Attachment 7

Economic Analysis - Water Supply Costs and Benefits

East Contra Costa County
Proposition 84 Round 1 Implementation Grant Proposal

ATTACHMENT 7 –
ECONOMIC ANALYSIS
WATER SUPPLY COSTS AND BENEFITS

This attachment describes the water supply benefits and costs provided by the projects included within this proposal. In accordance with the PSP, the following details are provided for each of the projects:

- ✓ Narrative description of the projects' economic costs
- ✓ Cost details for the entire project
- ✓ Narrative description of the project's expected water supply benefits including
  - o Estimates of without-project conditions
  - o Estimates of with-project conditions
  - o Description of methods used to estimate without and with-project conditions
  - o Distribution of the local, regional, and statewide benefits
  - o Identification of beneficiaries
  - o When benefits will be received
  - o Uncertainty of benefits
  - o Description of any adverse effects
- ✓ Narrative discussion that describes, qualifies and supports values entered in the tables
- ✓ Quantified estimates of physical and economic benefits
- ✓ Documentation to support information presented in the project
- ✓ For projects that contain a suite a projects, the relationship of each project to the overall project costs and benefits.

Overview of Water Supply Benefits and Costs

As described in the IRWM Plan, the East Contra Costa County region is bounded on the north and east by the San Joaquin River and Old River, and the associated maze of waterways effectively isolates East County from the Central Valley region. The entire region derives its water supply from the Delta and drains to the Delta primarily through the Marsh Creek, Kirker Creek, and Kellogg Creek watersheds. The region is unique in that its location is entirely within the boundaries of the statutory Delta and it is heavily reliant upon Delta supplies. Located within the Delta boundaries, and with Delta water as a primary source of drinking water for the region, the agencies in East County are particularly vulnerable to Delta supply reliability issues, and they share a common commitment to reducing reliance on Delta supplies and protecting and restoring the Delta water quality and environment.

The projects included in this proposal will further the IRWMP objectives of improving water supply reliability for a region dependent upon Delta supplies. Because East County is located within the statutory Delta and derives all of its surface water supplies from the Delta, any reduction in water use will reduce dependence on the Delta, providing statewide benefits. Specifically, the following projects will provide quantifiable water supply benefits:

- ***East County Water Conservation Program***: This project will implement a high efficiency toilet rebate program, leak detection and repair, and a weather-based irrigation controller retrofit program to save a combined total of 12,577 AF of supply over the life of the project. Of this conserved supply, approximately 12,223 AF is currently met with Delta supplies.
- ***East County Water Meter Installation Program***: This project will install meters in portions of the DWD and CCWD service areas. Based on data collected for similar programs, this program is expected to save approximately 3,640 AF of water over the life of the project, including approximately 3,385 AF of Delta water.
- ***Brentwood Nonpotable Water Distribution System Project:*** This project involves extending recycled water service to provide irrigation supply to 29 acres of municipal and utility-owned lands, offsetting 4,400 AF of Delta supplies over the life of the project.
- ***Pittsburg Recycled Water Pipeline Rehabilitation Project:*** This project involves rehabilitating approximately 5,240 feet of existing recycled water main, allowing continued delivery of approximately 526 AFY of Title 22 disinfected recycled water to Stoneman Park and Delta View Golf Course within the City of Pittsburg. Over the life of the project, this project will offset approximately 21,040 AF of Delta supply.
- ***Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project***: The primary benefits of this project are related to water quality; however, it will also provide improved supply reliability. When Delta water quality is poor, Delta supplies are blended with the high quality water stored in Los Vaqueros Reservoir to improve the water quality delivered to CCWD's untreated and treated water customers. By improving water quality, this project will reduce the amount of Los Vaqueros water required for blending, resulting in up to an additional 640 AFY of storage in Los Vaqueros Reservoir, reducing CCWD's reliance on Delta supplies by 47,360 AF over the life of the project. Similarly, less water will need to be released from upstream reservoirs to meet SWP and CVP water quality objectives at Rock Slough, resulting in an additional 3,950 AFY in SWP and CVP storage, for a total of 292,300 AF of increased SWP and CVP storage over the life of the project.

- ***Watershed Protection and Habitat Restoration Project:*** While this project is primarily intended to protect and restore watershed lands, it is a component of the East Contra Costa HCP / NCCP, the success of which is a condition for CCWD to exercise its full water right. Without the HCP / NCCP, 47,000 AFY of CCWD supply would be in jeopardy, approximately 470 AFY of which can be attributed to this project. This amounts to approximately 19,270 AF over the life of the project.

In addition to providing significant quantifiable water supply benefits, the following qualitative benefits will be achieved by the proposal:

- **Improved Water Supply Reliability:** The *East County Water Conservation Program*, the *East County Water Meter Installation Program*, the *Brentwood Nonpotable Water Distribution Project*, the *Pittsburg Recycled Water Pipeline Rehabilitation Project* and the Phase *2 Contra Costa Canal Levee Elimination and Flood Protection Project* will all provide enhanced water supply reliability by conserving or offsetting potable supplies. Stated preference studies have found that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability, and improved reliability is an undeniable water supply benefit of this proposal. However, due to the uncertainty involved in applying existing studies to the projects included herein, this benefit has not been quantified.
- **Improved Operational Flexibility for CCWD, Antioch, Pittsburg, DWD and Brentwood**: By avoiding the use of Delta supplies, the *East County Water Conservation Program*, the *East County Water Meter Installation Program,* the *Brentwood Nonpotable Water Distribution Project*, the *Pittsburg Recycled Water Pipeline Rehabilitation Project*, and the *Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project* all reduce demands on the CCWD, Antioch, Pittsburg, DWD and Brentwood systems, improving operational flexibility, allowing for longer shutdowns, deferring capital improvements, and improving reliability in a vulnerable part of the system. The *Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project* will provide further enhanced reliability by improving the quality of supplies in the Contra Costa Canal, and the Watershed Protection and Restoration Project provides this benefit by facilitating access to CCWD's Delta supply allotment.

Based on the economic analysis described below, the combined present value costs of projects contributing water supply benefits over the implementation period is $11.8 M in present value terms. Over the 50-year Proposal life, the Region will secure, conserve of offset 108,287 AF of supply, including 107,678 AF of Delta supply and 610 AF of local groundwater. The present value of the quantified water supply benefits alone totals $16.6 M in 2009 dollars over the life of the Proposal. This figure does not include the value of unquantifiable water supply benefits, water quality benefits, or other expected benefits provided by these projects, which are described in Attachment 8.

Detailed project-specific information is presented below. Overall Proposal costs and benefits are detailed in Attachment 10.

Task 1 – East County Water Conservation Program

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

The East Contra Costa County Water Conservation Program will implement water conservation programs designed to reduce per capita water use and reduce transmission line loss. This program combines the conservation efforts of Diablo Water District (DWD) and the City of Brentwood.

The Diablo Water District portion of the program has two components:

- High Efficiency Toilet (HET) Rebates: Currently DWD customers are able to secure rebates from DWD's wholesale provider Contra Costa Water District (CCWD) that help cover the cost of purchasing HETs. This new rebate will cover the installation costs for 490 HETs.
- Leak Detection and Repair: DWD will perform a leak detection survey of approximately seven miles of pipe. Over that span, it is anticipated that ten leaking service saddles and five leaking valves will be located and repaired.

The City of Brentwood portion of the program will retrofit 7,500 residential irrigation systems with weather-based irrigation controllers (WBICs). These systems allow for more accurate, customized irrigation through the use of real time evapotranspiration (ET) rates and weather information

This project will reduce water demand and system losses, preserving current potable supplies and reducing stress on the Sacramento – San Joaquin Delta. Table 1.1 provides an overview of the project costs and benefits. Water Supply benefits are discussed in more detail in the remainder of this attachment, and a complete discussion of Water Quality and Other Benefits is provided in Attachment 8.

The monetized water supply benefits from the proposed project include the avoided cost of Delta supplies used by Brentwood and DWD, and the avoided cost avoided cost of DWD groundwater use.

DWD currently pays $807 per AF of purchased Delta water. The DWD portion of the Water Conservation Program will avoid the purchase of 1,723 AF of Delta water over the 25 year project life. To pump and treat groundwater currently costs DWD $171.54 per AF. Over the 25 year project life, 350 AF of groundwater will be avoided.

The City of Brentwood currently pays $813 per AF of Delta water. Over the 10 year project life, The City of Brentwood will avoid the purchase of 10,500 AF of Delta water.

The cost of these supplies was assumed to remain constant in real dollars. The present value of avoided water supply costs over the life of the project totals $5,991,417 in 2009 dollars.

Table 1.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$3,002,527
Monetized Benefits	
Water Supply Benefits	
Avoided Purchased Water Costs	$5,991,417
Total Monetized Benefits	$5,991,417
Quantified Benefits	
Other Benefits	
Reduced CO_2 Emissions	2,021 Metric Tons
	Qualitative indicator*
Qualitative Benefit or Cost	
Water Supply Benefits	
Improved Water Supply Reliability	+
Improved Operational Flexibility	+
Water Quality Benefits and Other Benefits	
Reduced risk to public health	+
Improved aesthetic quality of delivered tap water	+
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

CO_2 = carbon dioxide

* 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 –.

Economic Costs

The project budget funds the various elements of the conservation programs: high efficiency toilet installation rebates, transmission line leak detection and repair, and the installation of weather-based irrigation controllers. All costs are considered implementation costs, with no post-implementation administration, operations or maintenance costs. For DWD, the program costs will be spread evenly

over an implementation period from July 2011 through July 2012. The present value of costs over the project implementation period is $207,600. For Brentwood, the project will be spread evenly over an implementation period from 2011 through 2015. The present value of costs over the project implementation period is $2,792,927. The present value of costs for both programs combined over the implementation period is $3,002,527. The calculation of present value costs is shown in Table 11.

Description of Without-Project Conditions

The following conditions are expected to persist in the DWD and City of Brentwood service areas in the absence of this project.

Diablo Water District

Without the project, DWD will continue to provide purchased Delta water from CCWD and local groundwater to meet the water demands of the toilets that would otherwise be replaced. The toilets proposed for replacement currently use between 3.5 and 5.0 gallons per flush (gpf); the high efficiency toilets that would replace them use only 1.28 gpf. Without replacement, DWD will continue provide an additional 2.22 to 3.72 gpf for the 490 toilets.

Additionally, without this project, DWD will continue to supply purchased Delta water from CCWD and local groundwater to meet a higher overall demand due to distribution system loss. Over the seven miles of transmission line proposed for inspection, it is anticipated that ten leaking service saddles and five leaking values will be replaced. Without replacement, DWD will continue to sustain water loss due to distribution inefficiency.

The City of Brentwood

Without the project, the City of Brentwood will continue to provide a mix of Delta water from CCWD and ECCID and groundwater to meet the irrigation demands of the 7,500 residential sites proposed for irrigation efficiency improvements. Based on results from their pilot program, average household use in this area is approximately 600 gallons per day, or 0.685 acre feet per year (AFY). The pilot program showed the proposed system improvements resulted in annual water savings of 21%. Without the proposed improvements, the City of Brentwood will continue to use an additional 0.14 AFY for each retrofitted residential site.

Description of Expected Water Supply Benefits (With-Project Conditions)

A variety of water supply benefits are anticipated to be generated by the East County Water Conservation Program, including avoided Delta water purchases, increased water supply reliability, and improved operational flexibility for CCWD, DWD and Brentwood.

Summary of Quantitative Water Supply Benefits

The primary water supply benefit that has been quantified for this project is avoided Delta water supply. This benefit is expected for both DWD and the City of Brentwood, as described below.

Diablo Water District

Over the two-year implementation period, the HET Program will replace 490 toilets. The program offers residential customers rebates to cover toilet installation. These new toilets will improve water use efficiency substantially, replacing 3.5 –5.0 gpf toilets with 1.28 gpf HETs. The installation of these toilets is assumed to result in savings for 25 years, the expected life of the HETs.

Over the two-year implementation period, the Leak Detection and Repair Program will perform a leak detection survey of approximately seven miles of pipe. It is anticipated that DWD will find and repair approximately ten leaking service saddles and five leaking valves. The repair of these transmission pipes is assumed to result in water savings for 25 years.

Implementation of these two components of the DWD program will result in a phase-in of water savings, beginning in 2011. In 2012 the programs will be fully implemented, achieving a maximum savings amount of 82 AFY. These savings will be phased-out from 2035 through 2036.

To calculate the avoided costs of purchased CCWD water over time, the amount of avoided water purchases from CCWD is multiplied by the estimated rate charged by CCWD to DWD (currently $807 per AF of water delivered). Over the 25-year life of the proposed project, DWD will avoid the use of about 1,723 AF of Delta water.

To calculate the avoided costs of groundwater over time, the amount of avoided groundwater is multiplied by the estimated cost to pump and treat groundwater (currently $172 per AF of water). Over the 25 year life of the proposed project DWD will avoid the use of about 355 AF of groundwater.

From project implementation in 2011 until the end of the anticipated lifetime of the water saving services and devices in 2036, 2077 AF of water will be saved, with an avoided cost of $681,714 in present-value 2009 dollars.

The City of Brentwood

Over the five-year implementation period, the SMART (ET) Irrigation Controller Conversion Program will retrofit approximately 7,500 residential irrigation systems, at a rate of 1,500 residential irrigation systems retrofitted each year. As discussed earlier, the City's pilot program has shown savings of approximately 21%, or 0.14 AF per household per year.

Implementation of this program will result in a phase-in of savings from 2011 through 2015. In 2015 the program will be fully implemented, achieving a maximum savings of 1050 AFY. From 2021 through 2024 these savings will be phased out, as the useful lives of the installed devices reach their end.

The avoided cost of the marginal water source (i.e., the most expensive portion of the current supply portfolio) was used to monetize the water savings. Currently CCWD provides the City of Brentwood 1,752 AFY. At $813 per AF of water delivered, CCWD is the marginal source of supply for the entire 1,050 AFY of avoided supply.

To calculate the avoided costs of purchasing Delta water over time, the amount of avoided water purchases from CCWD is multiplied by the cost of Delta supply. From project implementation in 2011 until the end of the anticipated lifetime of the water saving services and devices in 2024, 10,500 AF of water will be saved, with an avoided cost of $5,309,703 in present-value 2009 dollars.

Total

Implementation of all these programs will result in savings of 12,577 AF, which corresponds to an avoided cost of $5,991,417 in present value 2009 dollars. The present value benefits (water supply cost savings) are shown in Table 12.

Summary of Qualitative Water Supply Benefits

Additional water supply benefits expected from this project include improved water supply reliability and improved operational flexibility for CCWD, DWD and Brentwood.

Improved Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. By avoiding the use of Delta water, the East County Water Conservation Program will improve water supply reliability within the DWD service area and within the City of Brentwood.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through non-market valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables. However, it is provided here to give an idea of the potential magnitude of this benefit.

Improved Operational Flexibility for CCWD, DWD and Brentwood

By avoiding the use of Delta water, the project will help CCWD, DWD and the City of Brentwood in their supply operations, allowing for longer shutdowns, deferring capital improvements, and improving reliability in a vulnerable part of the system. The value of this increased operational flexibility is not monetized in the benefit tables.

Project Beneficiaries and Distribution of Benefits

In terms of water supply benefits, the East County Water Conservation Program will benefit stakeholders at the local, regional, and state levels, as is summarized in Table 1.2. At the local level, DWD and the City of Brentwood will benefit from avoided Delta water supply costs, avoided groundwater use costs and increased reliability of supply.

Regionally, CCWD will benefit from improved operational flexibility. Reduced demand on Delta supplies will provide a statewide water supply benefit. The project also helps meet a statewide water use efficiency goal of 20% reduction in per capita water use by 2020.

Table 1.2. Project Beneficiaries Summary

Local	**Regional**	*Statewide*
Diablo Water District, City of Brentwood	Contra Costa Water District	***Statewide Water Use Efficiency Goal, San Francisco Bay-Delta***

Timing of Benefits

The DWD portion of this program will be implemented over a one-year period, beginning in July of 2011. A water savings lifespan of 25 years has been identified for the high efficiency toilet, and transmission line leak detection and repair. Project benefits are expected to extend over 26 years, which allows for phase-in implementation over the first year and a phase-out at the end of the project.

To calculate water savings by year, it was assumed that the program will be implemented across the timeframe from July 2011 through July 2012. This results in a ramp-up period where approximately 67% of project benefits are realized in 2011, and all the benefits are realized in 2012. Due to the 25-year lifetime assumed for both portions of the project, benefits phase out between 2036 and 2037.

The City of Brentwood's portion of this program will be implemented over a five year period, beginning in 2011 and ending in 2015. A water savings lifespan of 25 years has been identified for the WBICs. Project benefits are expected to extend over 14 years, which allows for a phase-in implementation over the first 5 years, and phase out at the end of the project. To calculate water savings by year, it was assumed that the program will be implemented evenly between 2011 and 2015. This results in ramp up period where 20% of the benefits are realized in 2011, 40% in 2012, 60% in 2013, 80% in 2014 and all the benefits are realized in 2015. Due to the ten year lifetime assumed for WBICs, benefits phase out between 2021 and 2024.

Uncertainty of Costs and Benefits

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits. The project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 1.3.

Table 1.3. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Avoided CCWD Water Cost	+	The use of the current real price of water purchased from CCWD is used throughout the project lifetimes. However, given the critical issues associated with the Bay-Delta and other factors, it is possible that the real cost of CCWD-supplied water will increase in real terms (i.e., faster than the rate of general inflation)
Project lifetime for ET controllers	+	Lifetime of WBICs is assumed to be 10 years. A review of the marketplace showed that WBIC lifetime could be 15 years (U.S. EPA, 2009). If the longer WBIC lifetime applies then the associated savings from this portion of the project could be greater than shown here.
		.

*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 -.

Potential Adverse Effects

No adverse effects are anticipated from this project.

Documents Supporting Cost and Benefit Analysis

The following documents were used in developing this cost-benefit analysis:

- City of Brentwood. 2005 Urban Water Management Plan. Prepared for: City of Brentwood Department of Public Works. Prepared by: Brown and Caldwell, January 2006.
- Craun, Michael F., Gunther F. Craun, Rebecca L. Calderon, and Michael J. Beach. "Waterborne outbreaks reported in the United States." Journal of Water and Health 4.2 (2006): 19-30. Web. 15 Dec 2010. <http://courses.washington.edu/h2owaste/group1.pdf>.
- US EPA 2009. EPA WaterSense Draft Specification for Weather-Based Irrigation Controllers. Draft Version 1. November 19. Available: http://www.epa.gov/WaterSense/docs/controller_draftspec508.pdf. Accessed November 30, 2010.
- MWDOC and IRWD. The Residential Runoff Reduction Study. Municipal Water District of Orange County and Irvine Ranch Water District. July, 2004.
- Raucher, R.S., J. Henderson, and J. Rice. 2006. An Economic Framework for Evaluating the Benefits and Costs of Water Reuse. WateReuse Foundation. Arlington, VA.

Economic Analysis Tables

Tables 11 through 15 have been completed, and are provided below. As shown in **Table 11**, the present value of project costs is $3,000,527.

Table 12 presents the anticipated physically-quantifiable benefits that will accrue from project implementation. Physically quantifiable water supply benefits have an estimated present value of $5,991,417. **Table 13** has been excluded because benefits have been calculated based on physically quantifiable benefits as opposed to avoided water supply projects, and **Table 14** has been excluded because all anticipated water supply benefits have been quantified. As shown in **Table 15**, the total present value of quantifiable water supply benefits is estimated as $5,991,417.

Table 11: Economic Costs
Task #1: East County Water Conservation Program

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	$0						$0	1.00	$0
2010	$0						$0	1.00	$0
2011	$822,800						$822,800	0.89	$732,292
2012	$822,800						$822,800	0.84	$691,152
2013	$702,800						$702,800	0.79	$556,618
2014	$702,800						$702,800	0.75	$524,992
2015	$702,800						$702,800	0.71	$495,474
2016								0.84	
2017								0.79	
2018								0.79	
2019								0.75	
2020								0.75	
2021								0.71	
2022								0.71	
2023								0.71	
2024								0.67	
2025								0.67	
2026								0.67	
2027								0.63	
2028								0.63	
2029								0.63	
2030								0.59	
2031								0.59	
2032								0.59	
2033								0.56	
2034								0.56	
2035								0.56	
2036								0.53	
…								0.53	
Project Life	10 & 25 Years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									**$3,000,527**
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									

Comments:
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #1: East County Water Conservation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2009	Avoided DWD Delta Water	acre feet	0	0	0	$0	$0	1.00	$0
	Avoided Brentwood Delta Water	acre feet	0	0	0	$0	$0	1.00	$0
	Avoided DWD Groundwater	acre feet	0	0	0	$0	$0	1.00	$0
2010	Avoided DWD Delta Water	acre feet	0	0	0	$0	$0	0.94	$0
	Avoided Brentwood Delta Water	acre feet	0	0	0	$0	$0	0.94	$0
	Avoided DWD Groundwater	acre feet	0	0	0	$0	$0	0.94	$0
2011	Avoided DWD Delta Water	acre feet	0	45.3	45.3	$807	$36,584	0.89	$32,560
	Avoided Brentwood Delta Water	acre feet	0	210	210	$813	$170,730	0.89	$151,950
	Avoided DWD Groundwater	acre feet	0	9.3	9.3	$172	$1,600	0.89	$1,424
2012	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.84	$46,096
	Avoided Brentwood Delta Water	acre feet	0	420	420	$813	$341,460	0.89	$303,899
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.84	$2,017
2013	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.79	$43,462
	Avoided Brentwood Delta Water	acre feet	0	630	630	$813	$512,190	0.79	$405,654
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.79	$1,902
2014	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.75	$40,992
	Avoided Brentwood Delta	acre feet	0	840	840	$813	$682,920	0.75	$510,141

Table 12: Annual Water Supply Benefit
Task #1: East County Water Conservation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Water								
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.75	$1,794
2015	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.71	$38,688
	Avoided Brentwood Delta Water	acre feet	0	1050	1050	$813	$853,650	0.71	$601,823
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.71	$1,698
2016	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.67	$36,493
	Avoided Brentwood Delta Water	acre feet	0	1050	1050	$813	$853,650	0.67	$567,677
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.67	$1,601
2017	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.63	$34,407
	Avoided Brentwood Delta Water	acre feet	0	1050	1050	$813	$853,650	0.63	$535,239
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.63	$1,510
2018	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.59	$32,487
	Avoided Brentwood Delta Water	acre feet	0	1050	1050	$813	$853,650	0.59	$505,361
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.59	$1,426
2019	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.56	$30,621
	Avoided Brentwood Delta Water	acre feet	0	1050	1050	$813	$853,650	0.56	$476,337
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.56	$1,344
2020	Avoided DWD	acre feet	0	68	68	$807	$54,876	0.53	$28,920

Table 12: Annual Water Supply Benefit
Task #1: East County Water Conservation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Delta Water								
	Avoided Brentwood Delta Water	acre feet	0	1050	1050	$813	$853,650	0.53	$449,874
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.53	$1,269
2021	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.50	$27,273
	Avoided Brentwood Delta Water	acre feet	0	840	840	$813	$682,920	0.50	$339,411
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.50	$1,197
2022	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.47	$25,737
	Avoided Brentwood Delta Water	acre feet	0	630	630	$813	$512,190	0.47	$240,217
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.47	$1,129
2023	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.44	$24,255
	Avoided Brentwood Delta Water	acre feet	0	420	420	$813	$341,460	0.44	$150,925
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.44	$1,064
2024	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.42	$22,883
	Avoided Brentwood Delta Water	acre feet	0	210	210	$813	$170,730	0.42	$71,194
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,408	0.42	$1,004
2025	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.39	$21,621
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.39	$946
2026	Avoided DWD	acre feet	0	68	68	$807	$54,876	0.37	$20,359

Table 12: Annual Water Supply Benefit
Task #1: East County Water Conservation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Delta Water								
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.37	$891
2027	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.35	$19,207
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.35	$841
2028	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.33	$18,164
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.33	$795
2029	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.31	$17,121
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.31	$749
2030	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.29	$16,134
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.29	$706
2031	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.28	$15,256
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.28	$668
2032	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.26	$14,378
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.26	$629
2033	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.25	$13,554
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.25	$593
2034	Avoided DWD Delta Water	acre feet	0	68	68	$807	$54,876	0.23	$12,786
	Avoided DWD Groundwater	acre feet	0	14	14	$172	$2,402	0.23	$560
2035	Avoided DWD Delta Water	acre feet	0	68	68.0	$807	$54,876	0.22	$12,073
	Avoided DWD Groundwater	acre feet	0	14	14.0	$172	$2,402	0.22	$528

Table 12: Annual Water Supply Benefit
Task #1: East County Water Conservation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit**	**Without Project**	**With Project**	**Change from Project (e) – (d)**	**Unit $ Value**	**Annual $ Value (f) x (g)**	**Discount Factor**	**Discounted Benefits (h) x (i)**
2036	Avoided DWD Delta Water	acre feet	0	45.3	45.3	$807	$36,584	0.21	$7,573
	Avoided DWD Groundwater	acre feet	0	9.3	9.3	$172	$1,601	0.21	$331
Project Life	10 years & 25 years	acre feet	0	12,550	12,550				
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$5,991,417**

Comments:
The avoided CCWD Delta Water combines the savings from the Brentwood program and the portion of DWD program designated to be Delta savings.
All costs are in 2009 dollars.

Table 13: Annual Costs of Avoided Projects
Task #1: East County Water Conservation Program

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #1: East County Water Conservation Program

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #1: East County Water Conservation Program

Total Discounted Water Supply Benefits	Total Discounted Avoided Project Costs	Other Discounted Water Supply Benefits	Total Present Value of Discounted Benefits (a) + (c) or (b) + (c)
(a)	(b)	(c)	(d)
$5,991,417	N/A	N/A	**$5,991,417**
Comments: All costs are in 2009 dollars.			

Task 2 – East County Water Meter Installation Program

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

The East Contra Costa County Water Meter Installation Program will install 216 water meters on services that are currently unmetered. The Project is needed in order to meet the requirements of AB 1420, which requires all urban water users be metered. This project combines the metering efforts of DWD and CCWD.

The DWD portion of the program will install 110 small meters in the Knightsen and Willow Park Marina area of the District. The CCWD portion of the program will install 106 meters ranging in size from 2" to 8" on currently unmetered landscape customers.

It is anticipated that water use will decrease by at least 20% once the meters are installed and billing is based on water usage. This estimate is consistent with industry standards and is also validated by percent reductions in demand observed by CCWD following implementation of another meter installation program.

The reduction in demand will preserve current supplies, reduce stress on the Sacramento – San Joaquin Delta, and reduce demands on the local groundwater basin. Table 2.1 provides an overview of the costs and benefits presented in Attachments 7 and 8. Water Supply benefits are discussed in more detail in the remainder of this attachment, and a complete discussion of Water Quality and Other Benefits is provided in Attachment 8.

The monetized water supply benefits from the proposed project include the avoided cost avoided cost of DWD groundwater use and the avoided cost of raw Delta water from CCWD. To pump and treat groundwater currently costs DWD $171.54 per AF. Over the 25-year project life, 255 AF of groundwater use will be avoided. To pump and deliver raw Delta water costs CCWD $537 per AF of water. Over the 25-year project life, 3,385 AF of raw Delta water will be avoided. The cost of these supplies was assumed to remain constant in real dollars. The present value of avoided water supply costs over the life of the project totals $850,288 in 2009 dollars.

In addition to the monetized water supply benefits, this project offers significant water supply benefits that are not readily monetized, including an increased ability to meet water demands, improved water supply reliability, and others.

Table 2.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$670,861
Monetized Benefits	
Water Supply Benefits	
Avoided Delta Water Costs	$850,288
Total Monetized Benefits	$850,288
Quantified Benefits	
Other Benefits	
Reduced CO_2 Emissions	213 Metric Tons
Qualitative Benefit or Cost	Qualitative indicator*
Water Supply Benefits	
Improved Water Supply Reliability	+
Effectively Implement a Water Loss Control Program	++
Improved Operational Flexibility	+
Water Quality Benefits and Other Benefits	
Reduced Stress on the DWD Groundwater Basin	+
Reduced Stress on the Bay-Delta	+

O&M = Operations and Maintenance

CO_2 = carbon dioxide

* 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 –.

Economic Costs

The project budget funds the installation of 110 meters and 106 meters for DWD and CCWD customers, respectively. Most costs are considered implementation costs, with all a small amount of operations or maintenance costs for CCWD.

For DWD, the program costs will be spread over an implementation period from September 2011 through September 2012. 25% of the costs will occur in 2011, and the remaining 75% of the costs will

occur in 2012. This corresponds with a 12-month implementation period with 3 months in 2011, and 9 months in 2012. The present value of costs over the project implementation period is $85,250.

For CCWD, the project costs will be spread over an implementation period from 2011 through 2013. 25% of the costs will be incurred in 2011, 50% will be incurred in 2012, and the remaining 25% will be incurred in 2013. This corresponds with a 24-month implementation period with 6 months in 2011, 12 months in 2012 and 6 months in 2013. The present value of costs over the project implementation period is $576,583. As previously mentioned, the CCWD portion of the program has some minor operations and maintenance cost associated with meter reading. The present value of these costs over 25-year life of the project is $9,028.

The present value of costs for both elements combined, for the entire program over the 25-year life of the project is $670,861. This is shown in Table 11.

Description of Without-Project Conditions

The project is designed to reduce water demand by influencing consumer behavior through direct measurement of water consumption combined with volumetric pricing. The direct relationship between use and the user-borne cost will encourage water conservation.

Without this project, 110 meters identified by DWD in this project will not be installed. As a result, demand for DWD groundwater demand will remain 10.2 AF per year higher than with this project. Without this project, 106 meters identified by CCWD in this project would not be installed. As a result, demand for raw Delta water provided by CCWD will remain 135.4 AF per year higher that with this project. Additionally, without this project compliance with AB 1420 will be difficult for both DWD and CCWD.

Description of Expected Water Supply Benefits (With-Project Conditions)

Water supply benefits generated by the Meter Installation Program are expected to include avoided Delta water supply costs, increased water supply reliability for DWD and CCWD, and improved operational flexibility for CCWD, as described below.

Summary of Quantitative Water Supply Benefits

The primary water supply benefit that has been quantified for this project is avoided Delta water supply. This benefit is expected for both DWD and CCWD, as described below.

Diablo Water District

Over the one-year implementation period, DWD will install 100 meters on small residential water systems in the Knightsen area and 10 meters in the Willow Park Marina area of the District. These small customer systems use approximately 0.46 acre-feet per year (AFY). Metering of these properties will result in an average expected savings of approximately 0.093 AFY per site. The installation of these meters is assumed to result in savings for 25 years, the expected life of the meters.

Implementation of the DWD program will result in a phase-in of water savings in 2011. In 2012 the program will be fully implemented, achieving a maximum savings amount of 10.2 AFY. From 2035 to 2036 these savings will be phased-out as the meters reach the end of their expected useful lives.
To calculate the avoided costs of supplying local groundwater over time, the amount of avoided groundwater is multiplied by the estimated cost to pump and treat groundwater (currently $172 per AF

of water). From project implementation in 2011 until the end of the anticipated lifetime of the water saving services and devices in 2036, 255 AF of water will be saved, with an avoided cost of $20,205 in present-value 2009 dollars. This is shown in Table 12 at the end of this section.

Contra Costa Water District

Over the two-year implementation period, CCWD will install 106 meters for currently unmetered landscape customers who rely on CCWD-supplied raw water from the Bay-Delta. The meters will range in size from 2" to 8", with a total projected water savings of 135.4 AFY (a 20% reduction in water use per site). The installation of these meters is assumed to result in savings for 25 years, the expected life of the meters, for a total savings of 3,385 AF over the life of the project.

Implementation of the CCWD program will result in a phase-in of water savings in 2011 and 2012. In 2013 the program will be fully implemented, achieving a maximum savings amount of 135.4 AFY. From 2035 to 2038 these savings will be phased-out as the meters reach the end of their useful lives.

To calculate the avoided costs of Delta water, the amount of avoided raw Delta water is multiplied by the estimated cost to pump and deliver raw Delta water (currently $537 per AF of water). From project implementation in 2011 until the end of the anticipated lifetime of the water saving services and devices in 2036, 3,385 AF of Delta water will be saved, with an avoided cost of $830,083 in present-value 2009 dollars (see Table 12).

Total Savings

Implementation of all these programs will result in savings of 3,640 AF.

Total Avoided Cost

Implementation of all these programs will result in an avoided cost of $850,288 in present value 2009 dollars. The present value benefits (water supply cost savings) are shown in Table 12 at the end of this section.

Summary of Qualitative Water Supply Benefits

Qualitative water supply benefits expected from this project include improved water supply reliability, the ability to effectively implement a water loss control program, and improved operational flexibility for CCWD, as described below.

Improved Water Supply Reliability

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. By avoiding the use of Delta water, the East County Meter Installation Program will improve water supply reliability within the DWD and CCWD service areas.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through non-market valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to significantly value supply reliability. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought) (Raucher et al 2006).

Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables.

Effectively Implement a Water Loss Control Program

Accurate metering of residential and commercial water usage is essential for conducting a program to reduce water losses in the distribution system. Water losses can occur from leaks, main breaks, and unauthorized consumption of water. In a water audit and leak detection study conducted at 47 California water utilities, average water loss was 10 percent, with a range of 5-30 percent.

Water loss programs often start with a water audit program such as proposed by the American Water Works Association in Manual M36, Water Audits Loss Control Programs. The water audit conducts a water balance by identifying and measuring known sources of water consumption and subtracting that from the total input of water into the system. Once losses are known, programs can be conducted to reduce leakage and other sources of water loss. Reducing water losses is important for conserving water and reducing energy consumption.

While difficult to quantify for this project, obtaining accurate residential use information through metering is essential in quantifying water losses during a water audit. This can lead to significant benefits in reducing water loss and achieving water conservation goals.

Improved Operational Flexibility for CCWD

By reducing CCWD demands, the project will help CCWD directly in its supply operations, allowing for longer shutdowns, deferring capital improvements, and improving reliability in a vulnerable part of the system. The value of this increased operational flexibility is not monetized in the benefit tables.

Project Beneficiaries and Distribution of Benefits

In terms of water supply benefits, the Water Meter Installation Program will benefit stakeholders at the local, regional, and state level, as summarized in Table 2.2. At the local level, DWD will benefit due to avoided groundwater use costs and increased water supply reliability. This program will also help DWD comply with AB 1420, which requires all urban water users to be metered.

Regionally, CCWD will benefit due to the avoided use of Delta water, increased water supply reliability, and improved operational flexibility. This program will also help CCWD comply with AB 1420. The main statewide water supply benefit is reduced demand on the Sacramento-San Joaquin Bay-Delta.

Table 2.2. Project Beneficiaries Summary

Local	**Regional**	*Statewide*
Diablo Water District	Contra Costa Water District and other regional users of CCWD-supplied Raw Water	***Sacramento-San Joaquin Bay-Delta***

Timing of Benefits

The DWD portion of this program will be implemented over a one-year period, beginning in September of 2011 and ending in September of 2012. A water savings lifespan of 25 years has been identified for water meters. Project benefits are expected to extend over 26 years, which allows for the phase-in and a phase-out of benefits.

To calculate water savings by year, it was assumed that the program will be implemented across the 12-month timeframe from September 1, 2011 through September 30, 2012. This results in a ramp-up period where approximately 25% of project benefits are realized in 2011 (3-months of the 12-month total), and all the benefits are realized in 2012. Due to the 25-year lifetime, benefits phase out between 2036 and 2037.

The CCWD portion of this program will be implemented over a two-year period, beginning in July 2011 and ending in July 2013. As with DWD, 25 years has been identified as the general lifetime of the water meters. Project benefits are expected to extend over 27 years, which allows for the phase-in and phase-out of benefits.

To calculate water savings by year, it is assumed that the program will be implemented across the 24-month timeframe from July 1, 2011 and June 30, 2013. This results in ramp up period where 25% of the benefits are realized in 2011 (6-months out of the 24-month total), 75% in 2012 (12-months out of the 24-month total, plus the benefits from 2011), and all the benefits are realized in 2013. Due to the 25-year lifetime, benefits phase out between 2036 and 2038.

Uncertainty of Costs and Benefits

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits. The project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 2.3.

Table 2.3. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Avoided CCWD Water Cost	+	The use of the current real price of water purchased from CCWD is used throughout the project lifetimes. However, given the critical issues associated with the Bay-Delta and other factors, it is possible that the real cost of CCWD-supplied water will increase in real terms (i.e., faster than the rate of general inflation)

*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 -.

Potential Adverse Effects

No adverse effects are anticipated to result from project implementation.

Documents Supporting Cost and Benefit Analysis

The following documents support the cost-benefit analysis:

- M36 Water Audits and Loss Control Programs. 3rd ed. Denver, CO: American Water Works Association, 2009. Print.
- Raucher, R.S., J. Henderson, and J. Rice. 2006. An Economic Framework for Evaluating the Benefits and Costs of Water Reuse. WateReuse Foundation. Arlington, VA.
- Personal communication with Marie Valmores, Contra Costa Water District, December 12, 2010.

Economic Analysis Tables

Tables 11 through 15 have been completed, and are provided below. As shown in **Table 11**, the present value of project costs is $670,861.

Table 12 presents the anticipated physically-quantifiable benefits that will accrue from project implementation. Physically quantifiable water supply benefits have an estimated present value of $850,288. **Table 13** has been excluded because benefits have been calculated based on physically quantifiable benefits as opposed to avoided water supply projects, and **Table 14** has been excluded because all anticipated water supply benefits have been quantified. As shown in **Table 15**, the total present value of quantifiable water supply benefits is estimated as $850,288.

Table 11: Economic Costs
Task #2: East County Water Meter Installation Program

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2009	$0						$0	1.00	$0
2010	$0						$0	0.94	$0
2011	$196,500		$338				$196,838	0.89	$175,186
2012	$418,000		$775				$418,775	0.84	$351,771
2013	$171,500		$775				$172,275	0.79	$136,442
2014			$775				$775	0.75	$579
2015			$775				$775	0.71	$546
2016			$775				$775	0.67	$515
2017			$775				$775	0.63	$486
2018			$775				$775	0.59	$459
2019			$775				$775	0.56	$432
2020			$775				$775	0.53	$408
2021			$775				$775	0.50	$385
2022			$775				$775	0.47	$363
2023			$775				$775	0.44	$343
2024			$775				$775	0.42	$323
2025			$775				$775	0.39	$305
2026			$775				$775	0.37	$288
2027			$775				$775	0.35	$271
2028			$775				$775	0.33	$257
2029			$775				$775	0.31	$242
2030			$775				$775	0.29	$228
2031			$775				$775	0.28	$215
2032			$775				$775	0.26	$203
2033			$775				$775	0.25	$191
2034			$775				$775	0.23	$181
2035			$775				$775	0.22	$171
2036			$338				$338	0.21	$70
…									
Project Life	25 Years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									**$670,861**

Comments:
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #2: East County Water Meter Installation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2009	Avoided DWD Groundwater	acre feet	0	0	0	$0	$0	1.00	$0
	Avoided CCWD Delta Water	acre feet	0	0	0	$0	$0	1.00	$0
2010	Avoided DWD Groundwater	acre feet	0	0	0	$0	$0	0.94	$0
	Avoided CCWD Delta Water	acre feet	0	0	0	$0	$0	0.94	$0
2011	Avoided DWD Groundwater	acre feet	0	2.55	2.55	$172	$437	0.89	$389
	Avoided CCWD Delta Water	acre feet	0	33.85	33.85	$537	$18,177	0.89	$16,178
2012	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.84	$1,470
	Avoided CCWD Delta Water	acre feet	0	101.55	101.55	$537	$54,532	0.84	$45,807
2013	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.79	$1,386
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.79	$57,586
2014	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.75	$1,307
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.75	$54,314
2015	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.71	$1,234
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.71	$51,260
2016	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.67	$1,164
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.67	$48,352
2017	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.63	$1,097
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.63	$45,589
2018	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.59	$1,036
	Avoided CCWD	acre feet	0	135.4	135.4	$537	$72,710	0.59	$43,044

Table 12: Annual Water Supply Benefit
Task #2: East County Water Meter Installation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Delta Water								
2019	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.56	$976
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.56	$40,572
2020	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.53	$922
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.53	$38,318
2021	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.50	$870
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.50	$36,137
2022	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.47	$821
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.47	$34,101
2023	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.44	$773
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$573	$77,584	0.44	$34,292
2024	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.42	$730
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.42	$30,320
2025	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.39	$689
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.39	$28,648
2026	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.37	$649
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.37	$26,975
2027	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.35	$612
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.35	$25,448
2028	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.33	$579

Table 12: Annual Water Supply Benefit
Task #2: East County Water Meter Installation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.33	$24,067
2029	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.31	$546
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.31	$22,685
2030	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.29	$514
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.29	$21,377
2031	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.28	$486
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.28	$20,213
2032	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.26	$458
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.26	$19,050
2033	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.25	$432
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.25	$17,959
2034	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.23	$408
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.23	$16,941
2035	Avoided DWD Groundwater	acre feet	0	10.2	10.2	$172	$1,750	0.22	$385
	Avoided CCWD Delta Water	acre feet	0	135.4	135.4	$537	$72,710	0.22	$15,996
2036	Avoided DWD Groundwater	acre feet	0	7.65	7.65	$172	$1,312	0.21	$272
	Avoided CCWD Delta Water	acre feet	0	101.55	101.55	$537	$54,532	0.21	$11,288
2037	Avoided DWD Groundwater	acre feet	0	0	0	$172	$0	0.20	$0
	Avoided CCWD Delta Water	acre feet	0	33.85	33.85	$537	$18,177	0.20	$3,563

Table 12: Annual Water Supply Benefit
Task #2: East County Water Meter Installation Program

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit**	**Without Project**	**With Project**	**Change from Project (e) – (d)**	**Unit $ Value**	**Annual $ Value (f) x (g)**	**Discount Factor**	**Discounted Benefits (h) x (i)**
Project Life	25 Years				3640			…	
Total Present Value of Discounted Benefits Based on Unit Value									**$850,288**
(Sum of the values in Column (j) for all Benefits shown in table)									
Comments: Cost assumptions: the DWD program avoids groundwater use, and the CCWD program avoids Delta water use. All costs are in 2009 dollars.									

Table 13: Annual Costs of Avoided Projects
Task #2: East County Water Meter Installation Program

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #2: East County Water Meter Installation Program

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #2: East County Water Meter Installation Program

Total Discounted Water Supply Benefits	Total Discounted Avoided Project Costs	Other Discounted Water Supply Benefits	Total Present Value of Discounted Benefits (a) + (c) or (b) + (c)
(a)	(b)	(c)	(d)
$850,288	N/A	N/A	**$850,288**
Comments: All costs are in 2009 dollars.			

Task 3 – Brentwood Non-Potable Water Supply Project

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

The Brentwood Non-Potable Water Supply Project is a recycled water project being implemented by the City of Brentwood. The project involves the installation of a 12-inch non-potable water main that will provide 88 AFY for landscape irrigation. The pipeline will be approximately 9,400 feet in length, and will connect to the City's existing non-potable water distribution system.

The recycled water project will provide irrigation water for about 29 acres of municipal landscape that is currently irrigated with potable water. The City owns 11 of these 29 acres and the East Bay Municipal Utility District (EBMUD) owns the remaining 18 acres. The City maintains and uses EBMUD's 18 acres under an existing licensing agreement with EBMUD.

A summary of all benefits and costs of the project are provided in Table 3.1. Water Supply benefits are discussed in more detail in the remainder of this attachment, and a complete discussion of Water Quality and Other Benefits is provided in Attachment 8.

Table 3.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$1,761,480
Monetizable Benefits	
Water Supply Benefits	
Avoided Potable Water Supply Costs	$1,275,421
Water Quality and Other Benefits	
Avoided fertilizer costs	$64,861
Total Monetized Benefits	$1,405,143
Qualitative Benefit or Cost	**Qualitative indicator***
Water Supply Benefits	
Increased Water Supply Reliability for City of Brentwood customers	+
Improved Operational Flexibility for Contra Costa Water District	+
Water Quality and Other Benefits	
Improved Surface Water Quality	+
Reduced CO2 Emissions	+
Reduced Stress on the Delta	+

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 –.

Economic Costs

Capital costs for the project amount to $2,097,000 (2009 USD). Construction-related activities (including direct construction, and construction administration and contingency) account for $1,761,000, or about 85% of the total capital budget. Planning and design, environmental compliance/mitigation, and other administrative costs account for the remaining 15%.

The project will be constructed in 2012. Given this timeline, the present value capital costs for the project amount to $1,761,480. There are no incremental operations and maintenance (O&M) costs associated with the project.

Description of Without-Project Conditions

The City of Brentwood's water system currently provides water to about 51,000 residents in eastern Contra Costa County. The water system service area is primarily residential, with small areas of commercial, office, and light industrial land use. The City's land use plan has numerous parks, large areas of agriculture conservation, and special planning areas that are undeveloped.

Potable water demands within the City of Brentwood currently amount to about 13,500 AFY. The City relies on local groundwater resources to meet close to 35% of this demand, or about 4,725 AFY (City of Brentwood 2010). Surface water from the Sacramento-San Joaquin Delta accounts for the remainder of the City's supply (about 8,775 AFY).

The majority of the City's Delta water is supplied through water rights owned by the East Contra Costa Irrigation District (ECCID). In addition to ECCID water, the City also purchases 1,752 AFY of Delta supply from CCWD. CCWD obtains its water supply exclusively from the Delta, and serves treated and raw water to approximately 550,000 people in central and eastern Contra Costa County.

Without the project, the City of Brentwood would continue to rely in Delta supplies for approximately 65% of its total supply.

Description of Expected Water Supply Benefits (With-Project Conditions)

With project implementation, the City of Brentwood would have an additional 88 AFY of recycled water. This would, in turn, provide the following benefits:

- Avoided Delta Water Supply Costs: The Brentwood Non-Potable Water Supply Project will provide 88 AFY of recycled water for landscape irrigation within the City. This will result in the reduced reliance on Delta supplies.
- Improved Water Supply Reliability for City of Brentwood Customers: The project will provide a drought-resistant supply of water, improving supply reliability for Brentwood customers.

- Improved Operational Flexibility: By avoiding the use of Delta water, the project will marginally help CCWD, ECCID, and the City of Brentwood in their supply operations, allowing for longer shutdown, deferring capital improvements, and improving reliability in a vulnerable part of the system.

Summary of Quantitative Water Supply Benefits

The monetized water supply benefits from the proposed project include the avoided costs of potable water use for irrigation. To calculate the avoided costs of Delta water over time, the amount of avoided Delta water (88 AFY beginning in 2013) is multiplied by the estimated cost of potable supply. The cost of potable supply includes a quantity charge of $3.35/thousand gallons and a monthly meter charge of $17.99. The average monthly water use is 88 AFY / 12 = 7.33 AF/month, which equates to 2,389,577 gallons per month (7.33 AF / month * 325,851.429 gal / AF = 2,389,577 gal / month.) This would be billed at the rate of $3.35 / 1000 gal, which would equate to $8,005 / month ($3.35 / 1,000 gal * 2,389.6 thousand gallons = $8,005 / month). Adding in the monthly meter charge for a <1" meter, we get an average monthly charge of $8,023 ($8005 + $17.99 = $8023 / month). Converting back to a unit cost, we come up with $8023 / month / 7.33 AF / month = $1095 / AF. At a rate of 88 AFY, this will generate approximately $96,360 in avoided costs per year.

Over the life of the proposed project, the City of Brentwood will avoid the use of about 4,400 AF of potable water. Assuming no real increases in the water rates and charges described above, the total present value benefits associated with the avoided use of potable supply amounts to $1,275,421.

Summary of Qualitative Water Supply Benefits

Non-monetized benefits of the project include increased water supply reliability for the City of Brentwood, and improved operational flexibility for CCWD.

Improved Water Supply Reliability for City of Brentwood Customers

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. By avoiding the use of Delta water, the Brentwood Non-Potable Water Distribution System Project will improve water supply reliability within the City of Brentwood. As noted above, the availability of Delta water is subject to climatic changes (i.e., drought) and other unforeseen events such as earthquakes and floods.

Although current events have led to an increased interest in water supply reliability (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value through non-market valuation studies and other mechanisms. The results from these studies indicate that residential and industrial (i.e., urban) customers appear to place a significant value on supply reliability. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

The challenge in applying these values to determine the value of increased reliability as a result of the Brentwood Non-Potable Water Distribution System Project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay per household to ensure complete reliability (zero drought-related use restrictions in the future), whereas the Brentwood Non-Potable Water Distribution System only enhances overall reliability, but does not guarantee 100% reliability. Thus, if applied directly to the number of households within the City of

Brentwood service area, the dollar values from the studies would overstate the reliability value provided by the proposed project.

Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the economic analysis tables.

Improved Operational Flexibility for CCWD, ECCID, and the City of Brentwood
By avoiding the use of Delta water, the project will marginally help CCWD, ECCID and the City of Brentwood in their supply operations, allowing for longer shutdown, deferring capital improvements, and improving reliability in a vulnerable part of the system. The value of this increased operational flexibility is not monetized in the benefit tables.

Project Beneficiaries and Distribution of Benefits

In terms of water supply benefits, the Brentwood Non-Potable Water Distribution System Project will benefit stakeholders at the local, regional, and state level, as summarized in Table 3.2. At the local level, the City of Brentwood will benefit due to avoided Delta water supply costs and increased supply reliability. Regionally, CCWD will benefit from improved operational flexibility. Statewide water supply benefits include reduced demand on the Sacramento-San Joaquin Delta (ecological benefits to the Sacramento-San Joaquin Delta are discussed in more detail in Attachment 8). The project also helps meet statewide goals of increasing the use of recycled wastewater by at least one million AFY by 2020 and by at least two million AFY by 2030 (State Water Resources Control Board, 2009).

Table 3.2. Project Beneficiaries Summary

Local	**Regional**	*Statewide*
City of Brentwood	Contra Costa Water District	***Sacramento-San Joaquin Delta California - reclaimed water use goals***

Timing of Benefits

Construction of the new pipeline will be completed in 2012 and will come online in 2013. For this analysis, a 50-year useful project life is assumed, thus benefits and costs are calculated through 2062 (50 years after the project comes online).

Uncertainty of Costs and Benefits

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 3.3.

Table 3.3. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Increased water supply reliability	+	The monetized estimate of the potential benefit of increased water supply reliability as a result of the project has not been included due to uncertainties to applying values from the literature to a partial improvement in water supply reliability.
Project costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.

*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 –.

Potential Adverse Effects

Potential adverse effects of this project are expected to be limited to temporary construction-related impacts.

Documents Supporting Cost and Benefit Analysis

The following documents support the cost-benefit analysis:

- City of Brentwood. 2005 Urban Water Management Plan. Prepared for: City of Brentwood Department of Public Works. Prepared by: Brown and Caldwell, January 2006.
- Raucher, R.S., J. Henderson, and J. Rice. 2006. An Economic Framework for Evaluating the Benefits and Costs of Water Reuse. WateReuse Foundation. Arlington, VA.

Economic Analysis Tables

Tables 11 through 15 have been completed, and are provided below. As shown in **Table 11**, the present value of project costs is $1,761,480.

Table 12 presents the anticipated physically-quantifiable benefits that will accrue from project implementation. Physically quantifiable water supply benefits have an estimated present value of $1,275,421. **Table 13** has been excluded because benefits have been calculated based on physically quantifiable benefits as opposed to avoided water supply projects, and **Table 14** has been excluded because all anticipated water supply benefits have been quantified. As shown in **Table 15**, the total present value of quantifiable water supply benefits is estimated as $1,275,421.

Table 11: Economic Costs
Task #3: Brentwood Nonpotable Water Distribution System

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009								1.00	
2010								0.94	
2011								0.89	
2012	$2,097,000						$2,097,000	0.84	$1,761,480
2013								0.79	
2014								0.75	
2015								0.70	
2016								0.67	
2017								0.63	
2018								0.59	
2019								0.56	
2020								0.53	
2021								0.50	
2022								0.47	
2023								0.44	
2024								0.42	
2025								0.39	
2026								0.37	
2027								0.35	
2028								0.33	
2029								0.31	
2030								0.29	
2031								0.28	
…									
Project Life	50 Years							…	**$1,761,480**
Total Present Value of Discounted Costs (Sum of Column (i))									
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									

Comments:
No incremental increases in O&M costs are expected.
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #3: Brentwood Nonpotable Water Distribution System

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2009								1.00	
2010								0.94	
2011								0.89	
2012								0.84	
2013	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.79	$76,317
2014	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.75	$71,981
2015	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.71	$67,934
2016	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.67	$64,079
2017	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.63	$60,418
2018	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.59	$57,045
2019	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.56	$53,769
2020	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.53	$50,782
2021	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.50	$47,891
2022	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.47	$45,193
2023	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.44	$42,591
2024	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.42	$40,182
2025	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.39	$37,966
2026	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.37	$35,750
2027	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.35	$33,726
2028	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.33	$31,895
2029	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.31	$30,064

Table 12: Annual Water Supply Benefit
Task #3: Brentwood Nonpotable Water Distribution System

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2030	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.29	$28,330
2031	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.28	$26,788
2032	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.26	$25,246
2033	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.25	$23,801
2034	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.23	$22,452
2035	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.22	$21,199
2036	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.21	$19,947
2037	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.20	$18,887
2038	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.19	$17,827
2039	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.17	$16,767
2040	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.16	$15,803
2041	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.16	$14,936
2042	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.15	$14,069
2043	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.14	$13,298
2044	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.13	$12,527
2045	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.12	$11,852
2046	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.12	$11,178
2047	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.11	$10,503
2048	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.10	$9,925
2049	Avoided potable	AF	0	88	88	$1,095	$96,360	0.10	$9,347

Table 12: Annual Water Supply Benefit
Task #3: Brentwood Nonpotable Water Distribution System

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	water use								
2050	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.09	$8,865
2051	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.09	$8,383
2052	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.08	$7,902
2053	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.08	$7,420
2054	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.07	$7,034
2055	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.07	$6,649
2056	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.07	$6,263
2057	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.06	$5,878
2058	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.06	$5,589
2059	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.05	$5,203
2060	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.05	$4,914
2061	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.05	$4,625
2062	Avoided potable water use	AF	0	88	88	$1,095	$96,360	0.05	$4,433
Project Life									
								Total Present Value of Discounted Benefits Based on Unit Value	**$1,275,421**
								(Sum of the values in Column (j) for all Benefits shown in table)	

Comments:
All costs are in 2009 dollars.

Table 13: Annual Costs of Avoided Projects
Task #3: Brentwood Nonpotable Water Distribution System

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #3: Brentwood Nonpotable Water Distribution System

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #3: Brentwood Nonpotable Water Distribution System

Total Discounted Water Supply Benefits	Total Discounted Avoided Project Costs	Other Discounted Water Supply Benefits	Total Present Value of Discounted Benefits (a) + (c) or (b) + (c)
(a)	(b)	(c)	(d)
$1,275,421	N/A	N/A	**$1,275,421**
Comments: All costs are in 2009 dollars.			

Task 4 – Pittsburg Recycled Water Pipeline Rehabilitation Project

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

The Pittsburg Recycled Water Pipeline Rehabilitation Project is a recycled water improvement project being administered by Delta Diablo Sanitation District (DDSD), in partnership with the City of Pittsburg. The project involves the rehabilitation of approximately 5,240 feet of 20-inch and 30-inch asbestos cement (AC) recycled water pipeline. The existing recycled water main, which was previously converted from a raw water pipeline, delivers approximately 526 acre-feet per year (AFY) of Title 22 disinfected recycled water to Stoneman Park and Delta View Golf Course (DVGC) in the City of Pittsburg. The pipeline is over 35 years old, has experienced failures, and will likely not be able to withstand increased operating pressures that will be needed as the DDSD service area expands.

A summary of all benefits and costs of the project are provided in Table 4.1. Project costs and water supply benefits are discussed in the remainder of this attachment, and a complete discussion of Water Quality and Other Benefits is provided in Attachment 8.

The monetized water supply benefits from the proposed project include the avoided costs of potable Delta supplies. Stoneman Park and Delta View Golf Course would rely on potable supply in the absence of recycled water. Current City of Pittsburg cost for the potable water is $1,275/AF. The Recycled Water Pipeline Rehabilitation Project will avoid the import of 21,040 AF of water over the 50-year project life. Total present value avoided costs associated with this Delta supply amount to about $4.7 million in present value (2009 USD) through 2062. Non-monetized benefits of the project include increased water supply reliability for the City of Pittsburg, and improved operational flexibility for the City of Pittsburg.

Table 4.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital Costs	$1,278,750
Monetizable Benefits	
Water Supply Benefits	
Avoided Delta Water Supply Costs	$4,732,853
Water Quality and Other Benefits	
Avoided pipeline maintenance and repair costs	$28,250
Avoided fertilizer costs	$206,705
Total Monetized Benefits	$4,967,808
Qualitative Benefit or Cost	**Qualitative indicator***
Water Supply Benefits	

Increased Water Supply Reliability for City of Pittsburg customers	++
Improved Operational Flexibility for the City of Pittsburg	+
Water Quality and Other Benefits	
Improved Surface Water Quality	+
Reduced CO_2 Emissions	+
Recreational and Aesthetic Benefits	+
Reduced Stress on the Delta	+

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 –.

Economic Costs

Capital costs for the project amount to $1,500,000 (2009 USD). DDSD plans to expend about 25% of the project's total capital costs in 2011. The majority of the capital budget (the remaining 75%) will be expended in 2012. Given this timeline, the present value capital costs for the Pipeline Rehabilitation Project amount to $1,278,750. There are no incremental operations and maintenance (O&M) costs associated with the project. Project costs are shown in Table 11 at the end of this section.

Description of Without-Project Conditions

As noted above, the existing recycled water conveyance pipeline is more than 35 years old. Failures and pipeline repairs have occurred on this line, including a pipe joint failure during construction of the Pittsburg RWP, as well as a leak repair at the location of an illegal tap.

With the expansion of recycled water service to the City of Antioch, DDSD will need to increase system operating pressure from about 100 psi up to 150 psi. The combination of the age of the pipeline, past failures, and change in operating parameters significantly increase the risk of pipeline failure. One section of the pipeline to be rehabilitated is located beneath Highway 4. If a failure occurs in this location, it could cause significant damage, undermining the roadway, and potentially endangering the public.

Without the project, the existing recycled water conveyance pipeline will continue to fail and DDSD will continue to incur pipeline maintenance and repair costs (see Attachment 8). Eventually, the pipeline will fail completely (i.e., it will be beyond repair). If DDSD is not able to rehabilitate the existing pipeline, Stoneman Park and the Delta View Golf Course (DVGC) will be forced to rely on potable water for irrigation.

Potable water demand within the City of Pittsburg currently amounts to more than 13,500 AFY (City of Pittsburg 2009). The City purchases water from CCWD to meet 85% to 95% of this demand (City of Pittsburg 2009). CCWD obtains its water supply exclusively from the Delta, and serves treated and raw

water to approximately 550,000 people in central and eastern Contra Costa County. CCWD's access to Delta water supplies is based on a long-term contract with the United States Bureau of Reclamation (USBR).

The availability of Delta water from CCWD is subject to a number of factors, including drought. Under current water supply projections, water supplied to the City of Pittsburg may be reduced in the second and third year of a multi-year drought. In the past, yearly demand in the City of Pittsburg has exceeded dry year supply by 1,037 AFY. By 2020, that shortfall is expected to increase to 2,219 AFY in the 3rd year of a drought. In addition to drought, Delta supplies may be subject to conveyance disruptions (e.g., due to earthquakes or other natural disasters) along the 52-mile Contra Costa Canal that is used to convey water from the Delta to the City of Pittsburg. Thus, without the project, increased use of Delta water by existing recycled water customers will further reduce water supply reliability within the City.

Description of Expected Water Supply Benefits (With-Project Conditions)

Water supply benefits generated by the Recycled Water Pipeline Rehabilitation Project are expected to include avoided Delta water supply costs, increased water supply reliability for City of Pittsburg customers, and improved operational flexibility for the City of Pittsburg.

- Avoided Delta Water Supply Costs: The Recycled Water Pipeline Rehabilitation Project will provide for the continued delivery of 526 AFY of recycled water to Stoneman Park and DVGC. This will result in the avoided use of Delta water at these locations after the existing pipeline fails.
- Improved Water Supply Reliability for City of Pittsburg customers: By providing a drought-resistant recycled water supply, offsetting less reliable Delta supplies, the project will improve supply reliability for the City of Pittsburg. This benefit was not monetized, and is described in greater detail later in the Qualitative Benefits section.
- Improved Operational Flexibility for the City of Pittsburg: By avoiding the use of Delta water, the project will help the City's water operations, allowing for longer shutdown, deferred capital improvements, and improved reliability in a vulnerable part of the system. This benefit was not monetized, and is described in greater detail in the Qualitative Benefits section.

Summary of Quantitative Water Supply Benefits

The benefit associated with avoided Delta supply costs was monetized. As described above, the Recycled Water Pipeline Rehabilitation Project will provide for the continued delivery of 526 AFY of recycled water to Stoneman Park and DVGC. This will result in the avoided use of Delta water at these locations after the existing pipeline fails.

It is difficult to predict exactly when the existing pipeline will fail. However, to estimate avoided Delta water supply costs, it is assumed that the existing pipeline has a useful life of 50 years. The pipeline was built prior to 1973, and would therefore be expected to last through approximately 2022. For this analysis, it is assumed that after this time, the pipeline will fail completely (i.e., it will be beyond repair). Thus, without the Recycled Water Rehabilitation Pipeline Project, Stoneman Park and DVGC will begin to rely on Delta water supplies to irrigate their lands beginning in 2023.

To calculate the avoided costs of Delta water over time, the amount of avoided Delta water (526 AFY beginning in 2023) is multiplied by the estimated cost of potable supply. The cost of potable supply includes a quantity charge of $2.8205/hundred cubic feet (hcf) and an energy charge of $0.0767/hcf, for a total of $2.8972/hcf, or $1,262/AF (435.6 hcf/AF*$2.8972). In addition, there are daily charges for

service and demand based upon meter size. Assuming one 2-inch meter (Stoneman Park) and one 4-inch meter (Delta View Golf Course), these charges are $6,587 per year or $12.53/AF for 526 AF/year. This results in a total avoided water cost of approximately $1,275 / AF ($1,262 + $12.53). Over the 50-year life of the proposed project, the City of Pittsburg will avoid the use of about 21,040 AF of Delta water. Assuming no real increases in the water rates and charges described above, the total present value benefits associated with the avoided purchase of Delta water amounts to about $4.7 million.

In addition, if the pipeline is not replaced, there may be periods prior to 2023 when the park and golf course will be forced to rely on Delta water due to disruptions in recycled water delivery caused by breaks in the recycled water main. For example, in 2005, a break occurred along the existing recycled water main, which took the City of Pittsburg approximately 4 weeks to fix. Due to the uncertainty associated with the timing of expected breaks and the amount of time it take to repair them, the benefit of avoided Delta water supply costs is not quantified or monetized in the economic analysis tables.

Finally, additional Delta supply may be avoided in the future if additional customers tie into the new pipeline in the future, increasing recycled water demand beyond 526 AFY. The number of potential future customers, and the cost of connecting these customers to the recycled water pipeline, are unknown and were not monetized.

Summary of Qualitative Water Supply Benefits

The project will provide the following qualitative benefits. These benefits have not been monetized.

Improved Water Supply Reliability for City of Pittsburg Customers

The reliability of a water supply refers to the ability to meet water demands on a consistent basis, even in times of drought or other constraints on source water availability. By avoiding the use of Delta water, the Recycled Water Pipeline Rehabilitation Project will improve water supply reliability within the City of Pittsburg. As noted above, the availability of Delta water is subject to climatic changes (i.e., drought) and other unforeseen events such as earthquakes and floods.

Although interest in water supply reliability is increasing (e.g., due to increasing water demands and concerns over climate-related events), only a few studies have directly attempted to quantify its value (i.e., through non-market valuation studies). The results from these studies indicate that residential and industrial (i.e., urban) customers seem to value supply reliability quite highly. Stated preference studies find that water customers are willing to pay $95 to $500 per household per year (in 2009 USD) for total reliability (i.e., a 0% probability of their water supply being interrupted in times of drought).

The challenge in interpreting these values to determine a value of increased reliability as a result of the Recycled Water Pipeline Rehabilitation Project is recognizing how to reasonably interpret these survey-based household monetary values. The values noted above reflect a willingness to pay per household to ensure complete reliability (zero drought-related use restrictions in the future), whereas the Recycled Water Pipeline Rehabilitation Project only enhances overall reliability, but does not guarantee 100% reliability. Thus, if applied directly to the number of households within the City of Pittsburg service area, the dollar values from the studies would overstate the reliability value provided by the proposed project.

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

partial improvement in reliability from the proposed project, it is assumed that household willingness to pay for improved reliability is directly proportional to the amount of water made available as a result of the project as a percentage of the total potable water supply. This represents the percentage of total supply that has been improved in terms of overall reliability (i.e., by avoiding Delta water use with recycled water).

For example, the Recycled Water Pipeline Rehabilitation Project will ensure continued delivery 526 AFY, beginning in 2023. In that year, total Pittsburg potable water demand is expected to amount to about 17,130 AF. Without the project, total potable demand in that year would amount to 17,690. Thus, 3.2% of total potable demand (without the project) will be replaced with recycled water made available via the rehabilitated pipeline. To obtain a lower bound estimate for the value of improved reliability associated with this water, we assume that households within the City of Pittsburg are willing to pay about $3.04 per year ($95 multiplied by 3.2%). Applying this dollar value per household to the approximately 25,000 households within the City's service area would result in $76,600 of extra benefits in 2023. This benefit could be calculated for each year of the project, taking into account population growth and the percentage of Delta water supply that the Pipeline Rehabilitation Project avoids. Due to the uncertainty involved in applying these numbers to this situation, this benefit estimate is not included in the tables. However, it is provided here to give an idea of the potential magnitude of this benefit.

Improved Operational Flexibility for the City of Pittsburg

By avoiding the use of Delta water, the project will help the City of Pittsburg directly in their supply operations, allowing for longer shutdown, deferring capital improvements, and improving reliability in a vulnerable part of the system. The value of this increased operational flexibility is not monetized in the benefit tables.

Project Beneficiaries and Distribution of Benefits

In terms of water supply benefits, the Recycled Water Rehabilitation Pipeline Project will benefit stakeholders at the local, regional, and state level, as is summarized in Table 4.2. At the local level, patrons of the Delta View Golf Course and Stoneman Park will benefit from improved ability to irrigate during drought. Regionally, the City of Pittsburg will benefit due to avoided Delta water supply costs, increased reliability of supply, and improved operational flexibility. Statewide water supply benefits include reduced demand on the Sacramento-San Joaquin Delta (ecological benefits to the Sacramento-San Joaquin Delta are discussed in more detail in Attachment 8). The project also helps meet statewide goals to increase use of recycled wastewater by at least one million AFY by 2020 and by at least two million AFY by 2030 (State Water Resources Control Board, 2009).

Table 4.2. Project Beneficiaries Summary

Local	**Regional**	*Statewide*
DVGC and Stoneman Park Patrons	City of Pittsburg	***Sacramento-San Joaquin Delta California - reclaimed water use goals***

Timing of Benefits

Construction of the new pipeline will be completed in 2012 and will come online in 2013. For this analysis, a 50-year useful project life is assumed, thus benefits and costs are calculated through 2062 (50 years after the project comes online). To calculate avoided Delta water costs, it is assumed that the existing pipeline also has a useful life of 50 years, and will last through 2022. Thus, benefits associated

with avoided Delta water costs begin to accrue in 2023, after the expected failure of the existing pipeline.

Uncertainty of Costs and Benefits

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. These issues are listed in Table 4.3.

Table 4.3. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Increased water supply reliability	+	The monetized estimate of the potential benefit of increased water supply reliability as a result of the project has not been included due to uncertainties to applying values from the literature to a partial improvement in water supply reliability.
Avoided Delta water supply costs	+	If the existing pipeline is not replaced, there may be periods prior to 2023 when the park and golf course will be forced to rely on Delta water due to temporary disruptions in recycled water delivery caused by breaks in the recycled water main. Due to the uncertainty associated with the timing of expected breaks and the amount of time it take to repair them, the benefit of avoided Delta water supply costs is not quantified or monetized in the economic analysis tables. Additional Delta water may also be avoided in the future if additional customers hook into the new pipeline in the future. The number of potential future customers, and the cost of connecting these customers to the recycled water pipeline, is unknown.
Project costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.

*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 –.

Potential Adverse Effects

Adverse effects of project implementation are expected to be limited to temporary construction-related impacts.

Documents Supporting Cost and Benefit Analysis

The following documents were utilized to develop information in this analysis.

- City of Pittsburg. 2009. Water Supply Assessment for K2 Pure Solutions ECU and Bleach Plant Project
- Asano, T. 1981. Evaluation of Agricultural Irrigation Projects Using Reclaimed Water. Agreement 8-179-215-2. Office of Water Recycling. California State Water Resources Control Board, Sacramento.
- National Research Council Canada, 1995: A-7019.1 Final: Water Mains Break Data on Different Pipe Materials for 1992 and 1993.

Economic Analysis Tables

Tables 11 through 15 have been completed, and are provided below. As shown in **Table 11**, the present value of project costs is $1,278,750.

Table 12 presents the anticipated physically-quantifiable benefits that will accrue from project implementation. Physically quantifiable water supply benefits have an estimated present value of $4,732,853. **Table 13** has been excluded because benefits have been calculated based on physically quantifiable benefits as opposed to avoided water supply projects, and **Table 14** has been excluded because all anticipated water supply benefits have been quantified. As shown in **Table 15**, the total present value of quantifiable water supply benefits is estimated as $4,732,853.

Table 11: Economic Costs
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009								1.00	
2010								0.94	
2011	$375,000						$375,000	0.89	$333,750
2012	$1,125,000						$1,125,000	0.84	$945,000
2013								0.79	
2014								0.75	
2015								0.70	
2016								0.67	
2017								0.63	
2018								0.59	
2019								0.56	
2020								0.53	
2021								0.50	
2022								0.47	
2023								0.44	
2024								0.42	
2025								0.39	
2026								0.37	
2027								0.35	
2028								0.33	
2029								0.31	
2030								0.29	
2031								0.28	
…									
Project Life	50 Years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									**$1,278,750**
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									

Comments:
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2009								1.00	
2010								0.94	
2011								0.89	
2012								0.84	
2013								0.79	
2014								0.75	
2015								0.71	
2016								0.67	
2017								0.63	
2018								0.59	
2019								0.56	
2020								0.53	
2021								0.50	
2022								0.47	
2023	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.44	$296,427
2024	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.42	$279,661
2025	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.39	$264,236
2026	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.37	$248,811
2027	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.35	$234,728
2028	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.33	$221,985
2029	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.31	$209,243
2030	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.29	$197,171
2031	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.28	$186,441
2032	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.26	$175,710
2033	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.25	$165,651
2034	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.23	$156,261

Table 12: Annual Water Supply Benefit
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2035	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.22	$147,543
2036	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.21	$138,825
2037	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.20	$131,447
2038	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.19	$124,070
2039	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.17	$116,693
2040	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.16	$109,987
2041	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.16	$103,951
2042	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.15	$97,915
2043	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.14	$92,550
2044	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.13	$87,185
2045	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.12	$82,490
2046	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.12	$77,795
2047	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.11	$73,101
2048	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.10	$69,077
2049	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.10	$65,053
2050	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.09	$61,700
2051	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.09	$58,347
2052	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.08	$54,993
2053	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.08	$51,640
2054	Avoided Potable	AF	0	526	526	$1,275	$670,650	0.07	$48,957

Table 12: Annual Water Supply Benefit
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
	water use								
2055	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.07	$46,275
2056	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.07	$43,592
2057	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.06	$40,910
2058	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.06	$38,898
2059	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.05	$36,215
2060	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.05	$34,348
2061	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.05	$32,403
2062	Avoided Potable water use	AF	0	526	526	$1,275	$670,650	0.05	$30,569
Project Life									
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$4,732,853**
Comments: All costs are in 2009 dollars.									

Table 13: Annual Costs of Avoided Projects
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #4: Pittsburg Recycled Water Pipeline Rehabilitation Project

Total Discounted Water Supply Benefits	Total Discounted Avoided Project Costs	Other Discounted Water Supply Benefits	Total Present Value of Discounted Benefits (a) + (c) or (b) + (c)
(a)	(b)	(c)	(d)
$4,732,853	N/A	N/A	$4,732,853
Comments: All costs are in 2009 dollars.			

Task 5 – Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Program

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

The full CCWD Canal Levee Elimination and Flood Protection Project will replace the 21,000 feet of unlined Contra Costa Canal with a pipeline to improve source water quality available to CCWD by preventing intrusion of poor quality groundwater; eliminate up to eight miles of aging canal embankments that were not intended to provide flood protection (though they are currently relied upon for that purpose), and improve security and public safety by preventing access to the open water canal. This project is Phase 2 of the full project, which includes replacing approximately 400 feet of the canal with a pipeline and eliminating associated canal embankments. Phase 2 also includes a crossing of Marsh Creek.

It is important to note that the specific project submitted in this proposal, and evaluated in this Attachment, reflects a key portion of the greater canal levee elimination project (including the crossing of Marsh Creek), but not the entire 21,000 feet of anticipated pipeline installation to replace all of the existing canal. To evaluate benefits, we estimated (as feasible) the value of the benefits for the entire canal replacement project (because the benefits accrue from the entire project being completed), and then attributed a portion of those aggregate benefits to the specific portion of the pipeline that would be developed under this project. This specific project reflects 4.2% of the total $96 M canal replacement budget; therefore we assigned 4.2% of the overall project benefits to this specific portion of the project.

A summary of all benefits and costs of the project are provided in Table 5.1. Project costs and water supply benefits are discussed in the remainder of this attachment. Water quality and other benefits are described in Attachment 8, and flood damage reduction benefits are described in Attachment 9. In several instances, the water supply and water quality benefits are highly inter-woven, and could have been placed in either of the Attachments; however we have been careful to avoid double counting. Several of the most important benefits could not be reliably quantified or monetized.

Table 5.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$3,489,542
Monetizable Benefits	
Water Supply Benefits	
Avoided releases from SWP and CVP reservoirs	$1,146,091
Water for additional CCWD reservoir storage	$185,696
Value of avoided losses in water revenues	$452,633

Table 5.1. Benefit-Cost Analysis Overview

	Present Value
Water Quality and Other Benefits	
Public safety – reduced drowning risk	$812,419
Reduced energy use (water pumping/blending)	$150,878
Reduced levels of DBPs in drinking water	$877,412
Flood Damage Reduction	
Reduced levee failure flood damages	$13,823
Value of avoided levee breach repairs	$58,886
Total Monetized Benefits	$3,697,838
Qualitative Benefit or Cost	**Qualitative indicator***
Water Supply Benefits	
Increased Water Supply Reliability for CCWD retail and wholesale customers	++
Improved Operational Flexibility for Contra Costa Water District	++
Increased operational flexibility and added water storage (reduced water quality-driven releases) for SWP and CVP	++
Reduced stress on Bay-Delta water supplies	+
Water Quality and Other Benefits	
Enabled completion of Dutch Slough project (significant ecologic and other benefits)	++
Improved Water Quality for CCWD customers (beyond DBPs)	+
Reduced energy demands and CO2 Emissions (less pumping)	+
Reduced fish loss (including special status species)	+
Increased security (intentional or accidental contamination/disruption) of CCWD water supply	+

Table 5.1. Benefit-Cost Analysis Overview

	Present Value

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 –.

Economic Costs

Capital costs for the project amount to $4,000,000 (2009 USD), split between 2011 and 2012. Once the pipeline is in place and operational (beginning 2013), $2000 per year is anticipated to be required for routine maintenance. Over the 75-year anticipated lifetime of the pipeline, the present value costs amount to $3.49 million, as shown in Table 11 at the conclusion of this section.

Description of Without-Project Conditions

Without this project, CCWD will continue to rely on a long stretch of open, unlined canal in order to convey water to its intake at Pumping Plant 1 (PP1), also referred to as the Rock Slough Intake. Water quality at the intake would continue to be degraded due to seepage into the canal from groundwater. Higher salinity groundwater seeping into the canal has been identified as the primary source of water quality degradation to PP1. Residential area runoff from the increasingly developed adjacent areas could also pose new challenges to water quality in the canal.

The Dutch Slough Habitat Restoration Project, which will inundate adjacent properties, will exacerbate the existing seepage problem. Consequently, this and other ecologically important restoration projects near the Canal cannot be implemented until the open Canal is replaced with a pipeline. In addition, without the project, the canal would continue to pose a flooding and public safety threat to the increasingly residential adjacent land area. The levees that contain the canal were not designed for flood protection, yet they are currently used for this purpose.

Overall, this project will provide significant benefits at the local, regional, and state level through improved water supply reliability, and regional improvements in water quality. By reducing seepage into the canal, this project will improve both water supply and water quality for CCWD, the State Water Project (SWP), and the Central Valley Project (CVP).

Description of Expected Water Supply Benefits (With-Project Conditions)

This project is expected to provide a wide array of water supply benefits, including:

- Reduced releases from SWP and CVP reservoirs
- Enhanced Water Supply Availability and Emergency Supply for CCWD
- Improved Operational Flexibility and Continued Ability to Serve all CCWD Customers
- Avoided Levee Breach and Essential Utility Repair Costs

These benefits are discussed in further detail below.

Summary of Quantitative Water Supply Benefits

This section describes the quantifiable water supply benefits generated by the project. Calculations are summarized in Table 12 at the conclusion of this section.

Reduced Releases from SWP and CVP Reservoirs

There is a salinity standard station at Rock Slough, and the CVP & SWP are operated to meet that standard by releasing stored water from upstream as necessary. Replacing the unlined canal with a pipeline will lead to reduced salinity at Rock Slough Intake. Improving the water quality at Rock Slough will mean less water must be released from upstream reservoirs to meet the standard. Thus, encasing the Contra Costa Canal will decrease the amount of water upstream reservoirs must release to meet the Rock Slough water quality standard. This would result in an increase in water available in SWP and CVP storage for dry years, improving conveyance in the Delta by improving the design and the operational flexibility of reservoir supplies both locally and statewide.

Currently, local water quality degradation in the Canal is mitigated by additional releases from upstream SWP and CVP reservoirs, allowing the Rock Slough water quality standard to be met. The degraded water quality necessitates an additional 100 AFY of upstream releases during wet years and an additional 7,800 AFY of upstream releases during critically dry years in order to meet salinity standards. Assuming that dry years happen as often as wet years, the project would enable an average required release of 3,950 AFY to be avoided.

It is difficult to assign a value to the water released by SWP and CVP. Clearly, water preserved for use by urban and agricultural entities reliant on SWP and CVP waters has very high value in most circumstances, as evidenced by the rapidly escalating unit charge that water utilities pay for those waters in southern California (e.g., $686 per AF, at announced 2011 rates, for untreated Tier 2 water acquired from the Metropolitan Water District of Southern California), or what utilities pay to reduce their dependence on these waters (e.g., $700 to $2000 per AF, or more, to developed reclaimed water or desalination supplies). These SWP and CVP water values are especially high in dry years, when most of the SWP and CVP releases would occur. To be conservative, we assume the waters released by SWP and CVP to meet water quality requirements at Rock Slough have an opportunity cost of only $500 per AF.

Using the $500 per AF value, the 3,950 AFY released, on average, amounts to an average annual avoided cost of $1.98 million. Over the expected project lifetime, the present value benefits of this avoided cost amounts to over $27 million (see Table 12). Assigning 4.2% of this total value to the specific project, this amounts to $1.15 million in present value benefits.

Enhanced Water Supply Availability and Emergency Supply for CCWD

Replacing the unlined canal with a pipeline will lead to improved water quality at the Rock Slough intake, which will enable CCWD to release less water in order to meet our customer water quality delivery goals. Therefore, the project generates benefits to CCWD's water supply reliability by, in effect, reducing the need for blending water from the Los Vaqueros Reservoir by about 580 AFY in order to meet the utility's finished water quality goals (i.e., this effectively adds 580 AFY to water available for storage in reservoir). In addition, reduced evaporation losses from the open canal amount to an estimated 60 AFY saved per year. Combined, there is a "savings" of 640 AFY for CCWD.

Valuing water saved by CCWD, especially water it is enabled to add to (or keep in) storage in the Los Vaqueros Reservoir, is not straightforward, because of the value the stored water has across a range of needs and circumstances. For example, with the project, CCWD will have an increased emergency reserve supply. CCWD will use Los Vaqueros Reservoir less for blending during high salinity events, which will allow water to remain in the reservoir as emergency supply. This would leave an average of 10,000 AF of supply in Los Vaqueros Reservoir for use during periods of drought or other emergency supply restriction – approximately one month's supply.

The benefits of improved emergency supply reliability may be monetized using estimates of the price of emergency water. Obtaining water during emergencies is expensive, averaging around $1,200 per AF. Emergency interruption of supplies has plagued CCWD in the recent past, and is anticipated to occur again in the future (e.g., in 2004, the Jones Tract levee break impacted CCWD water quality).

Alternatively, CCWD is sometimes able to acquire water from spot markets, which can be relatively cost-effective when such water is available when needed (e.g., about $400 per AF). In 2007, CCWD initiated a study which examined a range of water supply enhancement options, and found most alternatives cost between roughly $700 and $1600 per AF (including conservation, groundwater development, reclaimed water projects, desalination, water supply banking and long-term lease deals).

To be somewhat conservative, we apply a value of $500 per AF for water supply enhancements (additions to storage) enabled by the canal replacement project. As shown in Table 12, this yields an annual value of savings of $320,000 (640 AF at $500 per AF). The present value benefits are $4.42 million. Allocating 4.2% of these benefits to this specific portion of the canal replacement project, the present value benefits amount to approximately $185,696.

Improved Operational Flexibility and Continued Ability to Serve all CCWD Customers

By enclosing the unlined canal, the project will help CCWD directly in their supply operations, allowing for longer shutdown, deferring capital improvements, and improving reliability in a vulnerable part of the system. Also, with the project, CCWD will have an increased emergency reserve supply, because less Los Vaqueros Reservoir would be required for blending during high salinity events, leaving more water in the reservoir as emergency supply.

Although it is physically possible for CCWD to meet most of its retail customers' demands even if the canal failed, failure would cause a serious disruption to their system and would have a lasting impact. Using the canal allows CCWD to fill the reservoir with other pumps, and if the canal failed, they would not be able to fill the reservoir because CCWD would have to use the other pumps to meet demands. If the canal were out of service for over a year, delivered water quality would suffer, reservoir levels would be significantly reduced, and drought and emergency supplies would be diminished. If the canal failed in the middle of a prolonged drought, the consequences could be quite serious but difficult to quantify given the number of unknowns.

As a way to provide a rough monetary estimate of part of the value of avoiding a canal/levee failure, consider that currently, about 30% of the water supplied to CCWD's retail and wholesale customers is derived from the Rock Slough intake. The 30% includes water pumped through CCWD's own system, as well as 100% of its raw water sales to various customers (e.g., the City of Brentwood relies on raw water purchases that originate in the canal for 65% of its total supply). Overall, water drawn through the canal accounts for roughly $39 million in annual revenues for the utility.

In the event of a levee failure (assumed to be a probability of roughly 1 in 50 years, or 2%), these revenues could be foregone. Using these foregone revenues as a conservative measure of the value of the water provided through the canal, and a 2% probability of losing these waters (and revenues) in a given year, the expected loss in a given year is $780,000, which has a present value of $10.8 million (see Table 12). Assigning 4.2% of this total value to this specific portion of the project, the present value benefits amount to $452,633.

Summary of Qualitative Water Supply Benefits

All expected water supply benefits have been quantified.

Project Beneficiaries and Distribution of Benefits

The project benefits are distributed across a wide array of local, regional, and state-wide beneficiaries, as summarized in Table 5.2.

Table 5.2. Project Beneficiaries Summary

Local	Regional	*Statewide*
CCWD and its customers Residents and other entities with property adjacent to the canal	Contra Costa Water District wholesale customers	***Sacramento-San Joaquin Delta CVP and SWP users***

Timing of Benefits

Construction of the new pipeline will be completed in 2012 and will come online in 2013. For this analysis, a 75-year useful project life is assumed, thus benefits and costs are calculated through 2087 (75 years after the project comes online).

Uncertainty of Costs and Benefits

This analysis of costs and benefits is based on available data and some assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In most cases, omissions lead to a downward bias in benefits: the project is expected to be much more beneficial than the subset of benefits that can be monetized would indicate. Several of these issues are listed in Table 5.3.

Table 5.3. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Reduced releases of SWP and CVP waters from upstream reservoirs in order to meet water quality compliance limits at Rock Slough	U/+	The monetized estimate of the potential value of reduced releases of SWP and CVP water are uncertain in terms of the quantities released and monetary value assigned per AF. However, the value of the water that can be stored and used by is probably very high, especially in dry years when the largest releases are avoided with the canal project. Higher values would increase the benefit estimate.

Value of increasing the volume of water that can be stored in Los Vaqueros Reservoir, and of avoided evaporation losses.	U	The water savings are difficult to value, because the value depends on the circumstances under which the water might be needed, or how the needed water would be replaced absent the project. A fairly conservative estimate is used in the analysis, which under-represents the cost of emergency replacement supplies and many other CCWD supply options. However the value applied is slightly higher than the spot market price that may be available in some years, for what may be a limited amount of water.
Value of supply reliability to CCWD raw water customers	+	In the event of canal levee failure, CCWD will lose its ability to supply raw water to its raw water customers. Some of these customers rely extensively (perhaps exclusively) on these supplies (e.g., Brentwood obtains 65% of its total supply in the form of CCWD raw water). The adverse impact on these customers is not reflected in the monetary values developed.
Project costs	U	The calculation of the present value of costs is a function of the timing of capital outlays and a number of other factors and conditions. Changes in these variables will change the estimate of costs.

*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 –.

Potential Adverse Effects

Adverse effects associated with this project are expected to be limited to temporary construction impacts.

Documents Supporting Cost and Benefit Analysis

The following documents were used to develop the cost and benefit analyses described in this section:

- CCWD, 2007. Future Water Supply Study recommendations (DRAFT).
- Newspaper and CCWD Board Meeting minutes: accounts of drownings (http://articles.sfgate.com/1995-09-28/news/17815737_1_dive-team-sheriff-s-department-contra-costa-canal, http://www.ccwater.com/atwork/minutes.asp?action=view&bmmID=214, http://www.allvoices.com/news/5278964/s/48951268-body-found-in-coco-county-canal-died-by-drowning, accessed 12/28/2010)
- US EPA, 2008. BenMAP, the Environmental Benefits Mapping and Analysis Program. Office of Air Planning and Standards. Available: http://www.epa.gov/air/benmap/download.html.
- US EPA, 2003. National Primary Drinking Water Regulations: Stage 2 Disinfectants and Disinfection Byproducts Rule; Proposed Rule. 40 CFR Parts 141,142, and 143, August 18.

Economic Analysis Tables

Tables 11 through 15 have been completed, and are provided below. As shown in **Table 11**, the present value of project costs is $3.49M.

Table 12 presents the anticipated physically-quantifiable benefits that will accrue from of the full project. Physically quantifiable water supply benefits have an estimated present value of $42,486,191, 4.2 percent of which can be attributed to Phase 2 of the project, for a total of $1,784,420 in present value benefits for this portion of the project. **Table 13** has been excluded because benefits have been calculated based on physically quantifiable benefits as opposed to avoided water supply projects, and **Table 14** has been excluded because all anticipated water supply benefits have been quantified. As shown in **Table 15**, the total present value of quantifiable water supply benefits is estimated as $42,486,191 ($1,784,420 of which can be attributed to this phase of the project).

Table 11: Economic Costs
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin.	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009							$0	1.00	$0
2010							$0	0.94	$0
2011	$2,053,150						$2,053,150	0.89	$1,827,296
2012	$1,946,850						$1,946,850	0.84	$1,634,613
2013				$2,000			$2,000	0.79	$1,584
2014				$2,000			$2,000	0.75	$1,495
2015				$2,000			$2,000	0.70	$1,410
2016				$2,000			$2,000	0.67	$1,330
2017				$2,000			$2,000	0.63	$1,255
2018				$2,000			$2,000	0.59	$1,184
2019				$2,000			$2,000	0.56	$1,117
2020				$2,000			$2,000	0.53	$1,054
2021				$2,000			$2,000	0.50	$994
2022				$2,000			$2,000	0.47	$938
2023				$2,000			$2,000	0.44	$885
2024				$2,000			$2,000	0.42	$835
2025				$2,000			$2,000	0.39	$787
2026				$2,000			$2,000	0.37	$743
2027				$2,000			$2,000	0.35	$701
2028				$2,000			$2,000	0.33	$661
2029				$2,000			$2,000	0.31	$624
2030				$2,000			$2,000	0.29	$588
2031				$2,000			$2,000	0.28	$555
2032				$2,000			$2,000	0.26	$524
2033				$2,000			$2,000	0.25	$494
2034				$2,000			$2,000	0.23	$466
2035				$2,000			$2,000	0.22	$440
2036				$2,000			$2,000	0.21	$415
2037				$2,000			$2,000	0.20	$391
2038				$2,000			$2,000	0.18	$369
2039				$2,000			$2,000	0.17	$348
2040				$2,000			$2,000	0.16	$329
2041				$2,000			$2,000	0.15	$310
2042				$2,000			$2,000	0.15	$292
2043				$2,000			$2,000	0.14	$276

Table 11: Economic Costs
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin.	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2044				$2,000			$2,000	0.13	$260
2045				$2,000			$2,000	0.12	$245
2046				$2,000			$2,000	0.12	$232
2047				$2,000			$2,000	0.11	$218
2048				$2,000			$2,000	0.10	$206
2049				$2,000			$2,000	0.10	$194
2050				$2,000			$2,000	0.09	$183
2051				$2,000			$2,000	0.09	$173
2052				$2,000			$2,000	0.08	$163
2053				$2,000			$2,000	0.08	$154
2054				$2,000			$2,000	0.07	$145
2055				$2,000			$2,000	0.07	$137
2056				$2,000			$2,000	0.06	$129
2057				$2,000			$2,000	0.06	$122
2058				$2,000			$2,000	0.06	$115
2059				$2,000			$2,000	0.05	$109
2060				$2,000			$2,000	0.05	$102
2061				$2,000			$2,000	0.05	$97
2062				$2,000			$2,000	0.05	$91
2063				$2,000			$2,000	0.04	$86
2064				$2,000			$2,000	0.04	$81
2065				$2,000			$2,000	0.04	$77
2066				$2,000			$2,000	0.04	$72
2067				$2,000			$2,000	0.03	$68
2068				$2,000			$2,000	0.03	$64
2069				$2,000			$2,000	0.03	$61
2070				$2,000			$2,000	0.03	$57
2071				$2,000			$2,000	0.03	$54
2072				$2,000			$2,000	0.03	$51
2073				$2,000			$2,000	0.02	$48
2074				$2,000			$2,000	0.02	$45
2075				$2,000			$2,000	0.02	$43
2076				$2,000			$2,000	0.02	$40
2077				$2,000			$2,000	0.02	$38
2078				$2,000			$2,000	0.02	$36
2079				$2,000			$2,000	0.02	$34

Table 11: Economic Costs
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin.	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2080				$2,000			$2,000	0.02	$32
2081				$2,000			$2,000	0.02	$30
2082				$2,000			$2,000	0.01	$28
2083				$2,000			$2,000	0.01	$27
2084				$2,000			$2,000	0.01	$25
2085				$2,000			$2,000	0.01	$24
2086				$2,000			$2,000	0.01	$23
2087				$2,000			$2,000	0.01	$21
2088									
Project Life	75 Years							…	
								Total Present Value of Discounted Costs (Sum of Column (i))	**$3,489,542**
								Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries	

Comments:
Annual maintenance includes regular right-of-way maintenance and periodic cleaning.
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
2009					0		$0	1.000	$0
2010					0		$0	0.943	$0
2011					0		$0	0.890	$0
2012					0		$0	0.840	$0
2013	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.79	$253,470
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.79	$617,833
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.79	$1,564,385
2014	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.75	$239,123
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.75	$582,861
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.75	$1,475,835
2015	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.70	$225,587
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.70	$549,869
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.70	$1,392,297
2016	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.67	$212,818
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.67	$518,745
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.67	$1,313,488
2017	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.63	$200,772
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.63	$489,382
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.63	$1,239,139
2018	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.59	$189,408
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.59	$461,681

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.59	$1,168,999
2019	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.56	$178,686
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.56	$435,548
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.56	$1,102,830
2020	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.53	$168,572
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.53	$410,894
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.53	$1,040,405
2021	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.50	$159,030
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.50	$387,636
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.50	$981,514
2022	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.47	$150,028
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.47	$365,694
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.47	$925,957
2023	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.44	$141,536
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.44	$344,995
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.44	$873,544
2024	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.42	$133,525
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.42	$325,467
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.42	$824,098
2025	Avoided water	AF	0	640	640	$500	$320,000	0.39	$125,967

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	purchase costs								
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.39	$307,044
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.39	$777,451
2026	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.37	$118,837
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.37	$289,664
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.37	$733,445
2027	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.35	$112,110
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.35	$273,268
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.35	$691,929
2028	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.33	$105,764
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.33	$257,800
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.33	$652,763
2029	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.31	$99,778
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.31	$243,208
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.31	$615,814
2030	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.29	$94,130
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.29	$229,441
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.29	$580,957
2031	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.28	$88,802
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.28	$216,454

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.28	$548,073
2032	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.26	$83,775
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.26	$204,202
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.26	$517,050
2033	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.25	$79,033
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.25	$192,643
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.25	$487,783
2034	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.23	$74,560
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.23	$181,739
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.23	$460,172
2035	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.22	$70,339
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.22	$171,452
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.22	$434,125
2036	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.21	$66,358
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.21	$161,747
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.21	$409,552
2037	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.20	$62,602
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.20	$152,592
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.20	$386,370
2038	Avoided water	AF	0	640	640	$500	$320,000	0.18	$59,058

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	purchase costs								
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.18	$143,954
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.18	$364,500
2039	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.17	$55,715
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.17	$135,806
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.17	$343,868
2040	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.16	$52,562
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.16	$128,119
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.16	$324,403
2041	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.15	$49,586
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.15	$120,867
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.15	$306,041
2042	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.15	$46,780
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.15	$114,025
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.15	$288,718
2043	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.14	$44,132
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.14	$107,571
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.14	$272,375
2044	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.13	$41,634
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.13	$101,482

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.13	$256,958
2045	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.12	$39,277
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.12	$95,738
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.12	$242,413
2046	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.12	$37,054
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.12	$90,319
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.12	$228,692
2047	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.11	$34,956
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.11	$85,206
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.11	$215,747
2048	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.10	$32,978
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.10	$80,383
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.10	$203,535
2049	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.10	$31,111
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.10	$75,833
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.10	$192,014
2050	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.09	$29,350
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.09	$71,541
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.09	$181,145
2051	Avoided water	AF	0	640	640	$500	$320,000	0.09	$27,689

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	purchase costs								
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.09	$67,491
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.09	$170,892
2052	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.08	$26,121
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.08	$63,671
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.08	$161,219
2053	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.08	$24,643
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.08	$60,067
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.08	$152,093
2054	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.07	$23,248
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.07	$56,667
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.07	$143,484
2055	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.07	$21,932
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.07	$53,459
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.07	$135,362
2056	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.06	$20,691
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.06	$50,433
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.06	$127,700
2057	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.06	$19,519
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.06	$47,579

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.06	$120,472
2058	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.06	$18,415
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.06	$44,886
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.06	$113,653
2059	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.05	$17,372
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.05	$42,345
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.05	$107,220
2060	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.05	$16,389
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.05	$39,948
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.05	$101,150
2061	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.05	$15,461
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.05	$37,687
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.05	$95,425
2062	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.05	$14,586
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.05	$35,554
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.05	$90,024
2063	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.04	$13,760
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.04	$33,541
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.04	$84,928
2064	Avoided water	AF	0	640	640	$500	$320,000	0.04	$12,982

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	purchase costs								
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.04	$31,643
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.04	$80,121
2065	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.04	$12,247
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.04	$29,851
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.04	$75,586
2066	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.04	$11,554
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.04	$28,162
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.04	$71,307
2067	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.03	$10,900
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.03	$26,568
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.03	$67,271
2068	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.03	$10,283
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.03	$25,064
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.03	$63,463
2069	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.03	$9,701
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.03	$23,645
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.03	$59,871
2070	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.03	$9,151
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.03	$22,307

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.03	$56,482
2071	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.03	$8,633
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.03	$21,044
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.03	$53,285
2072	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.03	$8,145
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.03	$19,853
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.03	$50,269
2073	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$7,684
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$18,729
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$47,423
2074	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$7,249
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$17,669
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$44,739
2075	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$6,839
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$16,669
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$42,207
2076	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$6,451
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$15,725
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$39,818
2077	Avoided water	AF	0	640	640	$500	$320,000	0.02	$6,086

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	purchase costs								
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$14,835
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$37,564
2078	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$5,742
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$13,996
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$35,437
2079	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$5,417
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$13,203
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$33,432
2080	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$5,110
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$12,456
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$31,539
2081	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.02	$4,821
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.02	$11,751
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.02	$29,754
2082	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.01	$4,548
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.01	$11,086
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.01	$28,070
2083	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.01	$4,291
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.01	$10,458

Table 12: Annual Water Supply Benefit
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Proj.	With Proj.	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Disc. Factor	Discounted Benefits (h) x (i)
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.01	$26,481
2084	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.01	$4,048
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.01	$9,866
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.01	$24,982
2085	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.01	$3,819
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.01	$9,308
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.01	$23,568
2086	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.01	$3,602
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.01	$8,781
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.01	$22,234
2087	Avoided water purchase costs	AF	0	640	640	$500	$320,000	0.01	$3,399
	Lost water sales	Probability	0%	2%	2%	$39,000,000	$780,000	0.01	$8,284
	SWP & CVP Storage	AF	0	3,950	3,950	$500	$1,975,000	0.01	$20,975
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$42,486,191**

Comments:
Present value is for the full canal encasement project. This project is responsible for approximately 4/96 = 4.2 percent of full project benefits, or $1,784,420.
All costs are in 2009 dollars.

Table 13: Annual Costs of Avoided Projects
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #5: Phase 2 Contra Costa Canal Levee Elimination and Flood Protection Project

Total Discounted Water Supply Benefits	Total Discounted Avoided Project Costs	Other Discounted Water Supply Benefits	Total Present Value of Discounted Benefits (a) + (c) or (b) + (c)
(a)	(b)	(c)	(d)
$42,486,191	N/A	N/A	**$42,486,191**

Comments:
Present value is for the full canal encasement project. This project is responsible for approximately 4/96 = 4.2 percent of full project benefits, or $1,784,420.
All costs are in 2009 dollars.

Task 6 – Drainage Area 55 - West Antioch Creek Channel Improvements

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

This project will install three 14 feet by 7 feet Caltrans Standard Box Culverts spanning 620 feet of West Antioch Creek. These box culverts will increase the storm and flood water capacity of the creek, replacing an inadequate concrete trapezoidal ditch and arch culverts. This installation will a provide a 25-year level of flood protection to commercial and multi-family properties adjacent to the channel and within a Disadvantaged Community Area. It addresses a 650' gap that exists between channel improvements made by the Contra Costa County Flood Control & Water Conservation District in 1993 and the earthen channel on the Antioch Fairgrounds property.

This project is expected to provide water quality and other benefits including flood protection, described in Attachments 8 and 9. However, this project does not provide direct water supply benefits.

Table 6.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$4,922,559
Monetizable Benefits	
Flood Control Benefits: Avoided losses in property damages, Avoided clean-up costs, Avoided traffic delays due to key road inundation (FRAM)	$8,409,721
Total Monetized Benefits	$8,409,721
Qualitative Benefit or Cost	**Qualitative indicator***
Water Quality and Other Benefits	
Improved Public Health Protection	++
Improved Surface Water Quality	++
Avoided Loss of Recreation	++
Reduced Street Maintenance Costs	++
Flood Benefit	
Avoided Emergency Response 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 –.

Economic Costs

Capital costs for the project amount to $4,922,559 in present value terms, as shown in Table 11. This includes initial spending starting in 2011 and continuing through 2013. The project lifetime is expected to be 50 years, and no annual costs are anticipated once the project is completed, in 2013.

Description of Without-Project Conditions

Without the project, annual flooding events will continue to plague this disadvantaged community. This area currently experiences two to three floods annually, which cause damage to local buildings and infrastructure. Additionally, during the flooding events considerable loss of function occurs. Local businesses are inaccessible, resulting in loss of revenue. The Pittsburg-Antioch Highway, which serves as a major transportation artery to and from Eastern Contra Costa County, is often forced to close during these events.

Considerable emergency response costs are incurred during these relatively frequent events. These costs are related to emergency flood response, security provision and flood clean-up. These floods also result in the loss of the ability to provide the community with essential city services due to impacts to the City's Maintenance and Service Center. The flooding levels and associated damages increase in more severe events, such as a 25-year storm.

Description of Expected Water Supply Benefits (With-Project Conditions)

Not applicable

Uncertainty of Costs and Benefits

Not applicable

Potential Adverse Effects

Adverse effects from this project are expected to be limited to temporary construction impacts.

Documents Supporting Cost and Benefit Analysis

The following references support this cost-benefit analysis:

- Personal communication with Phil Harrington, Director of Capital Improvements/Water Rights, City of Antioch (12/16/2010).
- State of California. *San Francisco Bay Basin Water Quality Control Plan (Basin Plan)*. Oakland, CA: RWQCB, 2007. Web. 24 Dec 2010.

Economic Analysis Tables

As shown in **Table 11**, the present value of project costs is $4,922,559. Because this project does not contribute water supply benefits, **Tables 12, 13, 14 and 15** are not applicable and have been excluded.

Table 11: Economic Costs
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009								1.00	
2010	$580,167						$580,167	0.89	$516,346
2011	$2,471,817						$2,471,817	0.84	$2,075,385
2012	$2,942,617						$2,942,617	0.79	$2,330,828
2013	$580,167						$580,167	0.89	$516,346
2014								0.75	
2015								0.70	
2016								0.67	
2017								0.63	
2018								0.59	
2019								0.56	
2020								0.53	
2021								0.50	
2022								0.47	
2023								0.44	
2024								0.42	
2025								0.39	
2026								0.37	
2027								0.35	
2028								0.33	
2029								0.31	
2030								0.29	
2031								0.28	
2032								0.26	
2033								0.25	
…									
Project Life	50 Years							…	
							Total Present Value of Discounted Costs (Sum of Column (i))		**$4,922,559**
							Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries		

Comments:
Project implementation is expected to decrease costs associated with maintaining the project area when compared to the without-project condition. As such, administrative, operations and maintenance costs have conservatively been excluded from this analysis.
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

NOT APPLICABLE

Table 13: Annual Costs of Avoided Projects
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project
NOT APPLICABLE

Task 7 – Upper Sand Creek Basin

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

The primary purpose of the Upper Sand Creek Basin (USCB) project is to prevent flooding along the lower reach of Marsh Creek between Sand Creek and the Marsh Creek outfall into the Sacramento-San Joaquin River at Big Break, in Oakley. The regional goal for USCB is to significantly reduce peak flows from Sand Creek into Marsh Creek, thereby reducing the flood-related risks and damages associated with a variety of storm frequency/severity events. It also will improve water quality in these receiving waters, by capturing sediment and other nonpoint source pollution carried by storm events.

The project consists of creating a detention basin that will capture upstream flows up to the 100-year storm event (920 AF of storage capacity). This detention basin will be created by enlarging an existing smaller detention basin that currently is not connected to the creek and therefore adds no direct capture and detention of upstream stormwaters. The enlarged basin will be hydrologically connected to the stream channel and will thus capture stormwater flows up to the 100-year, 6-hour storm event. Local stormwater runoff and stormwater generated in the watershed will be conveyed by Sand Creek to the basin, where it will be stored and released slowly through the basin outlet, reducing peak flows downstream and reducing the potential for flooding downstream properties. Secondary purposes of the Basin include habitat restoration and water quality enhancements.

A summary of all benefits and costs of the project are provided in Table 7.1. This project does not provide direct water supply benefits. However, it does provide water quality and other benefits (described in Attachment 8) and flood protection benefits (described in Attachment 9).

Table 7.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$11.74 M
Monetizable Benefits	
Flood Control Benefits: Avoided losses in property damages (FRAM)	$27.9 M
Total Monetized Benefits	$ 27. 9 M
Qualitative Benefit or Cost	Qualitative indicator*
Avoided traffic delays due to key road inundation	+
Avoided emergency response costs during floods	+
Water Quality and Other Benefits	
Improved Surface Water Quality	+
Improved riparian habitat	+

Recreational and Aesthetic Benefits	+
Increased Housing Values Near New Park Acreage	+
Avoided Permitting 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 –.

Economic Costs

Capital and maintenance costs for the project amount to $11.74 million in present value terms, as shown in Table 11 at the end of this section. This includes initial spending starting in 2011 and continuing through 2015. The project lifetime is expected to be 50 years, and an annual cost of $50,000 is expected to cover maintenance activities such as weed abatement, inspection and maintenance of the dam structure, monitoring and maintenance of the riparian restoration area (adaptive management), and maintenance of the inlets (trash removal) and emergency outlets (maintenance of the gate and emergency spillway). These costs are anticipated to begin in 2016, following project completion in 2015.

Description of Without-Project Conditions

Between Upper Sand Creek Basin and its confluence with Marsh Creek, the Sand Creek channel provides little to no flood protection from relatively minor storms. Lower Sand Creek Basin, an existing interim off-line basin, is located within this downstream reach, and will be built-out to its ultimate capacity subsequent to the completion of Upper Sand Creek Basin. Downstream of Lower Sand Creek Basin, Sand Creek enters into Marsh Creek, which has engineered banks designed to protect adjacent areas from flooding up to a 50-year event.

The area at risk covers over 10,000 acres, and includes residential developments (nearly 2000 homes), as well as over 250 commercial, industrial and institutional buildings, agricultural lands, and numerous important roads (including Highway 4) and bridges. Property tax assessment records indicate the value of existing properties in the 100-year floodplain of these creeks amounts to $759 million. These tax assessment figures are likely to understate the true market value of these properties, and do not include the value of contents and other personal property that may also be at risk in these neighborhoods. Approximately 15% of the properties at risk are located along the area at risk from flooding from Sand Creek ($112.4 million at risk = 15% of $749 million), and the remaining 85% of the at risk property values ($636.7 million = 85% of $749 million) are located in the areas subject to flooding from Marsh Creek.

Without the project, the properties along the Sand Creek portion of the watershed will be at risk of frequent flooding from a wide range of storm events.

Description of Expected Water Supply Benefits (With-Project Conditions)

Not applicable

Uncertainty of Costs and Benefits

Not applicable

Potential Adverse Effects

Adverse effects from this project are expected to include temporary construction impacts.

Documents Supporting Cost and Benefit Analysis

The following references support the cost-benefit analysis presented:

- Personal communication with Carl Roner, Associate Civil Engineer, Contra Costa Flood Protection and Water Conservation District (12/16/10).
- Crompton, John L. "The impact of parks on property values: empirical evidence from the past two decades in the United States." *Managing Leisure* 10. (2005): 203-218. Web. 28 Dec 2010. <http://www.rpts.tamu.edu/faculty/crompton/Crompton/Articles/4.1.pdf>.

Economic Analysis Tables

As shown in **Table 11**, the present value of project costs is $11,735,279. As shown in Attachment 5, planning, design, and environmental documentation will be complete prior to June 1, 2011. As a result, $459,000 in costs associated with planning, design, and environmental documentation have been considered sunk costs and excluded from the costs presented in column B. The costs in column B total $13,620,000, $459,000 less than the $14,079,000 presented in Table 7 of Attachment 4.

Because this project does not contribute water supply benefits, **Tables 12, 13, 14 and 15** are not applicable and have been excluded.

Table 11: Economic Costs
Task #7: Upper Sand Creek Basin

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2009							$0	1.00	$0
2010							$0	0.94	$0
2011	$143,100						$143,100	0.89	$127,358
2012	$8,768,767						$8,768,767	0.84	$7,362,426
2013	$4,111,600						$4,111,600	0.79	$3,256,772
2014	$298,267						$298,267	0.75	$222,882
2015	$298,267						$298,267	0.70	$210,266
2016				$50,000			$50,000	0.67	$33,253
2017				$50,000			$50,000	0.63	$31,371
2018				$50,000			$50,000	0.59	$29,595
2019				$50,000			$50,000	0.56	$27,920
2020				$50,000			$50,000	0.53	$26,339
2021				$50,000			$50,000	0.50	$24,848
2022				$50,000			$50,000	0.47	$23,442
2023				$50,000			$50,000	0.44	$22,115
2024				$50,000			$50,000	0.42	$20,863
2025				$50,000			$50,000	0.39	$19,682
2026				$50,000			$50,000	0.37	$18,568
2027				$50,000			$50,000	0.35	$17,517
2028				$50,000			$50,000	0.33	$16,526
2029				$50,000			$50,000	0.31	$15,590
2030				$50,000			$50,000	0.29	$14,708
2031				$50,000			$50,000	0.28	$13,875
2032				$50,000			$50,000	0.26	$13,090
2033				$50,000			$50,000	0.25	$12,349
2034				$50,000			$50,000	0.23	$11,650
2035				$50,000			$50,000	0.22	$10,991
2036				$50,000			$50,000	0.21	$10,368
2037				$50,000			$50,000	0.20	$9,782
2038				$50,000			$50,000	0.18	$9,228
2039				$50,000			$50,000	0.17	$8,706
2040				$50,000			$50,000	0.16	$8,213
2041				$50,000			$50,000	0.15	$7,748
2042				$50,000			$50,000	0.15	$7,309
2043				$50,000			$50,000	0.14	$6,896

Table 11: Economic Costs
Task #7: Upper Sand Creek Basin

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs (g) x (h)
2044				$50,000			$50,000	0.13	$6,505
2045				$50,000			$50,000	0.12	$6,137
2046				$50,000			$50,000	0.12	$5,790
2047				$50,000			$50,000	0.11	$5,462
2048				$50,000			$50,000	0.10	$5,153
2049				$50,000			$50,000	0.10	$4,861
2050				$50,000			$50,000	0.09	$4,586
2051				$50,000			$50,000	0.09	$4,326
2052				$50,000			$50,000	0.08	$4,081
2053				$50,000			$50,000	0.08	$3,850
2054				$50,000			$50,000	0.07	$3,633
2055				$50,000			$50,000	0.07	$3,427
2056				$50,000			$50,000	0.06	$3,233
2057				$50,000			$50,000	0.06	$3,050
2058				$50,000			$50,000	0.06	$2,877
2059				$50,000			$50,000	0.05	$2,714
2060				$50,000			$50,000	0.05	$2,561
2061				$50,000			$50,000	0.05	$2,416
2062				$50,000			$50,000	0.05	$2,279
2063				$50,000			$50,000	0.04	$2,150
2064				$50,000			$50,000	0.04	$2,028
2065				$50,000			$50,000	0.04	$1,914
Project Life: 50 years								…	
							Total Present Value of Discounted Costs (Sum of Column (i))		**$11,735,279**
							Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries		

Comments:
Maintenance costs include weed abatement, inspection and maintenance of the dam structure, monitoring and maintenance of the riparian restoration area (adaptive management), and maintenance of the inlets (trash removal) and emergency outlets (maintenance of the gate and emergency spillway).
Planning, design, and environmental documentation will be complete prior to June 1, 2011. As a result, $459,000 in costs associated with planning, design, and environmental documentation have been considered sunk costs and excluded from the costs presented in column B. The costs in column B total $13,620,000, $459,000 less than the $14,079,000 presented in Table 7 of Attachment 4.
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

NOT APPLICABLE

Table 13: Annual Costs of Avoided Projects
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #6: Drainage Area 55 – West Antioch Creek Channel Improvements Project

NOT APPLICABLE

Task 8 – Watershed Protection and Restoration

The following sections present a quantitative and qualitative analysis of project costs and water supply benefits. Tables 11 through 15 have been completed, and are included at the end of this section.

Overview

This project will fund a portion of the HCP Habitat and Watershed Protection/Restoration Project. The project involves acquiring a parcel of land between 200 and 500 acres in the northwest corner of the IRWMP area, restoring habitat, and creating wetlands in a region rich in natural resources and home to the headwaters to many small creeks. The project will contribute to the creation of a habitat corridor from the Concord Naval Weapons Station to the Black Diamond Mines Regional Preserve, protect valuable species habitat and source waters, and create two acres of additional wetlands. This project is designed to achieve the following objectives:

- Mitigate source water degradation due to development
- Provide comprehensive regional species protection
- Create new wetland habitat
- Contribute to species recovery

Protected and restored habitats will include annual grassland, oak savannah, oak woodland, chaparral, riparian vegetation and streams, permanent wetland, and seasonal wetlands.

In a 2002 Biological Opinion, the US Fish and Wildlife Service (FWS) required that CCWD develop a successful regional HCP as a condition for exercising its full water right. Without successful completion of the HCP, CCWD will not be permitted to increase its Delta withdrawals from 148,000 AFY to 195,000 AFY. This project is a portion of the HCP and is therefore a component of a project that is necessary for the CCWD to receive the additional 47,000 AFY of supply contingent upon successful implementation of the regional HCP. The full HCP will conserve approximately 30,000 acres of land; as such, this project represents approximately one percent of the total HCP.

Table 8.1 below provides an overview of the overall benefit-cost outcomes with a summary of the benefits and costs for this project. Water Supply benefits are discussed in more detail in the remainder of this attachment, and a complete discussion of Water Quality and Other Benefits is provided in Attachment 8.

Monetized benefits estimated for this project accrue from CCWD's ability to exercise its full Delta water right, increasing its withdrawals from 148,000 AFY to 195,000 AFY on successful implementation of the SCP. Although this specific project is not sufficient for the increased allotment, it represents approximately one percent of the necessary project. As such, monetized water supply benefits are based on one percent of the total increase in withdrawals, with a present value of $1.99 M.

Table 8.1. Benefit-Cost Analysis Overview

	Present Value
Costs – Total Capital and O&M	$1,606,290
Monetized Benefits	
Water Supply Benefits	
WS Benefit – Avoided Alternative Supply	$1,986,452
	Qualitative indicator*
Qualitative Benefits	
Water Quality Benefits	
Water quality improvements due to source water protection	+
Other Benefits	
Habitat Restoration	++
Threatened and endangered species	++
Recreation	+
Increased housing values	+
Avoided Permitting 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 –.

Economic Costs

Economic costs are presented in Table 11, as follows:

- Acquisition: Acquisition is scheduled to occur in 2012. The total purchase price is $1,200,000, as shown in Table 11, Column C. This is consistent with the land acquisition cost presented in the Watershed Protection and Restoration project Table 7 in Attachment 4: Budget.
- Construction: Construction is scheduled to occur in 2013. The total cost for planning, construction implementation, construction administration, and other construction related expenses is $540,000. All construction related costs are scheduled to occur in 2013.

Construction costs are reflected in Table 11, Column C, consistent with the budget provided in Table 7.

- Direct Project Administration: Project administration costs ($10,000) are spread over 3 years beginning in 2011. Direct Project Administration costs are reflected in Table 11, Column C.
- Administration, Operation and Maintenance: These costs will begin in 2014 and will continue for the 50 year planning horizon. Land banked property (property that is acquired and preserved but not yet open to the public) has initial administration and operating costs of $20 - $40 per acre. A conservative estimate of $30 per acre per year was used for Administration and Operating costs. In addition, these lands initially require $20 - $40 per acre in maintenance and monitoring costs. In Table 11, the $30 per acre Administration and Operations costs are split between columns D and E. In Table 11 the entire $30 per acre cost for Maintenance and Monitoring costs are shown in Column F. Over time, the ongoing administration, operations, and maintenance costs associated with these properties decreases. To reflect this continual decrease, these costs have been reduced by one half every five years.
- Other: Adaptive management of created wetlands will begin on completion of construction and continue for five years until 2019. For created wetlands, every project is monitored intensively for five years, after which monitoring continues in accordance with the standard management plan for the project. The costs associated with intensive wetland monitoring vary by project size and individual characteristics of the property location. Based on communications with HCP staff, costs for intensive adaptive management range from $15,000 to $25,000 per project per year. We conservatively selected the midpoint, $20,000 per year, to evaluate project costs. In Table 11, wetland monitoring costs are illustrated in column (f) other.

These assumptions result in a total discounted project cost of $1,606,290 utilizing 2009 dollars over the 50 year planning horizon.

Description of Without-Project Conditions

Failure to implement this project is expected to create the following conditions:

- CCWD may have difficulty obtaining USFWS and Bureau of Reclamation permission to exercise its full Delta water right.
- Matching funds from USFWS, the East Bay Regional Park District Measure WW Funds Local Assistance Grant, and CA Department of Fish and Game may be lost.
- New regional growth will affect a variety of important natural habitats, causing more disruption than has already occurred in the watersheds. Key habitat will continue to be threatened, affecting special status species including California Tiger Salamander and Red legged Frog. Source water will not be protected, threatening downstream users and habitat.
- Development of a wildlife and recreation corridor will potentially not occur and threatened and special status species populations will continue to decline.

Description of Expected Water Supply Benefits (With-Project Conditions)

A 2002 FWS Biological Opinion identified successful completion of the HCP as a condition for CCWD to increase water withdrawals from 148,000 AFY to 195,000 AFY, its full water right. In terms of acreage, this project represents approximately one percent of the negotiated HCP. Although this project is not

sufficient for the success of the HCP, it is a component of the full HCP, which is a necessary condition for CCWD to increase withdrawals by 47,000 AFY.

With the project, CCWD will be allowed to increase its Delta water withdrawals by 47,000 AFY to its full 195,000 AFY water right in future years.

Summary of Quantitative Water Supply Benefits

As described above, this project is responsible for approximately 1 percent of the HCP, a necessary condition for CCWD to exercise its right to 47,000 AFY. To monetize this benefit, estimates of unit water costs for supply alternatives being considered as part of the 2007 Future Water Supply Study Update (FWSS Update) were considered. The cost information was developed based on several completed feasibility studies, master plans, and planning documents and was summarized in a draft Dec 11, 2007 memorandum, which has been evaluated using common delivery and financial assumptions.

A conservative value for the water supply enabled by this project is based on valuing the future water at $500 per AF. At a high end, the water may be valued according the price of emergency water. Obtaining water during emergencies is expensive, averaging around $1,200 per AF. Emergency interruption of supplies has plagued CCWD in the recent past, and is anticipated to occur again in the future (e.g., in 2004, the Jones Tract levee break impacted CCWD water quality). Alternatively, CCWD is sometimes able to acquire water from spot markets, which can be relatively cost-effective when such water is available when needed (e.g., about $400 per AF). A future water supply study developed in 2007 for CCWD (pages attached) examined a range of water supply enhancement options, and found that most alternatives cost between $700 and $1600 per AF (including conservation, groundwater development, reclaimed water projects, desalination, water supply banking and long-term lease deals). To be somewhat conservative, we apply a value of $500 per AF for water supply enhancements enabled by this project.

Assuming this project is necessary for the CCWD to obtain one percent of their full Bay -Delta allotment, which is conditioned upon a successful HCP, the present value water supply benefit is estimated to be $1,986,452.

Summary of Qualitative Water Supply Benefits

No qualitative water supply benefits have been identified for this project; all water supply benefits have been quantified.

Project Beneficiaries and Distribution of Benefits

This project will provide local and regional benefits by preserving habitat and other ecosystem services. It will also benefit local governments interested in infrastructure improvement by reducing permitting costs for these projects, while improving the quality of the mitigation efforts. It will benefit local landowners in the area by providing economic incentives for land preservation. Finally, it will have a small positive impact on the Bay-Delta resulting from source water protection.

Table 8.2. Project Beneficiaries Summary

Local	Regional	*Statewide*
CCWD Home builders & Developers Local Cities Contra Costa County Local communities	Other users in watershed Species Habitat Regulatory agencies – DFG, USFWS (removes regulatory burden by streamlining permit process)	*Bay-Delta*

Timing of Benefits

This project will involve land purchase, restoration, and protection in perpetuity. Benefits of protecting this land will begin accruing immediately upon acquisition and will amplify as other property in the region is assembled into a larger regional preserve system.

Uncertainty of Costs and Benefits

This benefit and cost analysis is based on available data and specific assumptions. As a result, there may be some omissions, uncertainties, and possible biases. In this analysis, the main uncertainties are associated with the likelihood of the HCP being successful without this project, and the cost of future water units to CCWD. These issues are summarized in Table 8.3.

Table 8.3. Omissions, Biases, and Uncertainties, and Their Effect on the Project

Benefit or Cost Category	Likely Impact on Net Benefits*	*Comment*
Water Supply – Availability of additional water allotment to CCCWD	U	The Project is necessary but not sufficient for the HCP to be successful. The specific contributions of this individual HCP component to CCWD's ability to obtain full Bay-Delta allotment are uncertain.

*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 -.

Potential Adverse Effects

No potential adverse effects from this project have been identified. All land will only be purchased from willing sellers.

Documents Supporting Cost and Benefit Analysis

The following documents were used to develop the cost and benefit analyses described in this section:

- Habitat Conservation Plan / Natural Community Conservation Plan
- Pages from Draft Future Water Supply Study

Economic Analysis Tables

Tables 11 through 15 have been completed, and are provided below. As shown in **Table 11**, the present value of project costs is $1.9 M.

Table 12 presents the anticipated physically-quantifiable benefits that will accrue from project implementation. Physically quantifiable water supply benefits have an estimated present value of $1.99 M. **Table 13** has been excluded because benefits have been calculated based on physically quantifiable benefits as opposed to avoided water supply projects, and **Table 14** has been excluded because all anticipated water supply benefits have been quantified. As shown in **Table 15**, the total present value of quantifiable water supply benefits is estimated as $1,606,290.

Table 11: Economic Costs
Task #8: Watershed Protection and Restoration

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2010							$0	0.94	$0
2011	$3,334						$3,334	0.89	$2,967
2012	$1,203,333						$1,203,333	0.84	$1,010,342
2013	$543,333						$543,333	0.79	$430,371
2014		$4,500	$4,500	$9,000		$20,000.00	$38,000	0.75	$28,396
2015		$4,500	$4,500	$9,000		$20,000.00	$38,000	0.70	$26,789
2016		$4,500	$4,500	$9,000		$20,000.00	$38,000	0.67	$25,272
2017		$4,500	$4,500	$9,000		$20,000.00	$38,000	0.63	$23,842
2018		$4,500	$4,500	$9,000		$20,000.00	$38,000	0.59	$22,492
2019		$2,250	$2,250	$4,500			$9,000	0.56	$5,026
2020		$2,250	$2,250	$4,500			$9,000	0.53	$4,741
2021		$2,250	$2,250	$4,500			$9,000	0.50	$4,473
2022		$2,250	$2,250	$4,500			$9,000	0.47	$4,220
2023		$2,250	$2,250	$4,500			$9,000	0.44	$3,981
2024		$1,125	$1,125	$2,250			$4,500	0.42	$1,878
2025		$1,125	$1,125	$2,250			$4,500	0.39	$1,771
2026		$1,125	$1,125	$2,250			$4,500	0.37	$1,671
2027		$1,125	$1,125	$2,250			$4,500	0.35	$1,577
2028		$1,125	$1,125	$2,250			$4,500	0.33	$1,487
2029		$563	$563	$1,125			$2,250	0.31	$702
2030		$563	$563	$1,125			$2,250	0.29	$662

Table 11: Economic Costs
Task #8: Watershed Protection and Restoration

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
2031		$563	$563	$1,125			$2,250	0.28	$624
2032		$563	$563	$1,125			$2,250	0.26	$589
2033		$563	$563	$1,125			$2,250	0.25	$556
2034		$281	$281	$563			$1,125	0.23	$262
2035		$281	$281	$563			$1,125	0.22	$247
2036		$281	$281	$563			$1,125	0.21	$233
2037		$281	$281	$563			$1,125	0.20	$220
2038		$281	$281	$563			$1,125	0.18	$208
2039		$141	$141	$281			$563	0.17	$98
2040		$141	$141	$281			$563	0.16	$92
2041		$141	$141	$281			$563	0.15	$87
2042		$141	$141	$281			$563	0.15	$82
2043		$141	$141	$281			$563	0.14	$78
2044		$70	$70	$141			$281	0.13	$37
2045		$70	$70	$141			$281	0.12	$35
2046		$70	$70	$141			$281	0.12	$33
2047		$70	$70	$141			$281	0.11	$31
2048		$70	$70	$141			$281	0.10	$29
2049		$35	$35	$70			$141	0.10	$14
2050		$35	$35	$70			$141	0.09	$13
2051		$35	$35	$70			$141	0.09	$12
2052		$35	$35	$70			$141	0.08	$11
2053		$35	$35	$70			$141	0.08	$11
2054		$18	$18	$35			$70	0.07	$5
2055		$18	$18	$35			$70	0.07	$5
2056		$18	$18	$35			$70	0.06	$5
2057		$18	$18	$35			$70	0.06	$4
2058		$18	$18	$35			$70	0.06	$4
2059		$9	$9	$18			$35	0.05	$2
2060		$9	$9	$18			$35	0.05	$2
2061		$9	$9	$18			$35	0.05	$2
2062		$9	$9	$18			$35	0.05	$2
2063		$9	$9	$18			$35	0.04	$2
2064		$4	$4	$9			$18	0.04	$1
Project Life	50 Years							…	
Total Present Value of Discounted Costs (Sum of Column (i))									**$1,606,290**

Table 11: Economic Costs
Task #8: Watershed Protection and Restoration

	Initial Costs	Operations and Maintenance Costs [1]						Discounting Calculations	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
YEAR	Grand Total Cost (Table 7)	Admin	Ops.	Maint.	Replace.	Other	Total Costs (a) +…+ (f)	Discount Factor	Discounted Costs(g) x (h)
Transfer to Table 20, column (c), Exhibit F: Proposal Costs and Benefits Summaries									

Comments:
All costs are in 2009 dollars.

Table 12: Annual Water Supply Benefit
Task #8: Watershed Protection and Restoration

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit	Without Project	With Project	Change from Project (e) – (d)	Unit $ Value	Annual $ Value (f) x (g)	Discount Factor	Discounted Benefits (h) x (i)
2010								0.94	
2011								0.89	
2012								0.84	
2013								0.79	
2014								0.75	
2015								0.70	
2016								0.67	
2017								0.63	
2018								0.59	
2019								0.56	
2020	Delta supply	470	0	470	470	$500	$235,000	0.53	$123,795
2021	Delta supply	470	0	470	470	$500	$235,000	0.50	$116,788
2022	Delta supply	470	0	470	470	$500	$235,000	0.47	$110,177
2023	Delta supply	470	0	470	470	$500	$235,000	0.44	$103,941
2024	Delta supply	470	0	470	470	$500	$235,000	0.42	$98,057
2025	Delta supply	470	0	470	470	$500	$235,000	0.39	$92,507
2026	Delta supply	470	0	470	470	$500	$235,000	0.37	$87,271
2027	Delta supply	470	0	470	470	$500	$235,000	0.35	$82,331
2028	Delta supply	470	0	470	470	$500	$235,000	0.33	$77,671
2029	Delta supply	470	0	470	470	$500	$235,000	0.31	$73,274
2030	Delta supply	470	0	470	470	$500	$235,000	0.29	$69,127
2031	Delta supply	470	0	470	470	$500	$235,000	0.28	$65,214
2032	Delta supply	470	0	470	470	$500	$235,000	0.26	$61,522
2033	Delta supply	470	0	470	470	$500	$235,000	0.25	$58,040
2034	Delta supply	470	0	470	470	$500	$235,000	0.23	$54,755
2035	Delta supply	470	0	470	470	$500	$235,000	0.22	$51,655
2036	Delta supply	470	0	470	470	$500	$235,000	0.21	$48,731
2037	Delta supply	470	0	470	470	$500	$235,000	0.20	$45,973
2038	Delta supply	470	0	470	470	$500	$235,000	0.18	$43,371
2039	Delta supply	470	0	470	470	$500	$235,000	0.17	$40,916
2040	Delta supply	470	0	470	470	$500	$235,000	0.16	$38,600
2041	Delta supply	470	0	470	470	$500	$235,000	0.15	$36,415
2042	Delta supply	470	0	470	470	$500	$235,000	0.15	$34,354
2043	Delta supply	470	0	470	470	$500	$235,000	0.14	$32,409
2044	Delta supply	470	0	470	470	$500	$235,000	0.13	$30,575
2045	Delta supply	470	0	470	470	$500	$235,000	0.12	$28,844

2046	Delta supply	470	0	470	470	$500	$235,000	0.12	$27,211
2047	Delta supply	470	0	470	470	$500	$235,000	0.11	$25,671
2048	Delta supply	470	0	470	470	$500	$235,000	0.10	$24,218
2049	Delta supply	470	0	470	470	$500	$235,000	0.10	$22,847
2050	Delta supply	470	0	470	470	$500	$235,000	0.09	$21,554
2051	Delta supply	470	0	470	470	$500	$235,000	0.09	$20,334
2052	Delta supply	470	0	470	470	$500	$235,000	0.08	$19,183
2053	Delta supply	470	0	470	470	$500	$235,000	0.08	$18,097
2054	Delta supply	470	0	470	470	$500	$235,000	0.07	$17,073
2055	Delta supply	470	0	470	470	$500	$235,000	0.07	$16,106
2056	Delta supply	470	0	470	470	$500	$235,000	0.06	$15,195
2057	Delta supply	470	0	470	470	$500	$235,000	0.06	$14,335
2058	Delta supply	470	0	470	470	$500	$235,000	0.06	$13,523
2059	Delta supply	470	0	470	470	$500	$235,000	0.05	$12,758
2060	Delta supply	470	0	470	470	$500	$235,000	0.05	$12,036
Project Life									
Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)									**$1,986,452**

Comments:
All costs are in 2009 dollars.

Table 13: Annual Costs of Avoided Projects
Task #8: Watershed Protection and Restoration

NOT APPLICABLE

Table 14: Annual Other Water Supply Benefits
Task #8: Watershed Protection and Restoration

NOT APPLICABLE

Table 15: Total Water Supply Benefits
Task #8: Watershed Protection and Restoration

Total Discounted Water Supply Benefits	Total Discounted Avoided Project Costs	Other Discounted Water Supply Benefits	Total Present Value of Discounted Benefits (a) + (c) or (b) + (c)
(a)	(b)	(c)	(d)
$1,986,452	$0	$0	**$1,986,452**
Comments: All costs are in 2009 dollars.			