$74,000	0.37	$27,481
2027			$55,000	$19,000			$74,000	0.35	$25,925
2028			$55,000	$19,000			$74,000	0.33	$24,458
2029			$55,000	$19,000			$74,000	0.31	$23,074
2030			$55,000	$19,000			$74,000	0.29	$21,767
2031			$55,000	$19,000			$74,000	0.28	$20,535
2032			$55,000	$19,000			$74,000	0.26	$19,373
2033			$55,000	$19,000			$74,000	0.25	$18,276
2034			$55,000	$19,000			$74,000	0.23	$17,242
2035			$55,000	$19,000			$74,000	0.22	$16,266
2036			$55,000	$19,000			$74,000	0.21	$15,345
2037			$55,000	$19,000			$74,000	0.20	$14,477
2038			$55,000	$19,000			$74,000	0.18	$13,657
2039			$55,000	$19,000			$74,000	0.17	$12,884
2040			$55,000	$19,000			$74,000	0.16	$12,155
2041			$55,000	$19,000			$74,000	0.15	$11,467
2042			$55,000	$19,000			$74,000	0.15	$10,818
2043			$55,000	$19,000			$74,000	0.14	$10,205
2044			$55,000	$19,000			$74,000	0.13	$9,628
2045			$55,000	$19,000			$74,000	0.12	$9,083
2046			$55,000	$19,000			$74,000	0.12	$8,569
2047			$55,000	$19,000			$74,000	0.11	$8,084
2048			$55,000	$19,000			$74,000	0.10	$7,626
2049			$55,000	$19,000			$74,000	0.10	$7,194
2050			$55,000	$19,000			$74,000	0.09	$6,787
2051			$55,000	$19,000			$74,000	0.09	$6,403
2052			$55,000	$19,000			$74,000	0.08	$6,041
2053			$55,000	$19,000			$74,000	0.08	$5,699
2054			$55,000	$19,000			$74,000	0.07	$5,376
2055			$55,000	$19,000			$74,000	0.07	$5,072
2056			$55,000	$19,000			$74,000	0.06	$4,785
2057			$55,000	$19,000			$74,000	0.06	$4,514
2058			$55,000	$19,000			$74,000	0.06	$4,258
2059			$55,000	$19,000			$74,000	0.05	$4,017
2060			$55,000	$19,000			$74,000	0.05	$3,790
2061			$55,000	$19,000			$74,000	0.05	$3,575
2062			$55,000	$19,000			$74,000	0.05	$3,373
2063			$55,000	$19,000			$74,000	0.04	$3,182
2064			$55,000	$19,000			$74,000	0.04	$3,002
...									
Project Life	50 years							...	
								Total Present Value of Discounted Costs (Sum of Column (i))	$14,796,310
								Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries	

Comments: $873,340 in sunk costs in design incurred in 2010 is not shown here, but is reflected Attachment 4's Table 7. Hence the total budget in Table 7 is greater than the initial costs shown above, by the stated amount of sunk costs.

Table 11- Annual Cost of Project									
Wetland Ecosystem Restoration Program - Bair Island									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.00	$0
2010								0.94	$0
2011	$531,958					$17,500	$549,458	0.89	$489,016
2012	$1,060,730					$35,000	$1,095,730	0.84	$919,996
2013	$1,060,730					$35,000	$1,095,730	0.79	$867,921
2014	$531,958					$35,000	$566,958	0.75	$423,664
2015		$1,500				$35,000	$36,500	0.70	$25,731
2016		$1,500				$35,000	$36,500	0.67	$24,275
2017		$1,500				$35,000	$36,500	0.63	$22,901
2018		$1,500				$35,000	$36,500	0.59	$21,604
2019		$1,500				$35,000	$36,500	0.56	$20,381
2020		$1,500				$35,000	$36,500	0.53	$19,228
2021		$1,500				$35,000	$36,500	0.50	$18,139
2022		$1,500				$35,000	$36,500	0.47	$17,113
2023		$1,500				$35,000	$36,500	0.44	$16,144
2024		$1,500				$35,000	$36,500	0.42	$15,230
2025		$1,500		$10,000		$35,000	$46,500	0.39	$18,305
2026		$1,500				$17,500	$19,000	0.37	$7,056
2027		$1,500					$1,500	0.35	$526
2028		$1,500					$1,500	0.33	$496
2029		$1,500					$1,500	0.31	$468
2030		$1,500					$1,500	0.29	$441
2031		$1,500					$1,500	0.28	$416
2032		$1,500					$1,500	0.26	$393
2033		$1,500					$1,500	0.25	$370
2034		$1,500					$1,500	0.23	$349
2035		$1,500		$10,000			$11,500	0.22	$2,528
2036		$1,500					$1,500	0.21	$311
2037		$1,500					$1,500	0.20	$293
2038		$1,500					$1,500	0.18	$277
2039		$1,500					$1,500	0.17	$261
2040		$1,500					$1,500	0.16	$246
2041		$1,500					$1,500	0.15	$232
2042		$1,500					$1,500	0.15	$219
2043		$1,500					$1,500	0.14	$207
2044		$1,500					$1,500	0.13	$195
2045		$1,500		$10,000			$11,500	0.12	$1,412
2046		$1,500					$1,500	0.12	$174
2047		$1,500					$1,500	0.11	$164
2048		$1,500					$1,500	0.10	$155
2049		$1,500					$1,500	0.10	$146
2050		$1,500					$1,500	0.09	$138
2051		$1,500					$1,500	0.09	$130
2052		$1,500					$1,500	0.08	$122
2053		$1,500					$1,500	0.08	$116
2054		$1,500					$1,500	0.07	$109
2055		$1,500		$10,000			$11,500	0.07	$788
2056		$1,500					$1,500	0.06	$97
2057		$1,500					$1,500	0.06	$91
2058		$1,500					$1,500	0.06	$86
2059		$1,500					$1,500	0.05	$81
2060		$1,500					$1,500	0.05	$77
2061		$1,500					$1,500	0.05	$72
2062		$1,500					$1,500	0.05	$68
2063		$1,500					$1,500	0.04	$65
2064		$1,500					$1,500	0.04	$61
...							$0		
Project Life	50 years							...	
Total Present Value of Discounted Costs (Sum of Column (i))									$2,939,084
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									

Table 11- Annual Cost of Project									
Wetland Ecosystem Restoration Program - Pond A16/17									
	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009							$0	1.00	$0
2010								0.94	$0
2011	$2,052,900						$2,052,900	0.89	$1,827,074
2012	$2,897,100						$2,897,100	0.84	$2,432,461
2013	$2,897,100						$2,897,100	0.79	$2,294,775
2014	$1,452,900						$1,452,900	0.75	$1,085,691
2015		$1,000		$10,000			$11,000	0.70	$7,755
2016		$1,000		$10,000			$11,000	0.67	$7,316
2017		$1,000		$10,000			$11,000	0.63	$6,902
2018		$1,000		$10,000			$11,000	0.59	$6,511
2019		$1,000		$10,000			$11,000	0.56	$6,142
2020		$1,000		$10,000			$11,000	0.53	$5,795
2021		$1,000		$10,000			$11,000	0.50	$5,467
2022		$1,000		$10,000			$11,000	0.47	$5,157
2023		$1,000		$10,000			$11,000	0.44	$4,865
2024		$1,000		$10,000			$11,000	0.42	$4,590
2025		$3,000		$210,000			$213,000	0.39	$83,847
2026		$1,000		$10,000			$11,000	0.37	$4,085
2027		$1,000		$10,000			$11,000	0.35	$3,854
2028		$1,000		$10,000			$11,000	0.33	$3,636
2029		$1,000		$10,000			$11,000	0.31	$3,430
2030		$1,000		$10,000			$11,000	0.29	$3,236
2031		$1,000		$10,000			$11,000	0.28	$3,053
2032		$1,000		$10,000			$11,000	0.26	$2,880
2033		$1,000		$10,000			$11,000	0.25	$2,717
2034		$1,000		$10,000			$11,000	0.23	$2,563
2035		$3,000		$210,000			$213,000	0.22	$46,820
2036		$1,000		$10,000			$11,000	0.21	$2,281
2037		$1,000		$10,000			$11,000	0.20	$2,152
2038		$1,000		$10,000			$11,000	0.18	$2,030
2039		$1,000		$10,000			$11,000	0.17	$1,915
2040		$1,000		$10,000			$11,000	0.16	$1,807
2041		$1,000		$10,000			$11,000	0.15	$1,705
2042		$1,000		$10,000			$11,000	0.15	$1,608
2043		$1,000		$10,000			$11,000	0.14	$1,517
2044		$1,000		$10,000			$11,000	0.13	$1,431
2045		$3,000		$210,000			$213,000	0.12	$26,144
2046		$1,000		$10,000			$11,000	0.12	$1,274
2047		$1,000		$10,000			$11,000	0.11	$1,202
2048		$1,000		$10,000			$11,000	0.10	$1,134
2049		$1,000		$10,000			$11,000	0.10	$1,069
2050		$1,000		$10,000			$11,000	0.09	$1,009
2051		$1,000		$10,000			$11,000	0.09	$952
2052		$1,000		$10,000			$11,000	0.08	$898
2053		$1,000		$10,000			$11,000	0.08	$847
2054		$1,000		$10,000			$11,000	0.07	$799
2055		$3,000		$210,000			$213,000	0.07	$14,599
2056		$1,000		$10,000			$11,000	0.06	$711
2057		$1,000		$10,000			$11,000	0.06	$671
2058		$1,000		$10,000			$11,000	0.06	$633
2059		$1,000		$10,000			$11,000	0.05	$597
2060		$1,000		$10,000			$11,000	0.05	$563
2061		$1,000		$10,000			$11,000	0.05	$531
2062		$1,000		$10,000			$11,000	0.05	$501
2063		$1,000		$10,000			$11,000	0.04	$473
2064		$1,000		$10,000			$11,000	0.04	$446
...							$0		
Project Life	50 years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									$7,932,117
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									

San Francisco Bay Area Regional Priority Projects and Programs Attachment 8 – Economic Analysis: Water Quality and Other Expected Benefits

Project 4. Regional Green Infrastructure Capacity Building Program

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1 Summary

The Regional Green Infrastructure Capacity Building Program includes the implementation of three green infrastructure (GI) demonstration projects in the northern, southern and eastern sub-regions of the San Francisco Bay Area. The goal of implementing these projects is to develop and improve techniques for better stormwater management in the Bay Area by: 1) analyzing each project to determine water conservation and/or stormwater quality benefits, and 2) disseminating information on lessons learned from the projects to other cities, counties and water management entities region, and demonstrating the cost-effectiveness of natural drainage systems compared to building new, traditional treatment facilities.

In the San Francisco Bay Region, the Regional Water Quality Control Board is requiring municipalities to develop 10 Green Street Pilot Projects and implement Low Impact Development at 100% of new development projects. Costs for not complying with the permit could include fines, in addition to the costs of eventually coming into compliance. Thus Bay Area municipalities are eager to have the information on which Green Infrastructure solutions are best suited for their individual situations.

The three demonstration projects that will be implemented as part of the Regional Green Infrastructure Capacity Building Program include:

- San Pablo Spine and Regional Promotion of Green Infrastructure
- Hacienda Avenue Green Street Improvement Project
- Napa Valley Rainwater Harvesting Project

The San Pablo Avenue Stormwater Spine project includes the development of stormwater treatment demonstration projects along San Pablo Avenue from Oakland to San Pablo (7 cities in Alameda and Contra Costa Counties will treat up to 14 acres of impervious surface). Projects will build upon the

successful El Cerrito San Pablo Avenue stormwater planters implemented in spring 2010 with federal stimulus funding.

The Hacienda Avenue "Green Street" Improvement project will convert a portion of Hacienda Avenue to a "green street." Project elements include: reducing the roadway width by reclaiming and transforming approximately 25% of the existing roadway surface into a public green space running the length of Hacienda Avenue; implementing linear parkway options to increase the amount of open space in the area; and promoting groundwater replenishment by replacing non-pervious asphalt concrete surfaces with pervious material. Additional proposed improvements include installing bike lanes, planting street trees, installing bioswales and other stormwater treatment facilities, narrowing the existing pavement from 70 to 50 feet, and using open space or alternative permeable paving surfaces to allow stormwater infiltration.

The Napa Valley Rainwater Harvesting project will develop and implement a program that converts wine and other barrels to home rainwater harvesting barrels. The project will also provide funding for rain gardens in Napa Valley. The goals of this project is to coordinate, provide support funding, and conduct performance assessments of rain barrel and rain gardens in Napa Valley to determine what type of rainwater harvesting works best for various purposes in the different environments within the valley.

The San Francisco Estuary Partnership (SFEP) will serve as the lead coordinating agency for this project. Project partners include San Francisco Estuary Institute (SFEI), Stopwaste.org, Caltrans, Napa County, and the cities of American Canyon, Napa,St. Helena, Calistoga,Campbell, San Pablo, Richmond, El Cerrito, Albany, Berkeley, Emeryville, Oakland and the town of Yountville.

A summary of all benefits and costs of the project are provided in **Table 1**. Project costs and water supply benefits are discussed in the remainder of this attachment.

Table 1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$8,277,336
Monetizable Benefits	
Water Supply Benefits	
Avoided imported water supply costs	$30,359
Water Quality Benefits	
Improved surface water quality (avoided wastewater treatment costs)	$397,255
Total Monetized Benefits	$421,947
Qualitative Benefit or Cost	**Qualitative indicator***
Water Supply Benefits	
Local groundwater supply augmentation	+
Improved water supply reliability	+
Additional future water supply benefits	++
Water Quality Benefits	
Improved surface water quality and aquatic habitat	+
Increased aesthetics	+
Increased educational and recreational opportunities	+
Increased fire protection in unincorporated Napa County	+
Reduced energy use and associated change in carbon and other emissions	+
Air quality pollutant removal from added vegetation	+
Reduced urban temperatures	+
Climate change adaptation	+
Additional future water quality and other benefits**	++

O&M = Operations and Maintenance
* 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 –.
**Additional future water quality and other benefits include those associated with implementation of a full-scale regional GI program. The pilot projects serve as a first step toward implementing this goal.

2 The "Without Project" Baseline

The San Francisco Bay Area Region encompasses nine counties, including Napa, Marin, Sonoma, Solano, Contra Costa, San Francisco, Alameda, San Mateo, and Santa Clara. In this region, managing stormwater runoff through traditional "grey" infrastructure systems (e.g., storage tunnels and transmission pipelines) results in a variety of challenges, including high construction, maintenance, and repair costs; increasing combined sewer overflows (CSOs); and the continued introduction of pollutants into source water. These problems are exacerbated as population and development continue to increase and new challenges arise, such as climate change, increasing energy costs, environmental concerns, and aging water infrastructure.

In light of these challenges, water managers in the Bay Area region recognize that a new, integrated approach to stormwater management will be needed to help ensure that cities, water utilities, and water districts can provide the quality and quantity of water that will be demanded in the future by Bay Area residents. Through the Bay Area IRWMP process, water managers in this region have therefore identified the use of GI and other low impact development (LID) techniques as a critical component of overall water resources management.

The use of GI and LID can result in a number of environmental, economic, and social benefits (i.e., the "triple bottom line," or TBL). Although many GI and LID projects have been implemented by local governments, water/wastewater agencies, private developers, and homeowners within the nine county Bay Area region, there is no database of success stories, cost information, maintenance requirements, and, in the case of rainwater harvesting, the amount of water conserved (or potentially conserved) by various projects. Bay Area water managers have yet to conduct the robust analysis and make a case to policy makers as to the amount of funds needed to implement GI, and what the long term benefits of a regional GI program would be.

Without this project, three important regional test case projects will not be built and analyzed for performance. The result is that there will continue to be only limited, scattered and uncoordinated GI efforts conducted sporadically by individual entities. Lessons learned from those few projects will have much less impact on decision-making throughout the region. Thus, future opportunities for maximizing the many benefits of a regional GI program would be lost.

In addition, the San Francisco Bay is listed on the 303(d) list as an impaired water body due to high levels of legacy pollutants such as mercury and PCBs. Stormwater runoff is one of the largest pathways through which these pollutants enter San Francisco Bay. The San Francisco Bay Municipal Regional Permit (MRP), adopted in the fall of 2009, is a consolidated NPDES permit that aims to reduce pollutant loading from stormwater runoff. The demonstration projects in this proposal support the MRP: they are intended to reduce stormwater flow and volume by capturing and detaining stormwater. Without the project, the benefits associated with each pilot project, including improved water quality, among others, will not be realized.

3 Water Quality and Other Benefits

The project will provide a range of water quality and other benefits. This section provides a discussion of these benefits including: improved surface water quality and aquatic habitat, increased aesthetics, educational, and recreational opportunities, increased fire protection in Napa County, improved air quality, reduced urban temperatures, climate change adaptation, and additional future water quality and other benefits.

The true value of the pilot projects lies in the future benefits that will be realized with full-scale implementation of a regional Green Infrastructure program. Information gained from the pilot projects will provide water and wastewater agencies in the Bay Area with the knowledge and ability to

shift towards a more sustainable GI approach to stormwater management (e.g., that will increase urban livability by providing multiple benefits), rather than continuing to manage runoff through traditional grey infrastructure systems. Thus, the long-term benefits associated with the pilot projects are much greater than portrayed in this benefit cost-analysis.

Improved Surface Water Quality and Aquatic Habitat

San Pablo Avenue, a busy state roadway at the foot of the East Bay hills, receives large quantities of polluted urban runoff from all of the vehicles that traverse it as well as from the surrounding highly urbanized landscape. All of this pollution currently flows directly to San Francisco Bay. The green stormwater treatment facilities in the San Pablo Avenue Green Stormwater Spine will collect, slow, and treat this runoff. In addition, the Hacienda Green Street Project will reduce stormwater runoff that is currently collected by the City's storm drain system, and deposited into nearby Los Gatos Creek. The Napa Valley Rainwater Harvesting Project will reduce stormwater runoff by 74 AF over the life of the project.

By reducing and/or treating stormwater runoff, the demonstration projects will improve surface water quality due to decreased pollutant loading associated with urban runoff (e.g. by reducing pollution to the Bay during dry weather flows and treating dry weather polluted stormwater prior to discharge to the Bay). In addition, the volume, duration, and frequency of flows associated with stormwater discharges will be reduced. Reduced stormwater runoff will not only improve surface water quality but will also result in improved habitat for many sensitive species. The extent of water quality improvements due to the pilot projects is unknown. However, water quality constituents commonly found in urban runoff include trash, oil and grease, metals, polycyclic aromatic hydrocarbons (PAHs), bacterial contaminants, inorganic forms of nitrogen and phosphorous, sediment, and pesticides. All water samples taken as part of the project monitoring components will be analyzed for PCBs, PAHs, Mercury, Methyl Mercury and a suite of other possible stormwater contaminants.

Under the San Francisco Bay Municipal Regional Permit (MRP), the Regional Water Quality Control Board is requiring municipalities to develop 10 Green Street Pilot Projects and implement Low Impact Development at 100% of new development projects. The Permit also requires municipalities to implement pilot projects to divert dry weather and first flush stormwater flows to POTWs to address these flows as a source of PCBs and mercury to the Bay. Muncipalities must first conduct feasibility evaluations of costs, benefits, and impacts on the stormwater and wastewater agencies and the receiving waters relevant to the diversion and treatment of the dry weather and first flush flows. Then a minimum of five muncipalities must pump dry weather flows and first stormwater flush to POTWs. Contra Costa County is embarking on an $800,000 project (thanks to a substantial grant from USEPA) to conduct a feasibility evaluation and retrofit for pumping polluted runoff from one several-acre site in Richmond, CA to a POTW. By contrast, the cost of treating stormwater using raingardens as part of the Regional Green Infrastructure Capacity Building Permit will cost roughly $500,000 to install to treat roughly one acre.

While all the costs of compliance with the MRP have not fully been determined, the costs for not complying with the permit could include fines from the Regional Water Quality Control Board, in addition to the costs of eventually coming into compliance.

A conservative estimate of the value of improved surface water quality can be calculated based on the avoided cost of what it would cost to treat this water at local wastewater treatment plants. Bay Area water suppliers estimate that wastewater treatment costs in the region amount to about $1,000 per AF of wastewater[1]. At full implementation, the proposed pilot projects will avoid the treatment of 39 AFY of

[1] Bay Area Regional Water Recycling Program, 1999. TM5 –Evaluation Decision Model Guide Book. Section 1.5.2 Wastewater Avoided Costs; and Bay Area IRWM Implementation Grant Application, Step 2, 2005. Economic Analysis.

wastewater (this amount of water will be infiltrated into the groundwater aquifer rather than being diverted to local WWTPs)[2]. Thus, local wastewater managers will avoid $39,000 in wastewater treatment costs. Over the 50-year project life, the total present value of this avoided cost will be $397,255. While this figure of 39 AFY against an estimated cost of $1,000 per AF of treated wastewater is the best figure we have for comparison, it is not truly a valid one. In reality, there is no way currently to move the water that will be treated in these projects to a wastewater facility and the cost of a new facility to treat such stormwater would be extremely high and beyond the scope of this evaluation. It should be recognized that economic evaluations such as these have limited application to emerging technologies and the true value of these projects lie in the partnerships being created, the detailed evaluation that will be done on the projects, and the information that will emerge from these evaluations which will enhance the ability of stormwater managers region-wide to improve water management.

It is important to note that this calculation greatly underestimates the long-term benefits of these projects. The region will benefit in a number of important ways from the rigorous project evaluation and information-sharing incorporated into each LID project. This information, in turn, will reduce future costs and errors in stormwater management work around the region. New, important partnerships will be created with these projects. For example, the San Pablo Avenue Stormwater Spine project brings a major financial commitment from the California Department of Transportation into its very first work at retrofitting existing streetscapes to improve stormwater quality. With the success of this project, the potential for Caltrans to support improved stormwater management in this highly urbanized region will substantially increase. While currently non-quantifiable, these future benefits will be substantial.

Increased Aesthetics

Green areas, including trees, plants, and other GI project components, improve urban aesthetics and community livability. Several empirical studies show that property values are higher when trees and other vegetation are present in urban neighborhoods. For example, a study conducted by Stratus Consulting (based on existing literature) estimated that a city-wide GI program in Philadelphia would increase residential property values for properties located near GI retrofit projects by 2.5%, on average. When applied city-wide to all project areas, the estimated value of enhanced residential property values was over $1.1 billion (Stratus Consulting 2008).

Through the implementation of green areas and rain gardens, the three demonstration projects have the potential to increase urban aesthetics, which in turn, will increase the value of properties located near the proposed projects. Without a more extensive study on the effect of GI on current property values, these benefits are difficult to quantify. However, it is expected that these benefits will be of particular significance for the San Pablo Avenue Stormwater Spine demonstration project, much of which will be located in communities of concern or disadvantaged community cities of San Pablo, Richmond, and Oakland. Increased livability and urban aesthetics will also contribute to reduced green field development and increased infill development in urban areas.

Increased educational and recreational opportunities

In addition to increased aesthetics and quality of life, the proposed GI projects will result in additional educational and recreational opportunities for Bay Area residents. For example, San Pablo Avenue is a main thoroughfare, and the green stormwater projects along it will be seen by thousands of drivers each day, passengers on buses, bicyclists, and pedestrians. A primary goal of this project is to increase understanding of urban pollutants and sustainable stormwater management among the general public. The San Pablo Avenue Stormwater Spine demonstration units will include educational signs and will be a highly visible step in promoting GI throughout the Bay Area.

As part of the Napa Rainwater Harvesting Project, Napa County will work with Valley Oak High School, Napa Community Garden, and other public partners to install rain gardens. A main component of this project is to increase public outreach related to stormwater and water conservation issues.

In addition to educational opportunities, the projects will also enhance recreational activities in the region. For example, due to the general increase in vegetated acreage, more people will be able to enjoy outdoor activities along the San Pablo Avenue Stormwater Spine. In addition, a permeable paver bike lane will be installed as part of the Hacienda Avenue Green Street project. The roadway does not currently have a bike lane. The general greening of community areas that will occur as a result of the project will enhance recreational enjoyment.

Increased Fire Protection

As part of the Napa Rainwater Harvesting Project, a total of 750 rain barrels will be distributed for use throughout Napa County. In unincorporated areas of Napa County, residents are required to have water available for structural fire fighting. This project replaces the need to have cisterns filled with groundwater for fire protection purposes.

Reduced Energy Use and Related Changes in Carbon and Other Emissions

Green space helps lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling. In addition, diverting stormwater from wastewater collection, conveyance and treatment systems reduces the amount of energy needed to pump and treat the water (USEPA 2008), which in turn reduces emissions of greenhouse gases (GHG, including carbon dioxide, CO_2) and other air pollutants (e.g., sulfur dioxide, SO_2, and nitrogen oxides, NO_x) from power plants. Reduced energy demands in buildings, and increased carbon sequestration by added vegetation, also result in a lower carbon footprint (reduced CO_2 emissions).

Air Quality Pollutant Removal from Added Vegetation

Trees and vegetation planted as part of the projects will improve air quality by filtering some airborne pollutants (particulate matter and ozone) (USEPA 2008). Likewise, as noted above, reduced energy consumption results in decreased emissions (SO_2 and NO_x) from power generation facilities (as described and evaluated in the previous section). These air quality improvements can reduce the incidence and severity of respiratory illness. Green street projects (e.g., the Hacienda Avenue Improvement Project) and community planning and design efforts (e.g., the San Pablo Stormwater Spine) that facilitate shorter commute distances and the ability to walk to destinations will also reduce vehicle emissions.

Reduced Urban Temperatures

Summer city temperatures can average 10ºF higher than nearby suburban temperatures. High temperatures are also linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air (USEPA 2008). Limiting impervious surface under all three demonstration projects will also help to mitigate urban temperatures.

Climate Change Adaptation

Climate change impacts and effects vary regionally, but GI techniques provide adaptation benefits for a wide array of circumstances, by conserving and reusing water, promoting groundwater recharge, reducing surface water discharges that could contribute to flooding. In addition, there are mitigation benefits such as reduced energy demands and carbon sequestration by vegetation (USEPA 2008). The three demonstration projects will all contribute to this benefit.

Additional Future Benefits

Due to the relatively small-scale of the demonstration projects, many of the benefits mentioned above will not be fully realized (i.e. on a regional scale) until a broader GI program is implemented within the Bay Area. As noted in Attachment 7, the primary objective of the Regional Green Infrastructure Capacity Building Program is to develop and improve techniques for better stormwater management in the Bay Area by: 1) analyzing each project to determine water conservation and/or stormwater quality benefits, and 2) disseminating information on lessons learned from the projects to other cities, counties and water management entities in the region. The pilot projects will be used as tool to enable the use of GI and LID at the regional level. This will result in future water quality and other GI-related benefits throughout the Bay Area at a much larger scale.

The value of the knowledge gained from these pilot efforts is expected to be considerable, such as leading to enhanced and wider-scale implementation of those GI and LID approaches that are found to be most effective (and avoiding investments in projects or approaches that may be shown to be less effective).

No monetary value is assigned to this benefit, but the knowledge and confidence gained from these projects are likely to provide significant value in the future to utility practitioners/planners, and the communities they serve.

As an example of the magnitude of benefits that would be provided by a regional GI program, one can consider the monetized benefits of the Philadelphia Water Department's proposed city-wide GI program for controlling combined sewer overflows. In 2008, Stratus Consulting completed a triple bottom line analysis of Philadelphia's proposed GI program. This study quantified benefits of the program related to increased recreational opportunities, improved property values, reduction in heat stress mortalities, water quality and aquatic habitat enhancement, wetland services, social costs avoided by green collar jobs, air quality improvements, and energy savings. City-wide, total present value benefits were estimated to range from about $1.935 billion to more than $4.466 billion in benefits, depending on the level of GI implementation (ranging from treatment of 25% of impervious area in the City to treatment of 100% of total impervious area). The benefits of the proposed programs far outweighed the estimated costs.

Although these benefits cannot be directly applied to the Bay Area due to differences in type of GI implementation, as well as climate and a number of other factors, they provide an order of magnitude for the potential benefits that would be associated with a regional GI program. The proposed pilot projects are the first step towards enabling these larger regional benefits.

In addition to the cost savings described above, future benefits of GI may include cost savings compared to traditional treatment. According to the EPA, GI may save capital costs associated with paving, creating curbs and gutters, building large collection and conveyance systems, and digging big tunnels and centralized stormwater ponds; operations and maintenance expenses for treatment plants, pumping stations, pipes, and other hard infrastructure; energy costs for pumping water around; cost of treatment during wet weather; and costs of repairing the damage caused by stormwater, such as streambank restoration (EPA 2008).

Finally, in the Bay Area, in addition to the benefits described above, a major benefit associated with implementing a regional GI approach to stormwater management is increased urban livability and reduced greenfield development outside of urban areas. In many parts of the region, the general trend has been the expansion of residential areas outside of the urban core. This has resulted in long commutes, increased traffic, and reduced infill development. The use of GI is expected to increase livability, which in turn, will help to reduce this trend.

4 Distribution of project benefits and identification of beneficiaries

The Regional Green Infrastructure Capacity Building Program includes the full range of types of beneficiaries. At the local level, residents in the communities of Oakland, Richmond, San Pablo, and Campbell will benefit from increased aesthetics, recreational and educational opportunities associated with the San Pablo Stormwater Spine Project and the Hacienda Avenue Green Street Project. Napa County residents will also experience these benefits, as well as increased fire protection. The projects will result in regional and statewide benefits by improving surface water quality and aquatic habitat in the Bay Area (where many water bodies and aquatic species are of statewide significance), improving air quality, reducing urban temperatures, reducing impacts associated with climate change, and enabling future benefits associated with a regional GI program.

5 Project Benefits Timeline Description

The San Pablo Stormwater Spine project is scheduled for completion in 2013. For this analysis, it is assumed that the project will come online in 2014 and will have a 20-year useful life. The Hacienda Green Street Improvement Project will be completed in 2012 and will have a 25-year useful life. Implementation of Napa Valley Rainwater Harvesting Project will begin in 2011 and will continue through 2015. Benefits for this project are calculated through 2060, 50 years after the project begins to come online in 2011. The timing of future GI projects that will build upon the proposed pilot projects has not yet been established.

6 Potential Adverse Effects from the Project

Construction of the green streets projects could cause temporary traffic disruptions and require lane closures, which can impact surrounding businesses and residences. However, since these impacts are temporary and will be mitigated as part environmental compliance with CEQA, there are no significant unavoidable adverse effects associated with this project. The construction of rain gardens and installation of rain barrels in the Napa Valley Rainwater Harvesting project could restrict or limit access to construction areas temporarily, but will not cause any significant impacts after the installations are completed.

7 Summary of Findings

The implementation of GI pilot projects will lead to a tipping point, resulting in a number of cities in the Bay Area implementing GI such that it will begin to make a difference. Currently, less than 10 cities have experience with GI projects. Together, they are treating treating less than 20 acres out of the approximately 4,500,000 acres in the 9 county region. The true value of the proposed projects is the knowledge that will be gained from the projects, which will facilitate future implementation of GI (and associated benefits) throughout the region.

The proposed program will provide a wide range of both water quality and other benefits including $397,255 in present value avoided wastewater treatment costs, improved surface water quality and aquatic habitat within the Bay Area, increased aesthetics, increased educational and recreational opportunities, increased fire protection, reduced energy use, improved air quality, reduced urban temperatures and climate change mitigation.

References

Stratus Consulting. 2008. A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds, Final Report. *Prepared for* Office of Watersheds, City of Philadelphia Water Department.

USEPA (Environmental Protection Agency). 2008. Managing Wet Weather With Green Infrastructure Action Strategy. Available: http://www.epa.gov/npdes/pubs/gi_action_strategy.pdf. Accessed 12/31/10.

San Francisco Bay Area Regional Priority Projects and Programs Attachment 8 – Economic Analysis: Water Quality and Other Expected Benefits

Project 5. Integrated Water Quality Improvement, Flood Management and Ecosystem Restoration in Bay Area Disadvantaged Communities

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1 Summary

This program represents a suite of tasks which are designed to improve water quality, decrease flooding and restore valuable ecosystem habitats in disadvantaged communities in the Bay Area.

Tasks include: restoring streams as school projects with teachers, parents and students at disadvantaged schools; developing a flood hazard mapping tool with a disadvantaged community GIS overlay; upgrading stormwater improvement facilities at Bay Point; addressing over bank flows in the Pescadaro business district; establishing information on the downstream habitat improvements needs for Pescadero steelhead and coho to integrate with the flood control-water quality project; developing and implementing stream restoration guidance for multi-objective projects in the disadvantaged areas of Wildcat, San Pablo, Rheem, Pescadero and San Francisquito Creeks and adjacent wetlands; and, supporting the development of management options for anadromous fish populations in low lying areas on Corte Madera Creek, San Francisquito and Alameda Creek to inform future project designs .

Table 1 on the following page provides an overview of the project benefits and costs. The discounted costs of this project are $2,152,663 (Table 2).

There are no water supply benefits for this program.

The water quality and other monetized benefits of this program, using cost avoidance methodology, are about $2.67 million. Additional significant benefits accruing from this program include: Water Quality, Flood Control, Recreation Wetlands Creation/Restoration, Wildlife and Special Species Habitat Improvements, Climate Change and Environmental Justice. These benefits are discussed in detail in the remainder of this Attachment.

The qualitative benefits of this program are large. This program, designed to move many necessary water improvement projects in DACs from the "identified need stage" into implementation, has the potential to provide a snowball effect of water related, as well as social, economic, and environmental justice benefits.

Table 1. Benefit-Cost Analysis Overview

	Present Value
Costs Total Capital and O&M	$
Total annualized costs	2.1 million
Monetized Benefits	
Water Quality and Other Benefits	
Avoided Water Treatment Facility Construction and O&M	$2.67 million +
	*Qualitative indicator**
Qualitative Benefit or Cost	
Water Quality Benefits	++
Flood Controls	+
Recreation	+
Wetlands Creation/Restoration	+
Wildlife/Special Species Habitat Restoration	+
Climate Change	+
Environmental Justice	++

O&M = Operations and Maintenance
* 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 –.

Table 2- Annual Cost of Project
Integrated Water Quality Improvement, Flood Management and Ecosystem Restoration in Bay Area Disadvantaged Communities

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost From Table 7 (row (i), column(d))	Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009								1.00	$0
2010								0.94	$0
2011	$680,817						$682,830	0.89	$607,716
2012	$1,355,136						$1,357,151	0.84	$1,139,490
2013	$509,862						$511,879	0.79	$405,456
2014								0.75	$0
2015								0.70	$0
2016								0.67	$0
2017								0.63	$0
2018								0.59	$0
2019								0.56	$0
2020								0.53	$0
2021								0.50	$0
2022								0.47	$0
2023								0.44	$0
2024								0.42	$0
2025								0.39	$0
2026								0.37	$0
2027								0.35	$0
2028								0.33	$0
2029								0.31	$0
2030								0.29	$0
2031								0.28	$0
2032								0.26	$0
2033								0.25	$0
2034								0.23	
2035								0.22	
2036								0.21	
2037								0.20	
2038								0.18	
2039								0.17	
2040								0.16	
2041								0.15	
2042								0.15	
2043								0.14	
2044								0.13	
2045								0.12	
2046								0.12	
2047								0.11	
2048								0.10	
2049								0.10	
2050								0.09	
2051								0.09	
2052								0.08	
2053								0.08	
2054								0.07	
2055								0.07	
2056								0.06	
2057								0.06	
2058								0.06	
2059								0.05	
2060								0.05	
2061								0.05	
2062								0.05	
2063								0.04	
2064								0.04	
2065								0.04	
2066								0.04	
Project Life	50 years							…	
							Total Present Value of Discounted Costs (Sum of Column (i)) Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries		$2,152,663

Comments: Total Initial Costs do not equal the total in Table 7 & 8 as $335,800 ($25,000 for Task D, $80,800 for Task H and $230,000 for Task E) are sunk cost expenditures that occurred prior to 2010. Total costs for each year plus the sunk costs expenditures ($680.817+ $1,355,136 + $509,862 + $335,800) equals total Initital costs as expressed in Table 8 of $2,881,615.

2 The "Without Project" Baseline

Without this Program - flooding, ecosystem health and water quality for Bay Area DAC's will continue to decline at a rate significantly greater than those in areas with access to greater technical and financial resources. Due to a lack of funding for and/or expertise in flood mitigation and stream restoration design and engineering, area DACs will be unable to apply for the myriad grant and funding opportunities available for flood control and stream restoration. This will increase the schism between DACs and wealthier communities.

3 Water Quality and Other Benefits

Water Quality and Other Benefits are discussed below. For each type of benefits, (i.e. riparian restoration, flood reduction, etc.) a discussion is provided by project element and then summed for the entire Program.

Riparian Restoration

Project B. Stream restoration with schools and community in disadvantaged communities

STRAW - Students and Teachers Restoring A Watershed - will work with teachers and their students on professionally designed habitat restorations. Methods include removal of invasive plants and revegetation with native plants that will also assist with flood protection for low lying and sensitive areas.
In this Task stream corridor revegetation will occur as a result of 10 planting days - resulting in 7500 lineal feet of stream channel restoration.

In *Putting a Price on Riparian Corridors as Water Treatment Facilities*, a study conducted by The San Francisco Bay Water Quality Control Board in conjunction with the Economics Division of the Department of Water Resources, (Riley, et.al. 2009) Avoided Cost Methodology was used to compare the efficacy and costs of riparian habitat restoration with the construction and operation of a stormwater treatment plant. The study concluded that a typical bay area riparian corridor of 4000 feet for a stream with a flow of 0.5 cfs provides treatment equivalent to a physically constructed stormwater treatment plant designed to treat 320,000 gallons of runoff per day

The Riley study determined that for the water treatment plant examined, SMURRF, construction, operations and maintenance costs annualized over 50 years with a discount rate of 6% results in a cost of about $1.3 million per year for the treatment of 320,000 gallons. Annualized costs include the need for facility replacement after 20 years. Using the State update factor, annualized costs for the water treatment facility are $1,383,423 in 2009 dollars. We have used the Riley et.al. study as a basis for determining the benefits of the avoided costs associated with building a water treatment facility that would provide the same level of water quality benefit as this Task.

This task provides 7500 linear feet of restoration along streams with similar watershed profiles and riparian widths. Because both the project stream corridors and the corridors in the study represent similar channel dimensions we can apply the values from the above referenced study to this project. As illustrated in the paragraph above to achieve the water quality benefits obtained by a water treatment facility similar to SMURFF would cost $1,383,423 for every 4000 linear feet of restoration. This project provides 7500 linear feet of restoration for a cost avoided benefit of approximately $2.67 million dollars (7500/4000 =1.93; and 1.93 * $1,383,423 = $2.67 million). Because this is already a present value cost we did not develop a Table 12.

Project E. Disadvantaged Communities Richmond Shoreline and City of San Pablo Flood Project Program

This project addresses combined water quality and flood hazards in two specific locations at 23rd Street in the City of San Pablo and the Richmond Parkway in North Richmond. This project also supports providing the design guidance for these projects as well as other imminent stream restoration projects that will occur at nearby sites on Rheem Creek, Wildcat Creek, and San Pablo Creeks. The development of the design guidance is done in a manner to also provide occupational training for students at a nearby community college.

The tool developed in this task, as well as additional on site design and engineering work, will be used by the City of San Pablo to develop a restoration plan for Wildcat Creek at 23rd Street (the top priority implementation project identified in the Wildcat Creek Restoration Plan (Wildcat –San Pablo Creeks Watershed Council, 2010). The City Council of San Pablo has requested assistance to advance this project to the next step, which is to finalize hydraulic and sediment modeling, complete topographic surveys, and develop the final schematics to qualify the project for construction grants.

The Richmond Parkway site in task 5 will entail producing a design for the resolution of water quality and flood hazards reduction. The design will enable approximately 1000 feet of creek channel to be restored under and adjacent to the Richmond Parkway by removing a retaining wall acting as a hydraulic constriction and sediment trap. These water quality benefits will be matched by the additional substantial but unquantifiable benefits of avoiding the pollution of business and residential structures by significantly reducing overbank flood and stormwater flows which reach building interiors in East Palo Alto, San Pablo and Bay Point. The Richmond Parkway site will address a water pollution hazard for pedestrians and public safety hazard associated with an unsafe crossing at the Richmond Parkway. Task 4 located at Bay Point provides the necessary stormwater system assessment to identify corrections needed to reduce stormwater discharges into streets and remove water quality hazards from residential areas.

Projects F. and G. Pescadero Creek Watershed Disadvantaged Communities Integrated Flood Reduction and Habitat Enhancement Project

Residents of the town of Pescadero identify flooding from Butano Creek in the town center on the main access road used to enter and exit the town as a priority water resource management concern affecting the habitability of residences and businesses. The San Mateo County RCD will contract with a hydraulic engineer and hydrologist to do hydraulic modeling and present alternative solutions to help the community select a preferred alternative for addressing solutions to reducing sediment laden waters entering the town. Restoration design curves to guide design will be developed through community involvement, and providing job training benefits and fish monitoring and habitat assessment will provide for an integrated solution to the problem.

The downtown flood damage reduction project will restore approximately 2000 feet of stream channel. Using the cost avoidance methodology described above this project would have water quality benefits of about $555,500. These would be in addition to flood control benefits, which are tied to the water quality benefits. The restoration of Butano Creek in the downtown area will provide direct water quality benefits to downstream Pescadero Marsh, a critical component identified in resource management reports for improving endangered species habitat for a number of threatened and endangered species (CEMAR, California Coastal Conservancy 2010).

Project H. Stream channel shapes and floodplain Restoration Guidance and Watershed Restoration in San Francisquito Creek, East Palo Alto, a Disadvantaged Community

This project will develop stream channel and floodplain design guidance by developing regional stream restoration design curves through field work. The design guidance document will inform immediate needs for restoration work and function as a tool for many future miles of restoration. The areas which will use the design guidance as soon as it becomes available are listed as follows:

San Francisquito Watershed

- Lower watershed: 54 acres
- Middle watershed: 1500 feet of stream restoration +300 feet of daylighting restoration.

Eastern San Mateo County/Santa Clara County:

- Approximately 4,000 feet of Permanente Creek in San Mateo County

Wildcat Creek:

- 4706 linear feet (WRAPP plan) plus estimated 1,500 feet in upper watershed

Rheem Creek

- 105 acres/500 linear feet

San Pablo Creek

- 200 linear feet

Pescadero Creek Watershed

- Watershed-wide - 82 square miles of watershed – potentially 3,000 LF of creek restoration

Regionally in western San Mateo County

- Various creek restoration projects

The development of design/engineering curves will provide the technical information necessary for these priority projects, which represent about 16,000 linear feet of riparian restoration, to reach the stage where they have adequate information to advance to construction drawings and apply for implementation funding. Using the avoided cost methodology described above, and applying the average cost for a restoration project identified for this area by Riley, et.al. (2009) this project represents the first step in accruing avoided costs of over $4 million dollars.

The San Francisco Bay Regional Water Quality Control Board has identified both San Francisquito Creek and Pescadero Creek watersheds for adoption of sediment TMDLs. The project will provide critical information for developing actions to implement adopted TMDLs. As many as 10,000 lineal feet of creek channel on lower San Francisquito Creek may undergo restoration and provide future water quality benefits.

Other Riparian Habitat Improvement Benefits

Riparian areas improve water quality by removing nutrients, improving dissolved oxygen, storing sediment and regulating temperatures among other benefits. A significant body of water quality research details the ability of riparian systems to store sediment, and retain and transform excess nutrients, pesticides, and toxic substances (e.g., Meyer et al. 2003; Klapproth and Johnson 2000); Wenger 1999; Osborne and Kovacic 1993; Peterjohn and Correll 1984; Chagrin River Watershed Partners 2006;Perry et al 1999; Mayeret.al 2005).

In general, riparian areas are found to be efficient at processing organic matter and sediments, and sediment bound pollutants carried in surface runoff are deposited effectively in riparian forests and floodplain areas. The finer sediments are removed from runoff as a result of deposition and erosion, infiltration, dilution, and adsorption/desorption reactions with woodland soil and litter.

Riparian systems are also known to have significant impacts on water temperatures and microclimates (Bhowmilk et al. 1980; Lowrance et al 1984; Lowranceet et al., 1986; Naiman et al.1997). Researchers have also found that the loss of riparian areas to clearing and channelization not only equates to a loss of these treatment functions but may also result in the disturbance of areas that have served as nutrient sinks for sediment and sediment associated nutrients, which then causes the export of the nutrient sink accumulated over many years (Kuenzler et al. 1977).

Research also indicates that healthy aquatic systems can transform animal waste and chemical fertilizers into less harmful substances. Vegetated buffers and protected riparian areas with contiguous riparian corridors have been shown to be effective in reducing pathogens such as coliform and cryptosporidium parvuum (Meyer et al. 2003; Tate, et al. 2004; Tate 1978; Balance Hydrologics 2007).

Qualitative Flood Control Benefits

This program is designed, through a variety of tasks, to assist Bay area DACs in developing the information needed to ensure future flood mitigation projects provide maximum flood control benefits for the highest need areas. In addition, these tasks ensure designs for flood mitigation projects include consideration for water quality, habitat restoration, ecological health, and recreation opportunities. Reduction of water pollution is a primary concern to the DACs served by this grant project but the communities embrace multi-objective benefits and strategies and flood reduction is a critical need.

This program is necessary for DACs to receive the funding necessary for project implementation. In most communities, funding to develop the design/engineering plans needed to qualify for state and federal funding for flood and water quality projects are typically borne by a city, county or local district revenues. For DACs, which are mostly located in unincorporated areas or cities with very low tax revenues, funding resources to get to this first step are non-existent and these areas must typically depend on funding from outside sources. This program would ensure that Bay Area DACs have the technical resources necessary to apply for grants that will provide their communities with implementable pollution control and flood control projects which do not conflict with the requirements to protect and enhance endangered and threatened species habitat. This section provides a qualitative overview of the flood control benefits by Task.

<u>Project D. Storm Water Improvements and Flood Reduction Strategies Pilot Project in Bay Point</u>

This project produces a detailed assessment of flood and stormwater infrastructure for an unincorporated area of Contra Costa County. A community based process will identify the most serious and chronic hazard areas in which public health and safety from polluted waters is a high concern. This work will be the first step in implementing infrastructure projects in DACs in the Bay Area. The final report will include a description of the causes of flooding and potential implementation remedies that Bay Point may pursue. This project will serve to identify flood control infrastructure needs for over 1,200 acres.

<u>Project E. Disadvantaged Communities Richmond Shoreline and City of San Pablo Flood Project</u>

This project develops designs for the implementation of integrated water quality- flood management, habitat enhancement, and safe public access projects in several disadvantaged areas in the City of San Pablo and unincorporated North Richmond. The location of the City of San Pablo project is in an U.S.

Army Corps of Engineers flood control project area authorized for planning and design in the 1970s. The project was never implementable because the low property values in this disadvantaged community would not support a standard federal cost-benefit analysis. Therefore this community's only option to address flood damages is to use an incremental phased project approach using a combination of state and federal grants. The area is located in a recently mapped FEMA flood hazard zone which includes 574 structures.

The City of San Pablo Public Works records indicate that the cost to the City for central area flood responses were $23,000 in 1993, $31,000 in 1995, and $16,000 in 2005-6. Property damage to private property in the area is estimated at $360,000 for the 2005-6 flood. A USGS gage located directly upstream indicates the 2005-6 flood was a one in twenty-five year flood. This project is designed to provide planners with the construction documents and level of design necessary to apply for funding that will prevent these damages.

This project also produces a design to remove a hydraulic constriction and sediment trap under the Richmond Parkway which creates a hazard for pedestrian crossing of the parkway and compromises the required design freeboard for an existing flood control project. This is a chronic problem area for 12 months of every year and has not been resolved since the project was constructed in 1986.

Projects F. and G. -- Pescadero Creek Watershed Disadvantaged Communities Integrated Flood Reduction and Habitat Enhancement Project

These projects along with Project H (restoration design curves) bring together the necessary basic hydraulic engineering, fluvial geomorphology and fish habitat science to inform the community of flood damage reduction options for Butano Creek in downtown Pescadero. Existing reports (Swanson Hydrology and Geomorphology 2010, Cook 1997) identify the conditions and causes of problems experienced in this locale. The levees along Butano Creek prevent the overflow on the east bank from re-entering the stream channel and the Pescadero Bridge restricts conveyance of high flows. The recommendations before the community are to remove some or all of the remaining levees between Butano Creek and the marsh below and reconnect the creek with the flood plain. In 2010, Butano Creek jumped its channel at the bridge and flowed through the marshes in unchanneled flow. This is an acute problem that has to be addressed in a multi-objective manner because of the unusually high resource values of the marsh.

The downtown flood damage reduction project will restore approximately 1500 feet of stream channel. An interagency report prepared by the Pescadero Creek Watershed Coordinated Resource Management and Planning (1997) indicates:

The Butano Creek channel which chronically floods at Pescadero Road has filled with 6-9 feet of sediment. Estimates by consulting firms to dredge the sediment to restore capacity range from $577,825 to $605,220. These are one-time costs, not representative of potential long term costs because proceeding without more permanent channel-floodplain modifications can lead to repetitive needs to dredge The San Mateo County RCD will work with the watershed council and the subcontractor to identify and select project alternatives for the flood damage reduction plan in the task above.

Projects H. and I. -- Stream Channel shapes and Floodplain Restoration Guidance and Watershed Restoration in San Francisquito Creek, East Palo Alto, a Disadvantaged Community

Project H is designed to address the San Francisquito watershed needs for water pollution prevention and flood control. The City of East Palo Alto Public works records indicate that flood damages to East Palo Alto in 1998 flood were approximately $10 million. Annual storm drain damages for the area estimated at: $500,000. In addition, emergency repairs to the San Francisquito Creek levee totaled $450,000.

This project would provide the catalyst for development of projects designed to mitigate these damages while improving water quality and stream ecosystem health and engages the community in analyzing project alternatives. The other portions of these projects provide management and design strategies for a multi-objective approach for flood management options by integrating some geomorphology and fish population information.

Recreation

Project E. Disadvantaged Communities Richmond Shoreline and City of San Pablo Flood Project

Currently the Communities of Richmond, North Richmond and San Pablo are prevented from accessing their San Pablo Bay shoreline because of the construction of a six lane highway called the Richmond Parkway that intercepts the Wildcat Creek Regional Trail. One objective of Task 5 is to get the overpass project to a schematic stage so that the community can review and agencies can approve the design, in order to qualify the project for funding from County Measure WW funds, West County transportation funds and potential federal funding and to get it to the construction drawings and implementation phases.

City of San Pablo Business District Creek Restoration
The top priority implementation project identified in the 2010 Wildcat –San Pablo Creeks Watershed Plan, funded through CalFed is the restoration of Wildcat Creek at 23rd Street in the City of San Pablo. This strategic project will provide public access with a trail extension and creekside pocket parks on both sides of 23rd Street.

Wetlands Restoration

Project H. Stream channel shapes and floodplain Restoration Guidance and Watershed Restoration in San Francisquito Creek, East Palo Alto, a Disadvantaged Community

This task, designed to address the San Francisquito watershed needs, will create guidance that includes a golf course restoration to wetlands of approximately 8 acres and a wetlands restoration in the Cooley Landing area of about 50 acres.

Wildlife Habitat Restoration

Project B. Stream Restoration with Schools

The McDowell School restoration located near San Pablo Bay creates a transition zone habitat that is essential refuge for wildlife particularly during high tide events. Two endangered species, the California clapper rail and salt marsh harvest mouse require this habitat to weather high sea level elevations.
The San Pedro school project is located on grounds adjacent to the school and provides a wildlife corridor. The Blue Rock Springs restoration is another important wildlife corridor. The Mahone Creek project restores a creek at the tidally influenced zone and represents another important wildlife refuge.

Project E. Disadvantaged Communities Richmond Shoreline and City of San Pablo Flood Project Program

This project will benefit Wildcat Creek which through a collaborative effort of the Wildcat-San Pablo Creeks watershed council has benefited from a reintroduction of a steelhead population. The two projects proposed on Wildcat Creek will remove and lesson barriers to steelhead passage. The project at the Richmond Parkway site will improve the connectivity between the stream channel and marsh. The marsh contains the endangered Salt Mouse, Harvest Mouse, California clapper rail and San Pablo vole.
Design guidance for Rheem Creek will include 1500 lineal feet of riparian restoration in a coastal marsh containing the endangered clapper rail.

Project G. Pescadero Creek Steelhead Smolt Outmigrant Trapping

The San Mateo County Resource Conservation District (RCD) will lead a project to develop pollution control, water quality enhancement, flood management and fish and wildlife habitat protection for the lower Pescadero watershed.

The lower Pescadero watershed which this project addresses contains Pescadero marsh which is 340 acres of coastal wetlands, the largest wetland between San Francisco Bay and Elkhorn Slough near Watsonville. Approximately a two mile area of habitat will be addressed for fisheries habitat assessment. A report by Dr. Jerry Smith, San Jose University, estimated 10,000 steelhead rearing in this area. (Smith, 1990) A count of approximately 750 steelhead in 2008 indicates the critical need for an integrated response to the watershed management issues which need to be resolved in this area. The marsh is considered a critical habitat management need for the bay area because the lagoon and associated wetlands support the following threatened and endangered species: steelhead, tidewater goby, San Francisco garter snake, red legged frog and western pond turtle. The resolution of the flooding will have direct impacts on the habitat conditions for all of these species. The California Department of Fish and Game identifies Pescadero Creek for Coho population reintroduction.

Task 9 Steelhead and Coho bay area Monitoring As Indicator For Restoration Success

Understanding fish populations is an important component in an integrated effort to address water quality, flooding and restoration management needs.

Smolt trapping will initially be conducted in three watersheds, Coyote Creek, Sonoma Creek, and the Napa River. Coyote Creek drains an area of about 371 square miles, Sonoma Creek's watershed is about 155 square miles, and the Napa River basin is about 417 square miles. Because of the relative scarcity of steelhead rearing habitat in Bay Area streams, the program will account for an appreciable proportion of the region's steelhead production potential. The watersheds have been selected, and monitoring locations determined, based on the opportunity to capture the majority of the out migrating juvenile steelhead in each drainage.

The Upper Penintencia Creek site will sample downstream from about one third of the Coyote Creek watershed's rearing habitat. (The remainder has been sampled under a separate process). The Sonoma Creek watershed sites will provide data for the two most important tributaries, Carriger and Calabazas creeks. Together, these streams account for almost one-half of the total Sonoma Creek tributary habitat. The Napa River rotary screw trap produces information applicable to the entire basin's production potential. New, additional sampling locations will allow researchers to focus on the three tributaries with the greatest extent of rearing habitat to measure their contribution to the overall production. This process will assess the condition of the habitat and focus restoration strategy.

Data from the trapping sites can be compared to reference locations, thereby producing a measure of relative watershed health. Streams under-producing can then be the focus of instream flow enhancement projects, or channel or riparian improvements. Adequately producing streams can be protected without unnecessary additional cost. Achieving reasonable production levels in Bay Area streams will indicate that water supply and land management activities are being conducted in a compatible manner with maintaining the beneficial use of cold water habitat and fisheries. Over time, monitoring can be used to determine progress toward steelhead recovery, and possibly species delisting (under the Endangered Species Act).

The program benefits the public and the agencies concerned with stream habitat and steelhead. These agencies include, but are not limited to: the National Marine Fisheries Service, the Department of Fish and Game, the Regional Water Quality Control Board, the Santa Clara Valley Water District, the City of San Jose, the Southern Sonoma County Resource Conservation District, Sonoma County, the Sonoma

County Water Agency, the Napa County Resource Conservation District, and Napa County (including the Flood Control and Water Conservation District). The program will expand the number of watersheds monitored in future years and will increase the number of agencies that benefit from resource management guidance.

Climate Change

Projects A. through H. Mapping, Stream channel shapes and floodplain restoration guidance, Watershed restoration, Fish population enhancement, stormwater management

Recently published information on the impact of global climate change and resulting sea level rise in San Francisco Bay and surrounding communities indicates that the areas addressed in this project are expected to receive a permanent rise of 1.5 to 3 feet .This change is expected to submerge large portions of Bay Point, the North Richmond Shoreline, East Palo Alto and exacerbate the water management problems of Pescadero Marsh and Butano Creek. Other disadvantaged communities are expected to be impacted including the Alviso area near San Jose, West Oakland and other DACs we haven't yet identified along the rim of the Bay. The Mapping project in task 3 is being conducted to provide better information to work from on what DACs we should be mobilizing assistance for.

San Francisquito Creek has historically flooded every 11 years; the last flood of 1998 was considered a 70-year event and impacted our entire project area. Salt Ponds around the bay, including some along the project area, are being restored to native wetlands. The levees that were built to operate the salt ponds were never built for flood protection, leaving this area subject to devastating flooding. This project will provide identification and coordination of restoration / enhancement opportunities for the region; as well as coordination of flood control efforts.

The North Richmond shoreline project and Pescadero projects are likewise proposed in part to deliver resiliency to climate change, change in flood frequencies and address the rise in Bay elevations. The remedies stress removing hydraulic constrictions and backwater effects, and restoring floodplain areas. The Straw restoration projects add buffer zones to waterways.

Environmental Justice

The primary purpose of this program is to bring technical expertise to DACs in the Bay area so that they can compete on an equal footing with other regions for available water implementation funding. Refer to the **Attachment 12** which provides the details of the needs for the areas served by this program.

4 Distribution of Project Benefits, and Identification of Beneficiaries

All locations served by this program are geographically isolated areas in floodplains and wetlands and have suffered stormwater and flood damages over the years. The areas are known for their high poverty rates. In the 1980s and early 1990s, East Palo Alto had the highest crime rate in the country while North Richmond was a close contender for this unwelcome statistic, with Bay Point struggling to overcome its reputation as a crime magnet. All areas are characterized by under-performing schools, with East Palo Alto and North Richmond ranked among the lowest in the State.

Table 4. Project Beneficiaries Summary

Benefit	**Qualitative Indicator**	
Local	**Regional**	***Statewide***
Bay Area DACs including. North Richmond, City of San Pablo, City of East Palo Alto, Bay Point, town of Pescadero Title I disadvantaged schools in Marin, Sonoma, Napa and Solano counties.	Contra Costa County San Mateo County San Francisquito Watershed Pescadaro Creek Watershed	*Bay-Delta*

5 Project Benefits Timeline

All projects within this regional program will be completed within 2 years. Benefits of the program will begin to accrue immediately and will continue for 50 years.

6 Potential Adverse Effects from Project

There are no adverse effects associated with this program.

7 Summary of Findings

This section provides a summary of the costs and benefits of this regional program in the following tables. In Table 5 the qualitative benefits are summarized by type of Benefit, and are summed for the entire Program. In Table 6 Benefits are reviewed by project.

Table 5. Qualitative Benefits Summary – Water Quality and Other Benefits – Summed For Project

Water Quality	++
Flood Controls	+
Recreation	+
Wetlands	+
Wildlife/Special Species Habitat	++
Climate Change	+

Table 6. Benefits & Costs Summary – Water Quality and Other Benefits - By Task

Task	Benefit	Qualitative Indicator
Project B – Watershed Partnership Technical Assistance	Environmental Justice	++
	Water Quality	++
Project C – Floodplain Mapping for the Bay Area with DAC Focus	Environmental Justice	++
Project D – Stormwater Improvements and Flood Reduction Strategies Pilot Project in Bay Point	Environmental Justice	++
	Flood Control	+
	Water Quality	+
Project E – DACs Richmond Shoreline and City of San Pablo Flood Project	Environmental Justice	++
	Water Quality	++
	Flood Control	+
	Wildlife Habitat Restoration	+
Project F – Pescadero Creek Watershed DAC Integrated Flood Reduction and Habitat Enhancement Project	Environmental Justice	++
	Water Quality	+
	Flood Control	+
	Wildlife Habitat Restoration	++
Project G – Pescadero Creek Steelhead and Smolt Outmigrant Trapping	Environmental Justice	++
Project H – Stream Channel Shapes and Floodplain Restoration Guidance and Watershed Restoration in San Francisquito Creek	Environmental Justice	++
	Water Quality	+
	Flood Control	+
	Wetlands Restoration	+
	Climate Change	+
Project I – Steelhead and Coho: SF Estuary Steelhead Monitoring Program	Environmental Justice	+
	Wildlife habitat restoration	+
	Climate change	+

The qualitative benefits of this program are large. This program, designed to move many necessary water improvement projects in DACs from the "identified need stage" into implementation, has the potential to provide a snowball effect of water related, as well as social, economic, and environmental justice benefits.

Omissions, Biases, and Uncertainties, and Their Effect on the Project

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 rate of implementation of necessary projects as a result of these projects and the use of the Avoided Cost Methodology. Table 7 provides a summary.

Table 7. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	Comment
All categories	U	This program provides necessary technical assistance for DACs to apply for implementation funding. Although benefits of this type of start up funding are typically very large, it is difficult to assign direct benefits.
Water Quality	U	The use of an avoided cost methodology assumes that if the project is not funded, a different project will be needed to ensure water quality goals are met. To date none of these projects has an alternative project proposed. The S.F. Water Board is working on the development of a TMDL for sediment in two of these watersheds which requires that some type of implementation projects will be necessary. This greatly increases the validity of the use of the avoided cost benefits methodology.

*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 -.

References

San Francisco Bay Water Quality Control Board, Oakland, California (2009).(The full report is located on the websites of: California State Water Resources Control Board, Association or State Floodplain Managers and Association or State Wetland Managers)

Center For Ecosystem Management and Restoration,(2010) Considerations For Restoration of the Pescadero Marsh, Prepared for the Pescadero Marsh Working Group. California Coastal Conservancy and the U.S. Fish and Wildlife Service

Smith, Jerry J (1990) The Effects of Sand Bar Formation and Inflows on Aquatic Habitat and Fish Utilization in Pescadero , San Gregorio, Waddell and Pomponio Creek Estuary/Lagoon Systems, 1985-1989, San Jose State University

Swanson Hydrology and Geomorphology (2001)" Hydrologic Issues Regarding Management of Pescadero Marsh, prepared for California Department of Parks and Recreation.

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