San Francisco Bay Regional Water Enhancement Program

Attachment 7

Technical Justification of Project Physical Benefits

Association of Bay Area Governments

Proposition 84

Integrated Regional Water Management

Round 2, Implementation Grant Application

Introduction 1
Water Supply 2
Project 1 – Bay Area Regional Conservation and Education Program 2
Project 2 – East Bayshore Recycled Water Project Phase 1A (Emeryville) 6
Project 6 – North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project 9
Project 8 – Pescadero Water Supply and Sustainability Project 13
Project 11 – Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County 18
Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County 21
Project 15 – San Francisco International Airport Reclaimed Water Facility 24
Water Quality 28
Project 14 – San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing 28
Project 16 – San José Green Streets & Alleys Demonstration Projects 31
Project 19 – Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds 35
Habitat Restoration 39
Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Project 39
Project 4 – Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects 43
Project 7 – Oakland Sausal Creek Restoration Project 47
Project 12 – Richmond Breuner Marsh Restoration Project 52
Project 17 – San Pablo Rheem Creek Wetlands Restoration Project 56
Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project 61
Flood Protection 69
Project 5 – Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal 69
Project 9 – Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek 72
Project 10 – Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project 75

Introduction

This section presents the physical benefits and technical justification of the 19 projects included in San Francisco Bay Regional Water Enhancement Program Proposition 84, Round 2 Implementation Proposal (Proposal). This section documents the diverse range of benefits that the Program addresses, including:

- 7 projects whose primary benefit is water supply.
- 3 projects whose primary benefit is water quality improvement.
- 6 projects whose primary benefit is habitat restoration.
- 3 projects whose primary benefit is flood protection.

Presented in this section, for each project, are: 1) physical project benefits listed and described in the first table, 2) supporting documentation for each identified benefit described in the second table, and 3) the annual quantifiable physical benefits are shown in the third table, which is formatted to conform to Table 9 in the PSP. The projects are grouped according to the primary benefits claimed in the order shown below.

Primary Project Benefit	Project #	Project Proponent	Project Title
Water Supply	1	Zone 7	Bay Area Regional Conservation and Education Program
	2	EBMUD	East Bayshore Recycled Water Project Phase 1A (Emeryville)
	6	Sonoma Valley CSD	North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project
	8	San Mateo County	Pescadero Water Supply and Sustainability Project
	11	SFPUC	Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County
	13	Roseview Heights MWC	Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County
	15	CCSF Airport Commission	San Francisco International Airport Reclaimed Water Facility
Water Quality	14	ABAG	San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing
	16	City of San José	San José Green Streets & Alleys Demonstration Projects
	19	PRBO	Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds
Habitat Restoration	3	Marin MWD	Lagunitas Creek Watershed Sediment Reduction and Management Project
	4	Marin RCD	Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects
	7	City of Oakland	Oakland Sausal Creek Restoration Project
	12	EBRPD	Richmond Breuner Marsh Restoration Project
	17	CCWD	San Pablo Rheem Creek Wetlands Restoration Project
	18	City of St. Helena	St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project
Flood Protection	5	Napa County	Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal
	9	City of Petaluma	Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek
	10	City of Redwood City	Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project

Water Supply

Project 1 – Bay Area Regional Conservation and Education Program

An aggressive conservation program is essential to integrated regional water management. Consumer acceptance of water-efficient technology and practices will result in long-term demand reduction that improves the region's capacity to manage drought scenarios and other strains on Bay Area Water supplies and the Delta. This program offers drought relief and long-term water savings in the form of a package of water conservation programs to improve water use efficiency throughout the San Francisco Bay Region. This program is primarily focused on outdoor conservation and education. The participating agencies developed programs to provide the most quantifiable and sustainable water savings. The water supply benefits generated by this program, on an average 10 year life span, will reduce water demand, thus preserving current potable supplies and reducing stress on the CALFED Bay-Delta.

More than 50% of urban water demand is for landscape irrigation. Excess spray irrigation runs to local city sewer systems, often polluted with pesticides, herbicides and / or fertilizers. Cutting back on landscape irrigation will prevent stormwater pollution and also result in energy savings (less water must be pumped, treated, and conveyed to customers). This will reduce the carbon foot print of water agencies.

Project 1 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	The project will reduce potable water demand through encouraging use of water conservation practices Bay-wide.	Expected water savings vary in magnitude and duration by program element. Cumulatively, the program is expected to reduce potable water demands in the Bay Area over the next 30 years by 8,940 AF. The average annual demand reduction over this period is 298 AFY. *Mobile Water Lab:* This project will provide water conservation recommendations that will result in 44.2 AF water savings if practices are implemented by landowner/manager. Also see the Attachment 8 discussion of quantifiable benefits for Project 1.
Water Quality Improvement	N/A	N/A
Habitat or Ecosystem Improvement	N/A	N/A
Flood Protection	N/A	N/A
Recreation or Open Space Improvement	N/A	N/A
Greenhouse Gas Reduction	N/A	N/A
Other Physical Benefits	N/A	N/A

Project 1 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Urbanization has degraded water quality in the Bay Area. *Mobile Water Lab:* As currently managed, there is inadequate water supply available to meet the needs of humans and threatened salmonids in the Sonoma, Napa, and Petaluma Watersheds. Agricultural practices combined with urban development are competing for limited water resources. With the prospect of a high level of unpredictability in water supply reliability, an increase in population, global climate change, and the expansion of groundwater monitoring and regulation, the urgency to conserve water has never been greater. Providing growers in North Bay watersheds with irrigation efficiency evaluations and assisting them with fixing potential problems creating an unnecessary increase in water use will reduce water supply needs in three watersheds.
Estimates of no-project conditions in consideration of other planned projects	*Mobile Water Lab:* As an industry, agriculture has done many of the right things to conserve water. However, as a 2008 water use survey indicated, conservation practices are not universal and it is likely that some growers could make substantial improvements in irrigation water efficiency. This project works to provide information, technical assistance and cost-share opportunities for growers to evaluate and improve their irrigation systems.
Relation of Project to other Proposed Projects	*Mobile Water Lab:* This project would expand upon an existing vineyard mobile lab program implemented by the Sotoyome RCD in the Russian River Watershed in Sonoma County and implemented by other RCDs in the Central Coast region and in the Sacramento Valley region.
Methods used to Estimate Physical Benefits	N/A
New facilities, policies, and actions required to obtain the physical benefits	N/A
Uncertainty of benefits and contributing factors	N/A
Potential adverse effects	N/A

Table 9 – Annual Benefit: Project 1 – Bay Area Regional Conservation and Education Program					
(a)	(b)	(c)	(d)	(e)	(f)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project [1]	With Project	Change Resulting from Project
2012	water supply	AF	0	0.0	0.0
2013	water supply	AF	0	0.0	0.0
2014	water supply	AF	0	0.0	0.0
2015	water supply	AF	0	1,157.5	1,157.5
2016	water supply	AF	0	1,819.0	1,819.0
2017	water supply	AF	0	1,492.7	1,492.7
2018	water supply	AF	0	1,166.4	1,166.4
2019	water supply	AF	0	774.4	774.4
2020	water supply	AF	0	448.2	448.2
2021	water supply	AF	0	347.9	347.9
2022	water supply	AF	0	346.4	346.4
2023	water supply	AF	0	345.0	345.0
2024	water supply	AF	0	343.6	343.6
2025	water supply	AF	0	108.8	108.8
2026	water supply	AF	0	107.6	107.6
2027	water supply	AF	0	42.2	42.2
2028	water supply	AF	0	41.1	41.1
2029	water supply	AF	0	40.0	40.0
2030	water supply	AF	0	38.9	38.9
2031	water supply	AF	0	37.9	37.9
2032	water supply	AF	0	36.9	36.9
2033	water supply	AF	0	36.0	36.0
2034	water supply	AF	0	35.1	35.1
2035	water supply	AF	0	20.9	20.9
2036	water supply	AF	0	20.0	20.0
2037	water supply	AF	0	19.2	19.2
2038	water supply	AF	0	18.5	18.5
2039	water supply	AF	0	17.7	17.7
2040	water supply	AF	0	17.0	17.0
2041	water supply	AF	0	16.3	16.3
2042	water supply	AF	0	15.7	15.7
2043	water supply	AF	0	15.1	15.1
2044	water supply	AF	0	14.5	14.5
Comments: [1] Water savings from plumbing code requirements and other sources under the without-project condition have been netted out of the with-project savings estimates. Therefore, no water savings are reported for the without-project condition.					

References for supporting Project 1 benefits are provided with Attachments 3 and 8.

Water Lab References:

California Regional Water Quality Control Board, San Francisco Bay Region. 2008. *Sonoma Creek Sediment TMDL and Habitat Enhancement Plan*. http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/TMDLs/sonomacrksedimenttmdl.shtml

California Regional Water Quality Control Board, San Francisco Bay Region. 2009. *Napa River Sediment TMDL and Habitat Enhancement Plan*. http://www.swrcb.ca.gov/rwqcb2/water_issues/programs/TMDLs/napariversedimenttmdl.shtml

California Regional Water Quality Control Board, San Francisco Bay Region. 2012. Vineyard Program for Vineyard Facilities in the Napa River and Sonoma Creek Watersheds.
http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/TMDLs/vineyard/index.shtml

Project 2 – East Bayshore Recycled Water Project Phase 1A (Emeryville)

EBMUD's water supply is from the Mokelumne River, a tributary to the Sacramento-San Joaquin Delta. Additionally, EBMUD extracts Delta water supply from its Freeport diversion facility during drought periods. This proposed recycled water project will benefit the Delta by reducing potable water demand from the Bay-Delta, Central Valley Project, and State Water Project.

The total recycled water project yield from the East Bayshore Recycled Water Project (EBRWP) at full buildout is estimated to be 2.5 mgd (2,800 AFY). The EBRWP will offset the use of potable water for primarily irrigation demands, therefore improving potable water supply reliability for the region. The EBRWP will reduce the need for severe rationing during prolonged droughts and reuse a water resource that would otherwise be discharged to the San Francisco Bay. If the proposed project is not implemented, the EBRWP will not be operated at the full design capacity. Under this scenario, use of limited drinking water supply for non-potable applications will continue and a valuable water resource will be underutilized.

The EBRWP Phase 1A (Emeryville) will add to the Phase 1 pipeline project which was completed in October 2012. The Phase 1A (Emeryville) project will extend the recycled water pipeline north to users located in the Emeryville area. Ultimately, the EBRWP recycled water transmission pipeline will terminate in Albany, the northernmost extent of the EBRWP.

Project 2 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	The project will reduce potable water demand through the use of recycled water. The project will also increase regional supply reliability by reducing the risk of severe rationing during prolonged droughts	Initial amount of potable water saved or recycled water supplied = 50 AFY increment for Phase 1A (Emeryville) Project (this grant application). When the remainder of the I-80 pipeline is complete, total recycled water delivery through the Phase 1A (Emeryville) Project is estimated at 360 AFY. Overall project at buildout will supply 2,800 AFY.
Water Quality Improvement	The project will reduce discharges of treated wastewater to SF Bay and help realize TMDL goals for SF Bay.	This Phase 1A (Emeryville) Project will initially offset 0.04 MGD of tertiary treated recycled water that would otherwise discharge to SF Bay. When the remainder of the I-80 pipeline is complete, total recycled water delivery through the Phase 1A (Emeryville) Project is estimated at 0.32 MGD. The overall project at buildout will offset 2.5 MGD of tertiary treated recycled water that would otherwise discharge to SF Bay.
Habitat or Ecosystem	Increase flows to the Delta by reducing the need for	

Improvement	Mokelumne water, a tributary to the Delta, and reducing the need to divert Sacramento River water at Freeport during droughts. Increase Mokelumne instream flows for environmental uses.	
Flood Protection	Improve flood management by reducing demand from the Mokelumne River.	
Recreation or Open Space Improvement	N/A	N/A
Greenhouse Gas Reduction	N/A	N/A
Other Physical Benefits	N/A	N/A

Project 2 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Recycled water projects such as the East Bayshore Regional Water Project (EBRWP) are especially important during droughts where there are water shortages and the possibility of severe rationing. Recycled water is a drought-resistant supply not subject to rationing, which supports the local and regional economy. During the last EBMUD drought in 2008, recycled water customer did not need to ration and were not subject to drought rate surcharges. The East Bayshore Project provides a sustainable resource.
Estimates of no-project conditions in consideration of other planned projects	If this project is not implemented, potable water will not be preserved and diversions from Mokelumne River, tributary to the Delta, will continue year-round. Also, diversion from Sacramento River at Freeport will not decrease during a drought. Also, other project options may be considered such as desalination and water transfers that may have less environmental benefits.
Relation of Project to other Proposed Projects	The Phase 1A (Emeryville) Project supported by this grant application is part of the overall East Bayshore Recycled Water Project (EBRWP), a multi-phased project. The EBRWP is part of a number of EBMUD recycled water projects included in its regional Water Supply Management Program (WSMP) 2040 which has a goal of achieving 20 MGD of recycled water by the year 2040. The WSMP 2040 also includes other supplemental supplies such as water transfers, desalination, groundwater, etc. The EBRWP is an integrated project with multiple benefits that address multiple statewide priorities, with the primarily benefit being a recycled water project that will conserve the use of potable water, which compliments other types of projects in the Round 2 Proposal.
Methods used to Estimate Physical Benefits	Flow production monitoring at plant and water meters at customer sites. Flow meters will be continuously monitored and water meters at customer sites will be read every one to two months.

New facilities, policies, and actions required to obtain the physical benefits	A segment of the I-80 transmission pipeline must be complete in Emeryville (Phase 1A), which is included in this grant application.
Uncertainty of benefits and contributing factors	Recycled water demand metered will vary year to year, depending on weather and other factors. Also, meters may need to be serviced periodically for accuracy.
Potential adverse effects	Temporary construction impacts (noise, dust control, traffic).

Table 9 – Annual Benefit:
Project 2 – East Bayshore Recycled Water Project Phase 1A (Emeryville)

(a)	(b)	(c)	(d)	(e)	(f)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2012					
2013					
2014					
2015	Water Supply	AF	0	50	50
2016	Water Supply	AF	0	50	50
2017-2065	Water Supply	AF	0	360	360

References Cited:

East Bay Municipal Utility District (EMBUD). 2010. *Urban Water Management Plan*. June.

EBMUD. 2012. *Water Supply Management Program 2040 Plan.* Oakland, California. April.

EBMUD. 2013. Avoided Cost Worksheet. (see Attachment 8)

Project 6 – North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project

The North San Pablo Bay region of California's Napa, Sonoma, and Marin Counties faces serious long-term challenges in providing reliable water supplies. The area is not served by federal water projects, surface and groundwater sources are limited, and some local groundwater basins are over pumped. Urban, agricultural, and environmental demands, exacerbated by ongoing drought, exceed the region's ability to provide a reliable, sustainable, and economical water supply. A clean, dependable water supply is also needed to continue the restoration of vital tidal wetlands at the base of the San Pablo Bay watershed. The effects of climate change are further stressing the area's water supplies with reduced diversions from the Russian River, unpredictable rainfall, and fluctuating temperatures.

The region's wastewater treatment agencies have long faced strict limits on the timing and quality of the treated effluent they can send to San Pablo Bay. By treating wastewater to the strict levels required for reuse, these agencies can recycle the water in productive ways that augment local water supply and help protect limited potable water resources. Many studies conducted over the last decade have verified its safety and recycled water is already in wide use throughout the North Bay, elsewhere in California, and across the nation.

The Bay Area Clean Water Agencies' 2007 report titled, Importance of Recycled Water to the San Francisco Bay Area, identifies how recycled water will help address growing water demands, reduce dependence on vulnerable imported water supplies, and mitigate the risks of long-term climate change. The 2007 Sonoma Valley Groundwater Management identifies the increased use of recycled water to offset groundwater pumping as a key element in attaining groundwater sustainability. The State Water Resources Control Board wastewater recycling survey shows recycled water has become an integral part of California's water supply. Its 2013 Revised Recycled Water Policy sets a goal of increased recycled water use over 2002 levels by at least one million acre feet per year (AFY) by 2020 and by at least two million AFY by 2030.

The North Bay Water Reuse Authority (NBWRA) is a cooperative program in the San Pablo Bay region that supports sustainability and environmental enhancement by expanding the use of recycled water. The purpose of the NBWRA Program is to provide recycled water for agricultural, urban, and environmental uses thereby reducing reliance on local and imported surface and groundwater and reducing the amount of treated effluent releases to San Pablo Bay. NBWRA has completed a Feasibility Study and an Economic Analysis of Recycled Water Projects for North San Pablo Bay to evaluate water supply alternatives of the NBWRA wastewater agencies that have existing recycled water programs.

The purpose of the NBWRA's Sonoma Valley Recycled Water Project is to reduce the discharge of treated wastewater to the waters of the United States (U.S.), provide recycled water in compliance with federal and state regulations, including Title 22, offset peak water demand in Sonoma Valley, offset groundwater use for potable or agricultural purposes that may be creating stressed aquifer conditions in some areas of Sonoma Valley, and provide a reliable source of water to meet the current and future needs of users located in the Sonoma Valley. The expanded use of recycled water in Sonoma Valley could have significant water supply and environmental benefits from the reduction in discharges to waters of the U.S., reduction of peak potable water demands on the Valley of the Moon Water District and City of Sonoma distribution systems (including Russian River and groundwater supplies), and potential reduction of groundwater pumping for agricultural

and private municipal purposes through the use of recycled water.

The Sonoma Valley County Sanitation District (SVCSD) wastewater treatment facility is located within Sonoma Valley and operates under the jurisdiction of the San Francisco Bay Regional Water Quality Control Board. The SVCSD began operation of this treatment facility in 1953 and its service area encompasses approximately 4,500 acres extending from the unincorporated communities of Glen Ellen in the north to Schellville in the south. During the dry weather months (May through October) the SVCSD currently provides recycled water to users for irrigation of vineyards, dairies, and pasturelands. In addition, SVCSD began supplying recycled water for construction (dust control). The existing users are located in the southern end of Sonoma Valley (southeast of Schellville in the Carneros region, south of Highway 121 and west of Napa River) and to the northwest of SVCSD wastewater treatment facility. The SVCSD continues to implement the Sonoma Valley Recycled Water Project in a cost-effective manner, including the use of existing facilities to the degree feasible.

The 5th Street East and McGill Road Recycled Water Project is a component of the Sonoma Valley Recycled Water Project that will result in 9,420 additional linear feet of 6-inch and 8-inch diameter recycled water pipeline connected to an existing 18" diameter recycled water pipeline and providing up to 200 acre-feet per year of recycled water. This reduces reliance on surface and groundwater supplies, offsets potable water currently being utilized for landscape irrigation, reduces effluent releases to North San Pablo Bay, and provides a drought-proof supply of water approved for irrigation.

Project 6 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Increased Water Supply	The project will increase water supply and reduce potable water demand (Russian River water and groundwater) through the use of recycled water. The project will also improve water supply reliability for the region through the creation of a drought-proof supply that can offset use of potable water supplies for non-potable demands.	This project will provide the following benefits: 2015-2016 – 50 AFY 2017-2064 – 200 AFY 2065-2066 – 150 AFY It is anticipated that if fully constructed, the SVRWP could provide approximately 2,750 AFY of recycled water.
Reduced Fertilizer Use	Recycled water contains a higher amount of nutrients, thus use of fertilizer for landscape and agriculture irrigation is not necessary.	2015-2016 – 3,400 lbs. per year 2017-2064 – 13,600 lbs. per year 2065-2066 – 10,200 lbs. per year
Water Quality Improvement	The project will reduce discharges of treated wastewater to North San Pablo Bay and put the wastewater to beneficial use.	AF of water diverted for irrigation

Project 6 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Recycled water is important given recent water shortages (drought), and water quality issues associated with overdrafting ground and surface water sources. Urbanization has degraded water supply in the Bay Area by taxing the available supply of potable water. Recycled water provides a source of water that is not dependent on weather patterns.
Estimates of no-project conditions in consideration of other planned projects	If this project is not implemented, valuable potable ground and surface water will continue to be used in circumstances where recycled water can be put to beneficial use.
Relation of Project to other Proposed Projects	The two projects identified (5th Street East and McGill Road Recycled Water Pipeline Projects) are sub-projects of the Sonoma Valley Recycled Water Project which is itself a component of the North Bay Water Reuse Program. The North Bay region has very limited surface and groundwater supplies. It is not served by state or federal water projects and the local groundwater basin is showing signs of significant overdraft. Urban, agricultural and environmental demands exceed the region's ability to provide a reliable, sustainable and economical water supply. The project will provide a reliable irrigation supply for landscaping (parks and municipal landscaping) and agriculture (including vineyards and pasture lands), improved instream flows for riparian habitat and fisheries recovery, Reduction in demand on both surface and groundwater supplies, an environmentally responsible alternative to treated wastewater disposal, and Drought Resistance.
Methods used to Estimate Physical Benefits	Measure the volume of recycled water delivered to agricultural and urban users by monitoring flow at WWTP and meters at customer sites.
New facilities, policies, and actions required to obtain the physical benefits	Board approval of Construction contract.
Uncertainty of benefits and contributing factors	N/A
Potential adverse effects	Temporary increase in greenhouse gas emissions during construction.

Table 9 – Annual Benefit: Project 6 – North Bay Water Reuse Program – Sonoma Valley CSD 5th Street East/McGill Road Recycled Water Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2015-2016	Water Supply	AF	0	50	50
2015-2016	Avoided Fertilizer Application [1]	Lbs	0	3400	3400
2017-2064	Water Supply	AF	0	200	200
2017-2064	Avoided Fertilizer Application [1]	Lbs	0	13600	13600
2065-2066	Water Supply	AF	0	150	150
2065-2066	Avoided Fertilizer Application [1]	Lbs	0	10200	10200
Comments: [1] Estimated concentrations of nitrogen, phosphorous, and potassium in lbs per AF of recycled water from the project are 27.2, 13.6, and 27.2, respectively. Total fertilizer concentration is 68 lbs per AF. Commercial values for nitrogen, phosphorous, and potassium fertilizer in dollars per lb are $0.43, $0.73, and $0.30, respectively. The concentration-weighted average commercial value per lb of fertilizer is $0.44.					

References Cited:

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, CA. updated to 2006 using the national fertilizer price index. Updated from 2006 to 2009 based on the Consumer Price Index (CPI).

Brown and Caldwell. 2011. *2010 Urban Water Management Plan*. Prepared for Sonoma County Water Agency.

CDM Smith. 2012 (October). *North Bay Water Reuse Program Phase 2 Project Definition Scoping Study Report.* Prepared for North Bay Water Reuse Authority

Environmental Science Associates (ESA). 2006 (December). *Sonoma Valley Recycled Water Project Final. Environmental Impact Report.* Certified by Sonoma Valley County Sanitation District, 12/06 (SCH# 2005092083). Prepared for the Sonoma Valley County Sanitation District.

Environmental Science Associates (ESA). 2009. *Draft North San Pablo Bay Restoration and Reuse Project Environmental Impact Report/Environmental Impact Statement* (SCH# 2008072096). Prepared for Bureau of Reclamation and North Bay Water Reuse Authority.

Project 8 – Pescadero Water Supply and Sustainability Project

The San Mateo County Service Area 11 (CSA 11) water system provides potable water to approximately 100 households and businesses within the rural, unincorporated Town of Pescadero (Town). CSA 11 was identified as a disadvantaged community in a recent median household income survey conducted by the Rural Community Assistance Corporation (RCAC, 2013). The County of San Mateo Department of Public Works and Parks (County) operates and maintains the CSA 11 water system. Prior to 1993, the Town's water supply was from individual domestic wells, surface water impoundments, and locally derived groundwater from wells installed in the alluvial aquifer of Pescadero and Butano Creeks. In the 1970's and 1980's, it was discovered that these sources contain relatively high concentrations of nitrate, bacteria, and other naturally occurring salts. As a result, the County developed an alternative water source located in an underground aquifer in the Pigeon Point Formation about one mile west of the Town on top of a northwest trending ridge, adjacent to the Pacific Ocean. The CSA 11 water system consists of a production well, standby well, and storage tank, which have been CSA 11's sole source of drinking water and fire protection since 1993.

A recently completed water supply reliability assessment for the CSA 11 water system (HydroScience Engineers, 2013) found the rate of decline in groundwater surface elevation in the vicinity of the CSA 11 wells over the last 10 years to be approximately 0.6 feet per year, estimating well failure to occur by 2020. It was hypothesized in the report that the shallow configuration of the existing wells causes a localized drop in aquifer water levels. To provide a sustainable water supply system for CSA 11, HydroScience Engineers recommended that a deeper well be drilled and an additional storage tank be installed.

Therefore, the County proposes to construct a new 150 gpm municipal water well and 140,000 gallon storage tank to provide adequate water supply, emergency response, water reliability, and some groundwater improvement for the CSA 11 water system. This project would provide a well that accesses a deeper portion of the groundwater aquifer, without increasing the amount of groundwater extracted. The project also includes installation of a new alarm system, which would ensure that the operators are notified in the event of an emergency, pump shutdown, or low tank level. HydroScience Engineers estimated that these facilities would extend the life of CSA 11's water supply for at least the next 50 years and provide a reliable water supply in the event of an emergency. Without this project, the current water supply system for CSA 11 will likely become inadequate within 5 to 7 years. This project also includes implementing a water conservation program for the CSA 11 community, which is needed to reduce water supply demand and further support implementation of a sustainable water supply system.

Project 8 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply Enhancement	The project includes construction a new well and storage tank.	Connections: 100 Well capacity: 150 gpm Storage tank: 140,000 gallons
Water reliability	The project includes construction a new well and storage tank, and upgrades to the existing alarm system. The existing Well 1 will remain in service to provide redundancy. A fully functioning alarm system will serve to notify operators of system issues before a water outage occurs.	Storage tank: 5.5 days of storage, based on 25,500 gpd average Redundancy: 1 standby well (existing Well 1) Alarms: 1 functional system
Groundwater improvement	Reduced pumping from Well 1 aquifer, allowing the groundwater to be recharged over time.	Not quantified
Water conservation	The County wishes to implement a 2-year water conservation program in which either rebates are provided for the purchase and installation of 60 high efficiency toilets/urinals, and 40 washers, or the item and installation costs are provided by the County.	Potential water savings: 2 AFY

Project 8 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Water Supply	
Recent and historical conditions	The existing well draws from a shallow portion of the aquifer that is projected to fail between 2018 and 2020. The water level in the well has been declining steadily over the past 10 years. This may have been a factor in a recent water system outage in 2011. The pump failed unexpectedly, and it is suspected that the water level may have declined past the level of the pump, resulting in the pump pumping too much air and failing. The new well will draw from a deeper portion of the aquifer that has an estimated aquifer life of 50+ years based on current pumping rates of 24 AFY on average and a drawdown of 0.6 feet per year. The new well would be a long term solution for providing water supply to CSA 11 customers in Pescadero.
Estimates of no-project conditions in consideration of other planned projects	Without the project, Well 1 and 2 could fail within 5 years due to lack of water in the aquifer at the existing well locations.
Methods used to Estimate Physical Benefits	The average drawdown rate is based on intermittent well depth readings and top of screen interval readings between 1992 and 2001 and assumptions that the water level will decline linearly in the future.

Project 8 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
New facilities, policies, and actions required to obtain the physical benefits	The new well is recommended to be installed at a well depth of 100 feet below mean sea level in order to access a deeper portion of the aquifer and provide an estimated aquifer life of 50+ years. The new well would have a capacity of at least 150 gpm.
Uncertainty of benefits and contributing factors	The aquifer life and capacity are estimations based on the depth of the future well, existing water demand, and assumed drawdown rate. The actual aquifer life and capacity cannot absolutely be determined without additional pumping tests and well depth data at the deep aquifer.
Potential adverse effects	A new well could locally impact the groundwater levels of the deeper portion of the aquifer due to pumping.
Water Reliability	
Recent and historical conditions	The water system experienced a water outage in 2011 due to a combination of a pump failure at Well 1, alarm failure, lack of adequate water storage, and an unreliable standby well (Well 2). The exact cause of the pump failure could not be determined, however, it is suspected that declining water levels played a role in the pump's failure (see Water Supply discussion above). The alarm system did not notify operators of the low water level in the tank, and eventually the tank was drained of water and lost pressure. The standby well also only provided a fraction of its rated capacity (5-7 gpm out of 30 gpm) which was not sufficient to supply the water demands of CSA 11. The water system had no other form of backup storage to supply CSA 11 with sufficient water until the pump could be replaced, the tank refilled and repressurized, and the water tested for chlorine residual and bacteria (approximately 56 hours). A new well and storage tank used in conjunction with the existing Well 1 and storage tank would provide redundancy and reliability to the CSA 11 water system. Well 1 would serve as a standby well. Both wells would alternate pumping so that the pumps can be exercised and better maintained. The new tank could provide about 5.5 days of additional storage based on an average demand of 25,500 gpd. A new or retrofitted alarm system would also provide timely notification of pump failures or low water levels in the tank, so that backup systems can be put into place before a water outage occurs.
Estimates of no-project conditions in consideration of other planned projects	If the new well, storage tank, and alarm system are not constructed, then the existing water supply will be depleted and result in a water outage. CSA 11 customers would then be left without water for 2 days or more, and would be under boil water orders. As done in 2011, the County would have to provide bottled water, emergency water for fire- fighting purposes, and portable toilets for the residents. Businesses that sell non-packaged food would also have to be shut down until water service is restored, resulting in lost income. The cost of the 2-day water outage in 2011 was $30,420. The cost included a new pump, contractor pump installation, bottle water, portable toilets, bacteriological sampling, and County staff labor and equipment.
Methods used to Estimate Physical Benefits	The water outage timeline was measured based on historical events (2011). The estimated storage time of the tank was based on the volume of the tank (140,000 gallons) and the average water demand of CSA 11 customers (25,500 gallons per day). The cost of the water outage event was obtained from the Public Meeting conducted on 10/19/11 by County staff.
New facilities, policies, and actions required to obtain the physical benefits	A new well, tank, and alarm system is required to obtain water reliability benefits.

Project 8 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Uncertainty of benefits and contributing factors	The reliability of the new well, tank, and alarm system is dependent on proper maintenance and operation of the equipment. The water level in the wells should be monitored regularly (minimum annually) to ensure that the pumps are located at the correct depths for pumping. The alarm system should also be tested monthly to ensure that it is working properly.
Potential adverse effects	Potential short term adverse effects would result from construction of the facilities at the existing disturbed site. Care should be taken to ensure that sensitive species and habitats in the area are not disturbed.
Water Conservation	
Recent and historical conditions	CSA 11 within the Town of Pescadero has no water conservation program in place.
Estimates of no-project conditions in consideration of other planned projects	There would be no change to the existing water demands.
Methods used to Estimate Physical Benefits	A potential water savings of 2 AFY was calculated based on an assumed installation of 60 high efficiency toilets/urinals and 40 high efficiency washers.
New facilities, policies, and actions required to obtain the physical benefits	A water conservation program would be implemented in which CSA 11 customers could receive rebates for replacing older model toilets/washers with high efficiency toilets, urinals, or washers, or receive those items for no cost or low cost. Approximately 60 high efficiency toilets/urinals and 80 high efficiency washers are required to produce a water savings of approximately 2 AFY (or about 11% of the existing water demand).
Uncertainty of benefits and contributing factors	It is uncertain the exact number of high efficiency devices that the County will be able to fund. The estimated savings of 2 AFY also has a degree of uncertainty because it is based on many assumptions such as flush volume, flushes per day, toilets per household, gallons per wash cycle, etc.
Potential adverse effects	None.

Table 9 – Annual Benefit: Project 8 – Pescadero Water Supply and Sustainability Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2014	Water supply	gpm	60	150	90
	Water storage	gallons	140,000	280,000	140,000
	Water conservation	AFY	0	2	2
2015	Same as above				
2016	Same as above				

Est 2018	Water supply	gpm	0	150	150
	Water storage	gallons	140,000	280,000	140,000
	Water conservation	AFY	0	2	2
Last Year of Project Life Est 2064	Water supply	gpm	0	150	150

References Cited:

California Plumbing Code. 2010. "Plumbing Fixtures and Fixture Coverings." Table 4-1. p. 59.

County of San Mateo. 2013. "Conversation with County staff and operators." Personal communication with Carole Foster, January 8, 2013.

County of San Mateo, Department of Public Works. 2011. Pescadero Community Water System (County Service Area No. 11) Public Meeting, October 19. http://www.co.sanmateo.ca.us/publicworks/Divisions/Flood%20Control,%20Lighting,%20Sewer%20and%20Water/Water%20Services/CSA11%2010%2019%202011%20Public%20Meet%20Pres.pdf

East Bay Municipal Utility District. 2002. *Water Conservation Market Penetration Study Final Report*. March. Table 4-2, Table 7-2, Table 7-3, Pg. 7-19. http://www.ebmud.com/sites/default/files/pdfs/market-penetration-study.pdf

HydroScience Engineers, Inc. 2013. Technical Memorandum #1: Water Supply Reliability. Pg. 1-6.

Martin & Heaney. 2008. *BMP 5: Water Use by Urinals*. University of Florida. Pg. 1. library.conservefloridawater.org/publications/15512825.pdf

Pescadero Municipal Advisory Council. 2011. Meeting Minutes September 13, 2011. Item J, K, N.3 Calculated internally using references from East Bay Municipal Utility District. http://pescaderocouncil.files.wordpress.com/2011/10/pmacsept13minutes2011.pdf

San Mateo Local Agency Formation Commission. 2011. Municipal Service Review and Sphere of Influence Update for County Service Area 11 (Pescadero). October 12. http://www.co.sanmateo.ca.us/Attachments/lafco/pdfs/2011_10_19_lafco_agenda_item4.pdf p. 7–10.

Todd Engineers. 2002. *Assessment of Source Water for the Pescadero Water System - CSA 11*. Prepared for Department of Public Works, San Mateo County, California. Pg. 1, 8, 10, 16. http://www.co.sanmateo.ca.us/publicworks/ContentUnassigned/CSA11%20Assessment%20Report%20March%2002.pdf

U.S. Census Bureau. 2012. "San Mateo County, California." Retrieved January 18, 2013 at http://quickfacts.census.gov

Winzler & Kelly Consulting Engineers. 2009. Pescadero Fire Flow Analysis Memorandum. May 1. http://www.co.sanmateo.ca.us/Attachments/lafco/pdfs/lafco_pescadero_comm_fireflow_final_analysis.pdf

Project 11 – Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County

The proposed Regional Groundwater Storage and Recovery Project is part of SFPUC's Water System Improvement Program (WSIP). One of the many goals of the WSIP is to provide over 2.6 million people within the Bay Area with a local supply of water for use in times of drought. By storing water in wet years, when water supply is plentiful, this project will build a water savings account that can be tapped during dry years or in emergency situations, such as an earthquake.

Groundwater pumping from the South Westside Basin over the past half-century has lowered water levels resulting in available storage capacity. The lowering of water levels has since stabilized allowing for the sustainable use of the available storage capacity. The purpose of the Project would be to use the South Westside Basin as an underground reservoir to store water during periods when surface water supply available from SFPUC can be used to offset groundwater pumping by partner agencies, City of Daly City, City of San Bruno, and Cal Water Service Company. This project would also help to prevent sea water intrusion into the local aquifer because groundwater levels would generally be higher on average.

If this project is not implemented, the SFPUC may not be able to meet its dry year water supply demands. Further, the aquifer is more vulnerable to salinity degradation associated with sea water intrusion.

Project 11 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	The project will provide water supply from up to 16 groundwater wells	Amount of water supply produced: up to 7.2 mgd
Water Quality Improvement	Preventing salinity intrusion provides water quality benefits	Not quantifiable
Habitat or Ecosystem Improvement *(Examples Start)*	N/A	N/A
Flood Protection	N/A	N/A
Recreation or Open Space Improvement	N/A	N/A
Greenhouse Gas Reduction	N/A	N/A
Other Physical Benefits	N/A	N/A

Project 11 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	The SFPUC's past experiences with water shortages, due to drought and earthquakes, have helped shape its current plans and policies relative to water shortage preparedness and response: ▪ In 1987-92 San Francisco experienced a serious drought. This 6-year drought provides an example of how various stages of action were taken in times when the operational capabilities of Hetch Hetchy and other water supplies available to the SFPUC were taxed to a point that forced drastic actions to avoid water shortages. ▪ In April 2007, below normal precipitation and snow pack caused the SFPUC to initiate a 10% voluntary reduction in water use in the service area. The call for a voluntary reduction continued through 2009.
Estimates of no-project conditions in consideration of other planned projects	▪ SFPUC would implement only those WSIP facility improvement projects driven by regulatory requirements or existing agreements with regulatory agencies. It would endeavor to meet increasing customer purchase requests through the year 2030 by diverting additional Tuolumne River water only when available under CCSF's existing water rights. The wholesale customers would have to pursue supplemental supply sources and/or conservation measures to make up the supply shortfall/reduced reliability under this alternative. ▪ *Level of Rationing*: Allow for greater than 20% system wide rationing ▪ *Facility projects*: Fewer
Relation of Project to other Proposed Projects	The proposed Groundwater Storage and Recovery Project is part of SFPUC's Water System Improvement Program (WSIP). One of the many goals of the WSIP is to provide over 2.6 million people within the Bay Area with a local supply of water for use in times of drought. By storing water in wet years, when water supply is plentiful, this project will build a water savings account that can be tapped during dry years or in emergency situations, such as an earthquake. The Regional Groundwater Storage and Recovery Project will fulfill the drought-year water supply for the regional system.
Methods used to Estimate Physical Benefits	Luhdorff and Scalmanini estimated the amount of storage capacity in the aquifer to be 60,500 acre-feet. The gallons/day combined capacity of the wells is 7.2 mgd.
New facilities, policies, and actions required to obtain the physical benefits	The project requires 16 wells and 16 associated well stations to obtain the physical benefits. Wells will consist of the dug well, up to 800 feet in depth as well as the well-casing. Well stations will vary from well site to site, but can include fencing, a building with the pump, piping, associated electrical controls, and rooms with treatment facilities. Water treatment in the building can require up to 5 rooms with these different functions: 1. Combined mechanical and electrical room 2. Ammonia chemical room 3. Chlorination room 4. Fluoridation chemical room 5. Iron/manganese removal room The project will also require pipelines to deliver the treated groundwater to the distribution system.
Uncertainty of benefits and contributing factors	N/A
Potential adverse effects	N/A

Table 9 – Annual Benefit: Project 11 – Regional Groundwater Storage and Recovery Project Phase 1A - South Westside Basin, Northern San Mateo County					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2017-2066	Water Supply	AF	0	1,820	1,820

References Cited:

Berkeley Economic Consulting, Inc. 2010. *Residential Losses from Urban Water Shortages in California*. Prepared for California Urban Water Agencies. July 7.

City and County of San Francisco, San Francisco Planning Department. 2008. *Final Program Environmental Impact Report for the San Francisco Utilities Commission's Water System Improvement Program*. Volume 3, Section 5.6; Volume 4, Section 9.2, Table 9.3.

Kennedy/Jenks Consultants. 2010. *Final Feasibility Study for Developing an Alternative Water Supply for Golf Course Irrigation*. Prepared for December 22.

Luhdorff and Scalmanini. 2004. *Update on the Conceptualization of the Lake-Aquifer System, Westside Ground-Water Basin, San Francisco and San Mateo Counties. Exploratory Drilling and Well Construction Conceptual Model Components, Lake Merced Water Additions In-Lieu Recharge Demonstration Aquifer Testing*. Prepared for SFPUC. P. ES-8, bottom section. http://sfwater.org/Modules/ShowDocument.aspx?documentid=3095

Luhdorff and Scalmanini. 2005. *Results of In-Lieu Recharge Demonstration Fall 2002 Through Spring 2005 Westside Basin Conjunctive Use Pilot Project*. Prepared for SFPUC. October. Page 2 mentions the approximate amount of storage in the basin. http://sfwater.org/Modules/ShowDocument.aspx?documentid=3093.

MWH, Inc. 2008. *San Francisco Public Utilities Commission Water System Improvement Program Groundwater Conjunctive Use Project - WSIP Project CUW30103 - Conceptual Engineering Report*. For SFPUC. November. Section 2.2, Table 2-2, page 2-3

SFPUC. 2011. *2010 Urban Water Management Plan for the City and County of San Francisco*. June. Section 5.4.1, p. 57. http://www.sfwater.org/Modules/ShowDocument.aspx?documentID=1055

SFPUC. 2013. *Regional Groundwater Storage and Recovery (WSIP)*. 3rd paragraph. http://www.sfwater.org/bids/projectDetail.aspx?prj_id=309

Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County

This section presents the physical benefits and technical justification of Project 13. The physical benefits include reduction in water supply loss/waste and a reduction in energy use. The technical justification for the new water storage tank sizes was determined to meet the Santa Clara County Fire Marshal's current standards. The Santa Clara County Fire Marshal's current standards are:

- Fire protection water shall be 1500 gallons per minute for 30 minutes for homes sized 3,600–10,000 square feet (Page 3, Section II, B, 2a)
- Fireflow shall be for 2 hours for (new) subdivisions, regardless of the size of the proposed or existing structures (Page 7, Section IV, C).
- Major Residential Subdivision: A division of land into five or more lots zoned for residential use (Page 1, Definitions)

Project 13 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	Reduction in water supply losses will increase water supplies for customers and reduce amount of CA imported water used.	Estimated 25% decrease in water waste. Additional 4,500ccf/3.4 MG/10AF per year of saved/added supply. Cost savings of $13,000/year @ $2.70/ccf
Habitat or Ecosystem Improvement	N/A	
Flood Protection	N/A	
Recreation or Open Space Improvement	N/A	
Greenhouse Gas Reduction	Reduction in energy use due to reduced pumping needs.	Calculated 25% reduction in kWh used. 9,500kWh/ year = $2,000/yr. @ $0.20/kWh
Fire Suppression Capability	N/A Moved to non-monetized	
Catastrophic failure prevention	N/A Moved to non-monetized	

Project 13 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Water Supply Benefits	
Recent and historical conditions	Exiting water infrastructure is outdated and susceptible to failure and the cause of water leakage/waste.
Estimates of no-project conditions in consideration of other planned projects	Status quo -
Relation of Project to other Proposed Projects	None
Methods used to Estimate Physical Benefits	Multi-year usage analysis comparing water purchased from San Jose Water Company versus water quantities billed to RHMWC customers. Also comparisons of water amounts before & after temporary repair performed on main source of leakage.
New facilities, policies, and actions required to obtain the physical benefits	Bolted steel water storage tanks to be installed.
Uncertainty of benefits and contributing factors	None
Potential adverse effects	Possibility of stagnant water in low water usage periods.
Greenhouse Gas Benefits	
Recent and historical conditions	Prevention of excess energy use from water pumping to overcome historical water leak rate.
Estimates of no-project conditions in consideration of other planned projects	Status quo
Relation of Project to other Proposed Projects	None
Methods used to Estimate Physical Benefits	Multi-year kWh usage analysis of PG&E billing and records. Also comparisons of kWh used before & after temporary repair performed on main source of leakage.
New facilities, policies, and actions required to obtain the physical benefits	Bolted steel water storage tanks to be installed.
Uncertainty of benefits and contributing factors	None
Potential adverse effects	Increased greenhouse gas emissions during construction.

Table 9 – Annual Benefit: Project 13 – Roseview Heights Infrastructure Upgrades for Water Supply and Quality Improvement, Santa Clara County					
(a)	(b)	(c)	(d)	(e)	(f)
Year	**Avoided Residential Structure EAD**	**Avoided Residential Water Shortages EAD**	**Avoided Water Purchases**	**Avoided Energy Purchases**	**Total Annual Benefit**
2012					$0
2013					$0
2014					$0
2015	$28,000	$20,549	$12,995	$1,929	$63,472
2016	$28,000	$20,549	$13,361	$1,929	$63,838
2017	$28,000	$20,549	$13,738	$1,929	$64,215
2018	$28,000	$20,549	$14,125	$1,929	$64,602
2019	$28,000	$20,549	$14,523	$1,929	$65,001
2020	$28,000	$20,549	$14,933	$1,929	$65,410
2021	$28,000	$20,549	$15,354	$1,929	$65,831
2022	$28,000	$20,549	$15,787	$1,929	$66,264
2023	$28,000	$20,549	$16,232	$1,929	$66,709
2024	$28,000	$20,549	$16,690	$1,929	$67,167

References Cited:

EPA. 2006. *Initial Distribution System Evaluation Guidance Manual for the Final Stage 2 Disinfectants and Disinfection Byproducts Rule*. Page 150.

Roseview Heights Mutual Water Company. 2013. *Water and Power Usage 1999, 2004–2012*. Prepared by Tim Schacher, Board President. January 19.

San Jose Water, PG&E, and Roseview Heights Mutual Water Co. 2012. Typical Roseview User Invoice Showing Reserve & Maintenance Fees.

Santa Clara County Fire Marshal's Office. Rev. 2010. *Standard Details & Specifications: Fire Protection Water Supplies for One and Two Family Dwellings and Associated Structures*. Spec. No. CFMO-W1.

Project 15 – San Francisco International Airport Reclaimed Water Facility

Repeated droughts and rising potable water prices have created the need to conserve water and reduce dependence on water supplies from Hetch Hetchy. The San Francisco International Airport Reclaimed Water Facility will produce up to 0.65 MGD of recycled water which will be used for irrigation, cooling towers, and non-potable reuse in terminal restrooms. This will significantly reduce the overall amount of potable water that the airport currently uses from the Hetch Hetchy, while also reducing the drought vulnerability of the airport. Additional benefits of this project include a reduction of pollutant loading to the bay, because of a reduced volume of waste water that will be sent to the bay. This will have benefits to local wildlife in the area, including several species of fish.

Project 15 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	The project will reduce non-potable water demand through reuse of recycled wastewater.	0.65 MGD of potable water supply saved, with annual increase of 0.01 MGD every year.
Water Quality Improvement	First flush storm water will be treated to a higher quality, which will positively increase the water quality effluent released to the bay.	Treat as much as 1.7 MGD of storm water during wet events. Offset as much as 1.0 MGD of effluent entering the bay through recycling water. Potentially remove and treat as much as 253.2 kg of TSS per day during heavy rain events. Potentially remove as much as much as 4.08 kg of Ammonia per day during heavy rain events.
Habitat or Ecosystem Improvement	A reduction of copper and ammonia entering the bay, which has adverse health effects to local fish populations	Longfin smelt and Delta smelt will benefit from having an increase in both quantity and quality of wastewater effluent. The populations of these fish have been estimated to be less than 100. Potentially remove and treat as much as 0.16 kg of copper per day during heavy rain events. Potentially remove and treat as much as 4.08 kg of ammonia per day during heavy rain events.
Flood Protection	N/A	
Recreation or Open Space Improvement	N/A	
Greenhouse Gas Reduction	N/A	
Other Physical Benefits	N/A	

Project 15 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Existing water infrastructure is outdated and susceptible to failure. New infrastructure will be less likely to break.
Estimates of no-project conditions in consideration of other planned projects	Aside from initial savings in capitals costs and avoidance of land disturbance, there are no foreseeable benefits for a no-project condition.
Relation of Project to other Proposed Projects	A separate pipeline project is being built in congruence with this project. This pipeline will deliver the water to the Terminals.
Methods used to Estimate Physical Benefits	Cost-Benefit Analysis
New facilities, policies, and actions required to obtain the physical benefits	See the project description in Attachment 3.
Uncertainty of benefits and contributing factors	These repairs are known and will be implemented using well-studied designs and methods.
Potential adverse effects	Temporary effects during project construction.

Table 9 – Annual Benefit: Project 15 – San Francisco International Airport Reclaimed Water Facility					
(a)	(b)	(c)	(d)	(e)	(f)
Year	Type of Benefit	Measure of Benefit (Units) [1]	Without Project	With Project	Change Resulting from Project (e) – (d)
2017	Water Supply	AF	0	728.1	728.1
2018	Water Supply	AF	0	739.3	739.3
2019	Water Supply	AF	0	750.5	750.5
2020	Water Supply	AF	0	761.7	761.7
2021	Water Supply	AF	0	772.9	772.9
2022	Water Supply	AF	0	784.1	784.1
2023	Water Supply	AF	0	795.3	795.3
2024	Water Supply	AF	0	806.5	806.5
2025	Water Supply	AF	0	817.7	817.7
2026	Water Supply	AF	0	828.9	828.9
2027	Water Supply	AF	0	840.1	840.1
2028	Water Supply	AF	0	851.3	851.3
2029	Water Supply	AF	0	862.5	862.5
2030	Water Supply	AF	0	873.7	873.7
2031	Water Supply	AF	0	884.9	884.9
2032	Water Supply	AF	0	896.1	896.1
2033	Water Supply	AF	0	907.3	907.3
2034	Water Supply	AF	0	918.5	918.5
2035	Water Supply	AF	0	929.7	929.7
2036	Water Supply	AF	0	940.9	940.9
2037	Water Supply	AF	0	952.1	952.1
2038	Water Supply	AF	0	963.3	963.3
2039	Water Supply	AF	0	974.5	974.5
2040	Water Supply	AF	0	985.7	985.7
2041	Water Supply	AF	0	996.9	996.9

References Cited:

CH2M Hill. 2012. “Technical Memorandum 3.” pg. 1.

CH2M Hill. 2012. “Technical Memorandum 4.”

CH2M Hill. 2012. “Technical Memorandum 5.” pg. 6.

Department of Public Works Bureau of Engineering. 2009. *San Francisco International Airport Recycled Water Project Alternatives Analysis Report*. Prepared for San Francisco Airport Commission. June 15. pg. 2-3 and Figure 7.3.

Water Quality

Project 14 – San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing

According to the 2011 Bay Conservation and Development Commission Study, *Living with a Rising Bay*, at least 22 wastewater treatment plants around San Francisco Bay are vulnerable to the effects of sea level rise over the next century. Scientists and wastewater treatment plant managers have been grappling with a long list of questions as to how to respond to this challenge: Can resiliency to sea level rise be designed into ongoing infrastructure renewal? What solution meets potentially dueling objectives of property protection and habitat protection? How do we respond to growing concerns over hormonally active/trace pharmaceutical pollutants and increasing nutrient levels in the Bay? How can we reduce the energy footprint of wastewater treatment and control costs?

The project seeks to test and provide a 'proof of concept' for a potential answer to these problems: constructing an ecotone slope along the side of an equalization facility. The ecotone slope has the potential to provide a resilient barrier to sea level rise, provide an upland refuge and transition zone for wildlife of all forms, and provide wastewater effluent polishing for problematic trace pharmaceuticals, nutrients, and contaminants of emerging concern. These potential benefits are provided with a modest cost, low energy, and environmentally sound green infrastructure concept.

Additionally, constructing an ecotone slope in San Leandro restores a type of moist grass meadow that dominated the SF Bay landscape prior to widespread dyking and channelization of stream runoff. Moist grassland/bayland ecotone, have been identified by resource agencies as a high priority for restoration and conservation.

Project 14 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Habitat or Ecosystem Improvement	The project will create upland habitat including a diverse palette of native plants, mixing with more salt-tolerant species near the upper tidal edges. This ecotone will provide important seasonal terrestrial habitat for nesting mallards and the endangered salt marsh harvest mouse.	10 acres of habitat restored, including 2.4 acres of rare native moist grassland/baylands ecotone.
Water Quality Improvement	One percent of the treated effluent (36.5 million gallons per year) will be routed through the treatment wetland and ecotone slope for further polishing and denitrification. Planted wetland vegetation and soil amendments will improve the quality of Stormwater runoff from the San Lorenzo/San Leandro Industrial Park.	36.5 Million Gallons per year of effluent polishing. With the project, total Nitrogen levels are expected to be reduced to near 1 mg/L, depending upon the rate of flow through the ecotone. The project team also expects significant reductions in trace pharmaceuticals and other consumer products. Approximately 20 Million Gallons per year of stormwater from the San Lorenzo/San Leandro Industrial Park will be routed to and treated in the ecotone. The Industrial Park includes distribution warehouses, several manufacturing facilities, food production facilities, and an industrial material recovery facililty.

Project 14 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Parcel contains an existing stormwater easement. Stormwatershed includes the San Leandro/San Lorenzo Industrial Park. Existing 10 acre Parcel contains 2.2 acres of designated wetlands. Wetlands will be retained and the balance of the parcel will be transformed into available habitat.
Estimates of no-project conditions in consideration of other planned projects	The no project alternative would first result in the consideration of a conventional, deep, concrete basin. However, the estimated cost of this type of basin is $16,000,000. Given that this cost exceeds the present worth of the ongoing EBDA savings and reduced capital expense associated with a smaller nutrient process, the District would simply construct the larger nutrient removal facility to treat peak flows at an additional cost of $7,080,725. The no project alternative would also result in the loss of wildlife habitat in the natural wetland system and the Bay Area will lose time in exploring a promising adaptation to sea level rise.
Relation of Project to other Proposed Projects	If the pilot project proves as successful as expected, the project will open the door for implementation in the greater Bay Area and State.

Project 14 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Methods used to Estimate Physical Benefits	This is a pilot project to implement recommendations identified in research studies on sea level rise. See references cited.
New facilities, policies, and actions required to obtain the physical benefits	See project description in Attachment 3.
Uncertainty of benefits and contributing factors	A detailed monitoring effort, with public distribution of monitoring results, will identify the level of benefits achieved and contribute to future project designs.
Potential adverse effects	Temporary impacts during project construction.

Table 9 – Annual Benefit: Project 14 – San Francisco Bay Climate Change Pilot Projects Combining Ecosystem Adaptation, Flood Risk Management and Wastewater Effluent Polishing					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2017-2066	Restored Wetland/Upland Habitat	Acres	2.2	10.0	7.8

References Cited:

ESA PWA and Peter Baye. 2012. *Oro Loma Wet Weather Equalization, Treatment Wetland and Ecotone Demonstration Project, Initial Feasibility Study*. July 29, 2012.

San Francisco Bay Conservation and Development Commission (BCDC). 2011. *Staff Report: Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline*. October 6, 2011.

Project 16 – San José Green Streets & Alleys Demonstration Projects

By reducing and/or treating stormwater runoff, the San José Green Streets & Alleys Demonstration Projects will improve surface water quality due to decreased pollutant loading associated with urban runoff (e.g. by reducing pollution to the Bay during dry weather flows and treating dry weather polluted stormwater prior to discharge to the Bay). In addition, the volume, duration, and frequency of flows associated with stormwater discharges will be reduced. Reduced stormwater runoff will not only improve surface water quality but will also result in improved habitat for many sensitive species. The extent of water quality improvements due to the pilot projects is unknown. However, water quality constituents commonly found in urban runoff include trash, oil and grease, metals, polycyclic aromatic hydrocarbons (PAHs), bacterial contaminants, inorganic forms of nitrogen and phosphorous, sediment, and pesticides.

The USEPA supports LID stormwater practices and finds that by implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions. LID has been characterized as a sustainable stormwater practice by the Water Environment Research Foundation and others (USEPA, 2013).

The Natural Resources Defense Council finds that LID approach to stormwater management provides multiple benefits. LID techniques reduce pollution and erosion problems generated by urban runoff at the source and provides important environmental benefits by reducing pollution of downstream rivers, lakes, and coastal waters. Furthermore, NRDC has found that LID techniques can deliver water and energy savings for California and that LID approach to stormwater management enables cities, states, and individuals to increase access to safe and reliable sources of water while reducing the amount of energy consumed and global warming pollution generated by supplying water (Natural Resources Defense Council, 2009).

International Stormwater Best Management Practices (BMP) Database project website, which features a database of over 500 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications. This project has provided scientifically sound information about the design, selection and performance of some of the LID BMPs included in the project (International Stormwater BMP Database, 2012).

Under the San Francisco Bay Municipal Regional Permit (MRP), the Regional Water Quality Control Board is requiring municipalities to develop 10 Green Street Pilot Projects and implement Low Impact Development at 100% of new development projects. The Permit also requires municipalities to implement pilot projects to divert dry weather and first flush stormwater flows to POTWs to address these flows as a source of PCBs and mercury to the Bay. While all the costs of compliance with the MRP have not fully been determined, the costs for not complying with the permit could include fines from the Regional Water Quality Control Board, in addition to the costs of eventually coming into compliance.

The project's green infrastructure components improve urban aesthetics and community livability. Several empirical studies show that property values are higher when trees and other vegetation are present in urban neighborhoods. For example, a study conducted by Stratus Consulting (based on existing literature) estimated that a city-wide GI program in Philadelphia would increase residential property values for

properties located near GI retrofit projects by 2.5%, on average. When applied city-wide to all project areas, the estimated value of enhanced residential property values was over $1.1 billion (Stratus Consulting 2008).

Through the implementation of green infrastructure and rain gardens, the these projects have the potential to increase urban aesthetics, which in turn, will increase the value of properties located near the proposed projects. Without a more extensive study on the effect of green infastructre on current property values, these benefits are difficult to quantify.

Green space and reflective or light colored pavements help lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling. Reduced energy demands in buildings, and increased carbon sequestration by added vegetation, also result in a lower carbon footprint (reduced CO2 emissions).

Project 16 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	N/A	
Water Quality Improvement	Providing biotreatment and infiltration facilities along roadway segments where treatment would not otherwise be provided. The treatment measures will improve the quality of Stormwater runoff from paved urban areas. By lining the reconstructed alleyways with porous pavers and an infiltration trench, the green infrastructure improvements will capture rain water and eliminate runoff from the alleys and adjacent impervious areas.	Chynoweth Project: Approximately 11,000 square feet of biotreatment areas. Treating approximately 35,000 square feet of impervious surface (existing pavement and sidewalk, and new sidewalk). Project also includes approximately 4,400 square feet of permeable pavers, stormwater permit required treatment volume for 35,000 square feet of impervious area including existing pavement, sidewalk, and new sidewalk is equivalent to treating 300,000 gallons of stormwater with potential pollutants such as metals (lead, zinc, copper), hydrocarbons, oil and grease. Green Alleys Project: The infiltration trenches and alleys will be designed to store and infiltrate 80% of the annual runoff volume from at least a 2.5 acre tributary area. This is estimated to result in infiltration of more than 699,500 gallons of stormwater annually.
Habitat or Ecosystem Improvement	N/A	
Flood Protection	N/A	
Recreation or Open Space Improvement	N/A	
Greenhouse Gas Reduction	N/A	

Project 16 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Other Physical Benefits	N/A	

Project 16 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Recent water shortages, loss of habitat or ecosystem function, water quality issues. Urbanization has degraded water quality in the Bay Area
Estimates of no-project conditions in consideration of other planned projects	Urbanization has degraded water quality in the Bay Area. Region-wide, municipal agencies are required to comply with stormwater treatment and runoff reduction permit requirements.
Relation of Project to other Proposed Projects	Other similar projects are proposed for the region. These projects are demonstration pilot projects.
Methods used to Estimate Physical Benefits	Documented studies and direction from federal and state agencies. See references cited.
New facilities, policies, and actions required to obtain the physical benefits	See proposed project description in Attachment 3.
Uncertainty of benefits and contributing factors	Monitoring and restorative action plans will ensure project success.
Potential adverse effects	Temporary impacts on traffic during project construction.

Table 9 – Annual Benefit: Project 16 – San Jose Green Streets and Alleys Demonstration Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2015-2039	Stormwater and Dry Weather Nuisance Runoff Treatment Capacity	Gallons	0	300,000	300,000

References Cited:

EPA. 2013. "Low Impact Development (LID)." http://water.epa.gov/polwaste/green/index.cfm

International Stormwater BMP Database. 2012. *Urban Stormwater BMP Monitoring Manual*. http://www.bmpdatabase.org/

Natural Resources Defense Council. 2009. *A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century*. August. http://www.nrdc.org/water/lid/

Project 19 – Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds

STRAW's restoration work directly addresses the environmental issues in the San Francisco Bay Area from development impacts such as polluted storm runoff, loss of habitat, erosion and sedimentation problems, invasive species, increased flood severity and decreased biodiversity (Monroe et.al. 1999). Engaging educated and inspired students and community members to create a minimum of 15,000 linear feet of restored stream habitat annually will provide the critical benefits of water quality improvement, stormwater management improvement, infiltration, habitat restoration and flood protection. Restored waterways provide (1) lasting flood protection through flood prevention design practices that maximize native vegetation while removing/discouraging species prone to channel blockage, and (2) storm water treatment improvements through filtration by established native vegetation.

Restoring degraded ecological conditions has been identified as a strategy for preparing for climate change (U.S. EPA, 2012). The restoration of riparian areas has been specifically identified because it can enhance connectivity, provide thermal refugia, and build upon existing resiliency (Seavy, 2009). The implementation of STRAW's "climate smart" designs will ensure that these projects will be as robust and resilient as possible and will provide the opportunity to educate land managers, public agencies, and the general public about the importance of these projects as a successful and concrete means of adapting to climate change.

Project 19 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	N/A	
Water Quality Improvement	Functioning riparian corridors will filter incoming storm water, reducing temperature and concentrations of sediment, nutrients, metals and other contaminants. Planted wetland and riparian vegetation will improve the quality of stormwater runoff from urban areas. Restoration of 15,000 ft. of stream with approximately 0.5 cfs flow will provide the treatment equivalent of a stormwater treatment plant designed to treat 1.2 million gallons of runoff per day.	A storm water treatment plant valued at approximately 4.2 million dollars would be necessary to treat the equivalent amount (1.2 million gallons daily) of runoff.
Habitat or Ecosystem Improvement	STRAW restoration projects will create new habitat in denuded and degraded areas. This funding will result in a minimum of 17 acres of new habitat, based on a minimum of 15,000 linear feet with a 50 ft. average width.	Approximately 17 acres of newly created riparian and wetland habitat will be created, with an approximate value of $5457 annually in perpetuity. This is based on a composite value per acre of $321.00, derived from the values for these habitat types presented in the cited handbook.
Flood Protection	N/A	

Project 19 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Recreation or Open Space Improvement	N/A	
Greenhouse Gas Reduction	N/A	
Other Physical Benefits	N/A	

Project 19 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Water Quality – Over the last 200 years, urbanization has had a detrimental effect on the Bay Area's water quality. Increases of impervious surfaces and storm-water re-routing into storm drains and detention basins has changed the timing and duration of peak stream flows. This modified hydrology has been shown to cause flashier flow regimes (Chadwick 2006) and negatively affect water chemistry (Morse et.al. 2003). In conjunction with the loss of riparian and wetland habitat, this altered hydrology has diminished the capacity of many Bay Area streams to sequester concentrations of sediment, nutrients, heavy metals and other contaminants. Habitat or Ecosystem Improvement – Over the last 200 years, ecosystems in the San Francisco Bay Area have experiences dramatic declines in area and function, and is one of the most modified estuaries in the United States (Monroe et.al. 1999). In addition, although riparian habitat is considered to be critical to ecosystem integrity and function, it has been in a steady decline over the past 150 years (RHJV 2000).
Estimates of no-project conditions in consideration of other planned projects	N/A – There will be no project activity in absence of ours
Relation of Project to other Proposed Projects	N/A
Methods used to Estimate Physical Benefits	Water Quality and Habitat or Ecosystem Improvement – Project dimension measurements, monitoring protocols cited
New facilities, policies, and actions required to obtain the physical benefits	See proposed project description in Attachment 3.

Project 19 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Uncertainty of benefits and contributing factors	Water Quality and Habitat or Ecosystem Improvement – The level of uncertainty for these projects is quite low. STRAW has been successfully implementing professional quality habitat restoration projects for over 20 years. Over 400 projects have been completed to date. We have the unique ability to implement multiple projects in conjunction with extensive monitoring data, which allows us to constantly fine-tune project design and implementation practices to maximize success. The references cited assess the positive success of projects over the long-term as well. Habitat or Ecosystem Improvement – The acreage estimations for this project could be considered overly conservative in that we are only calculating directly treated acreage. There are a lot of available multipliers for a restoration's potential to enhance and influence a larger area, but we have not found one that was supported enough in the literature. Water Quality Improvements - For the water quality calculations, there is possible uncertainty in the total cost of an adequately-sized storm water treatment plant, in that the value was extrapolated linearly from the cited study using 4000 linear feet. A larger storm water treatment facility might not cost as much due to economies of scale.
Potential adverse effects	N/A

Table 9 – Annual Benefit: Project 19 - Students and Teachers Restoring a Watershed (STRAW) Project—North and East Bay Watersheds					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2020-2049	Stormwater and Dry Weather Nuisance Runoff Treatment Capacity	Gallons	0	87,600,000	87,600,000
2016-2045	Riparian Habitat Restoration	Acres	0	17	17

References Cited:

Chadwick, M.A., D.R. Dobberfuhl, A.C. Benke, A.D. Huryn, K. Suberkropp, and J.E. Thiele. 2006. "Urbanization Affects Stream Ecosystem Function by Altering Hydrology, Chemistry, and Biotic Richness." *Ecological Applications*. 16(5): 1796-1807.

ECONorthwest. 2012. *Handbook for Estimating Economic Benefits of Environmental Projects*. December.

Lennox, M., N. Scolari, and D. Lewis. 2010. *Riparian Zone Monitoring Plan* (RZMP). Prepared by University of California Cooperative Extension for Marin Resource Conservation District, Point Reyes Station CA. 75 p. http://cesonoma.ucanr.edu/files/76316.pdf.

Monroe, et al. 1999. *Goals Project. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project.* U. S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, Calif. http://www.sfei.org/node/2123

Morse, C.C., A.D. Huryn, and C. Cronan. 2002. "Impervious Surface Area as a Predictor of the

Effects of Urbanization on Stream Insect Communities in Maine, U.S.A." *Environmental Monitoring and Assessment*. 89: 95-127.

Riparian Habitat Joint Venture (RHJV). 2000. *The Riparian Bird Conservation Plan: A strategy for reversing the decline of riparian associated birds in California*. Version 1.0. California Partners in Flight. http://www.prbo.org/calpif/pdfs/riparian_v-2.pdf

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin and D.F. DeSante. 1993. *Handbook of field methods for monitoring landbirds*. USDA Forest Service General Technical Report PSW-GTR-144**.**

Seavy, N. E., and T. Gardali. 2012. "Developing a riparian bird index to communicate restoration success in Marin County, California." *Ecological Restoration* 30:157-160.

Riley, et al. 2009. *Putting a Price on Riparian Corridors as Water Treatment Facilities*. The San Francisco Bay Water Quality Control Board in conjunction with the Economics Division of the Department of Water Resources. http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/watershed/Riley_2009.pdf

Songbird Response to Riparian Restoration on Marin County Ranches, PRBO Conservation Science Unpublished Data.

University of California Cooperative Extension. 2010. *Riparian Zone Monitoring Plan* (RZMP). Prepared for Marin Resource Conservation District. August. http://cesonoma.ucanr.edu/files/76316.pdf.

University of California Cooperative Extension, County of Sonoma. 2001. *Riparian Revegetation Evaluation on California's North Coast Ranches*. June. http://cesonoma.ucanr.edu/files/27406.pdf

Habitat Restoration

Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Project

This project is an element of MMWD's Lagunitas Creek Stewardship Plan and it is an important recovery action in the State's Recovery Strategy for CA Coho Salmon and the federal Recovery Plan for Central CA Coastal Coho Salmon. Lagunitas Creek supports the largest and most stable population of endangered coho salmon in Central California; it also supports a robust population of threatened steelhead trout. These plans call for reducing sedimentation into Lagunitas Creek and improving fish passage.

The recently completed Lagunitas Creek roads assessment (Stetson Engineers 2012, for MMWD) has identified the crossings along the Cross Marin Trail as some of the largest potential sediment loads to Lagunitas Creek and some of the highest priority crossings to implement repairs on.

Sedimentation, particularly by fine sediments, has been identified as being detrimental to the habitat of Lagunitas Creek for coho and steelhead. The State Water Resources Board has identified Lagunitas Creek as being impaired by sediment and is in the process of preparing a sediment TMDL for Lagunitas Creek.

The Department of Fish and Game/Wildlife has conducted habitat assessments of the tributary streams to Lagunitas Creek where this project will be implemented; specifically, they evaluated the streams at the Jewell Creek and Eucalyptus sites. They have recommended managing these streams for anadromous salmonids (including facilitating fish passage) and they observed steelhead in the Jewell Creek tributary. Winter refuge habitat can also be enhanced in these tributaries.

This project will implement actions aimed at reducing fine sediments from entering the creek, leading to enhanced water quality and streambed conditions of Lagunitas Creek; it will also improve fish passage in the streams and enhance winter refuge habitat.

Project 3 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	Benefit of water supply reliability from stabilizing water transmission pipeline route(s). One site is currently facing imminent failure, showing signs of failure (culvert collapsing, mass wasting of fill in stream crossing). Others are at high risk. All are undersized and at risk of plugging and catastrophic failure. Replacement reduces chance of catastrophic failure to near zero.	▪ Avoided costs associated with a potential catastrophic failure ▪ Avoided costs associated with currently ongoing maintenance and repair ▪ Value of water lost from failure
Water Quality Improvement	Chronic and catastrophic sediment inputs to Lagunitas Creek will be prevented as a result of culvert replacement and other proposed treatments. Benefit of improved water quality through reduced turbidity from reduced fine sediment loading. Improved benefit from sedimentation of creek.	▪ Avoided costs of sediment deposition (4,193 cubic yards over 10 years) ▪ Reduced compliance costs for TMDLs
Habitat or Ecosystem Improvement	Stream crossing improved with natural bottom arched culvert will allow Coho salmon and steelhead access to tributary streams. Benefits of improved instream habitat for listed salmonids from reduced sediment loading into the creek; increased populations.	Coho salmon, steelhead, and freshwater shrimp are listed species in the project. Expected economic benefits: ▪ Spawning and rearing habitat improved in mainstem of Lagunitas Creek. ▪ 2,375 lineal feet of spawning and rearing habitat in tributary streams will become available. ▪ Winter refuge
Flood Protection	N/A	N/A
Recreation or Open Space Improvement	Project will repave sections of bike path. Benefit to recreation and recreational users from greater stability and reliability of unpaved roads, for hikers, cyclists, and equestrians; reduced potential for trail closures; increased safety to recreational users as potential for catastrophic failure is repaired.	▪ Maintenance and repair costs avoided on failing crossing. ▪ Avoided cost or replacing bike path ▪ Avoided cost of no use due to catastrophic failure
Greenhouse Gas Reduction	N/A	N/A
Other Physical Benefits	N/A	N/A

Project 3 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	**Water Supply:** MMWD's Nicasio Transmission Line (NTL) is a major water transmission pipeline, moving raw water from Nicasio Reservoir to the San Geronimo Treatment Plant, whence treated drinking water is provided to MMWD's service area. In the project area, the path of the NTL follows alongside Lagunitas Creek, and is crossed by numerous culverted tributaries draining to Lagunitas Creek. The stability of this major transmission line is threatened by potential catastrophic failure of these tributary culverts, extreme instances of which could wash out the earth supporting the pipeline and lead to collapse of the pipeline. Climate change forecasts suggest increased severity of extreme events suggesting risk may be climbing. Replacing these undersized and failing culverts would contribute to water supply reliability by stabilizing the water transmission pipeline route. **Water Quality:** Sedimentation, particularly deposition of fine sediment, has been identified as detrimental to water quality in Lagunitas Creek. The State is currently developing sediment TMDL for Lagunitas Creek. This project will provide a benefit of improved water quality through reduced turbidity and improved spawning habitat for salmonids in Lagunitas Creek.
Estimates of no-project conditions in consideration of other planned projects	**Water Supply:** There are no other planned projects that would result in these water supply benefits. **Water Quality:** Levels of physical benefit that may occur in the future without the project. This project includes treatment at a subset of sites identified in previous studies, *and e*ach site treated will yield separate and stand-alone benefits. The work included in this project will reduce chronic and catastrophic sediment inputs by 4,193 cubic yards. The "no project" conditions are that these levels of sediment inputs would continue unabated.
Relation of Project to other Proposed Projects	This project includes treatment at a subset of sites identified in previous studies, including the pending Lagunitas Creek Unpaved Roads Sediment Source Site Assessment, which recommends treating 300 sites throughout the greater Lagunitas Creek watershed estimated to cost approximately $2.84 million (not including utilities and recreational amenities). Each site treated will yield separate and stand-alone water supply reliability/security benefits. The work included in this project constitutes approximately 2 of 9 sites rated in highest risk category and 2 out of 3 directly associated with the NTL and the mainstem of Lagunitas Creek.
Methods used to Estimate Physical Benefits	• Sediment estimates were those from a comprehensive road related sediment assessment on Lagunitas Creek Watershed for all watershed lands downstream of reservoirs and in areas not previously surveyed. Field based surveys were accomplished on every unpaved road in the watershed lands based on previous unpaved road inventory • TMDL compliance costs estimated based on following assumed requirements: costs for baselines studies, costs for ongoing monitoring, and watershed mitigation measures.
New facilities, policies, and actions required to obtain the physical benefits	Construction of the proposed treatments at project sites, including installation of arched and standard culverts.
Uncertainty of benefits and contributing factors	N/A
Potential adverse effects	N/A

Table 9 – Annual Benefit: Project 3 – Lagunitas Creek Watershed Sediment Reduction and Management Plan					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units) [1]**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
100-Yrs, Starting 2016	Present Value of Expected Increase in Adult Fish Population	2012 Present Value Dollars	$0	$1,955,277	$1,955,277
100-Yrs, Starting 2016	Present Value of Expected Reduction in Sediment Loading	2012 Present Value Dollars	$0	$108,909	$108,909
Comments: [1] Because project benefits are stochastic, expected present value is reported. See supporting analysis for benefit estimation methodology, assumptions, and data.					

References Cited:

Stetson Engineers. 2012. *Lagunitas Creek Unpaved Roads Sediment Source Site Assessment*. Draft, for MMWD and CDFW.

Stetson Engineers. 2013. *Jewell Creek Culvert Replacement Project: 100-year flow analysis and 50% design submittal.* For MMWD.

Project 4 – Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects

The Conserving Our Watersheds (COW) project is part of a 10 year effort to implement restoration services and activities on rangelands. Funding supports ranchers within the Marin and Southern Sonoma Resource Conservation Districts by providing them with technical, planning, permitting and construction assistance. Through voluntary participation in the program, ranchers are able to continue and improve upon BMP's and work towards pristine water quality conditions. The program implements critical watershed planning documents including the Tomales Bay Pathogen Total Maximum Daily Load (TMDL), Walker Creek Mercury TMDL, Tomales Bay Watershed Stewardship Plan, Tomales Bay Integrated Coastal Watershed Management Plan, San Antonio Creek Watershed Plan, Walker Creek Watershed Enhancement Plan, Lagunitas Limiting Factors Analysis for Coho Salmon and Steelhead, Central California Coast Coho Recovery Plan.

The projects to be implemented are guided by a multi-agency technical advisory committee who bring forth local biological, engineering, rangeland management, construction and water quality expertise in the development of projects. All BMPs are pre-approved by the USDA Natural Resources Conservation Services (USDA, 2006), abide by California Department Fish and Wildlife's California Salmonid Stream Habitat Restoration Manual, and are illustrated in Marin RCD's Groundwork: A Handbook for Erosion Control in Northern Coastal California. In addition, BMPs were previously reviewed and approved in a public CEQA process for the Marin Coastal Permit Coordination Program (MCPCP), exclusively tailored to meet grazing lands conservation priorities. BMP project success will be evaluated using the Marin RCD Riparian Zone Monitoring Plan authorized in three prior EPA funding grant agreements.

Project 4 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Quality Improvement	Functioning riparian corridors will filter incoming storm water, reducing concentrations of sediment, nutrients from agricultural operations. Management practices are predicted to result in a 50-75% reduction in fine sediment delivery from riparian fencing and revegetation projects and 75-95% reduction from headcuts, gullies and streambank repairs. Management practices are predicted to result in a 60-90% reduction in pathogen loading.	The entire COW program is estimated to result in 36,375 cubic yards of sediment saved from entering waterways (average of 1,800cy sediment saved per project x 15 projects) multiplied by $9.30, a value determined by EcoNorthwest (2012).
Habitat or Ecosystem Improvement	Restoration projects will create new habitat in denuded and degraded areas. This funding will result in 75 acres of enhanced habitat.	Approximately 75 acres of riparian and wetland habitat will be affected, with an approximate value of $9,700 annually in perpetuity. This is based on a value per acre of $128.00 for riparian habitat, derived from the value represented in EcoNorthwest (2012).

Project 4 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	**Water Quality:** "Several past studies suggest that runoff from dairies and livestock-grazed land are the primary source of fecal coliforms to Tomales Bay. Results of the 2001 study are consistent with past findings…" "Sedimentation is rapidly occurring in Tomales Bay. Comparisons were made between 1861 and 1957 …. These calculations showed a bay wide average infilling rate of 5mm/yr. This is equivalent to a watershed erosion rate of approximately 80,000 tons per year. **Wildlife Habitat:** "Although some habitats in the Tomales Bay watershed are relatively healthy, many have been seriously compromised and need to be restored. "
Estimates of no-project conditions in consideration of other planned projects	No project option results in the continued degradation of water quality and wildlife habitat.
Relation of Project to other Proposed Projects	**Water Quality & Wildlife Habitat:** The COW Program includes implementation of a total of 80 conservation practices (10 year effort), representing over 60,000 feet of exclusionary fencing, 8 lined waterways, 22 grade stabilizations, 4 road repairs, numerous troughs, tanks, solar pumps, and 15 acres of revegetated critical habitat areas within the Tomales Bay, San Antonio, and Novato Creek watersheds. 20-30 BMPs are planned in the next 2 years through this proposal. **Water Quality:** The efforts of this project contribute to an overall Tomales Bay Watershed enhancement effort. Three of seven source categories qualify for COW funding. The overall watershed effort is estimated to cost as much at 73M over a 10 year period.
Methods used to Estimate Physical Benefits	**Water Quality & Wildlife Habitat:** A Riparian Zone Monitoring Plan has been developed by UCCE for Marin RCD's permitted conservation projects. Implementation, effectiveness and validation monitoring methods are used including the Rangeland Hydrology and Erosion Model (RHEM) to estimate erosion and Riparian Line Intercept Transects for vegetation.
New facilities, policies, and actions required to obtain the physical benefits	None required
Uncertainty of benefits and contributing factors	**Water Quality & Wildlife Habitat:** Based on experience, uncertainty factor is low. High level of success is anticipated. In the last 50 years, over 230 landowners have participated in cost-share programs and another 100 have received technical assistance, resulting in 1,393 plans developed and over 3,579 conservation practices implemented in Marin County.

Project 4 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Potential adverse effects	**Water Quality & Wildlife Habitat:** Restoration of riparian habitats is central to the purpose of the program. The 17 conservation practices selected for coverage by the Marin Coastal Permit Coordination Program are specifically designed to stem and resolve erosion and sediment problems, to minimize polluted runoff from agriculture and to be installed in such a manner that there is low to no risk of causing environmental impacts. Best management practices, erosion control and avoidance measures for special status species are utilized during construction.

Table 9 – Annual Benefit: Project 4 – Marin/Sonoma Conserving Our Watersheds: Agricultural BMP Projects					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2016-2045	Sediment Reduction	Tons	0	1,942	1942.2
2016-2045	Riparian Habitat Restoration	Acres	0	75	75
2016-2045	Livestock Grazing Productivity	Acres	0	5,925	5925

References Cited:

Water Quality:

California Regional Water Quality Control Board, San Francisco Bay Region. 2005. Pathogens in Tomales Bay Watershed Total Maximum Daily Load (TMDL). http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/12-21-05finalstaffreport.pdf - Page 34

Tomales Bay Watershed Council. 2003. Tomales Bay Watershed Stewardship Plan: A Framework for Action. July. http://www.tomalesbaywatershed.org/stewardship_framework.pdf - Page 26

Wildlife Habitat:

Tomales Bay Watershed Council. 2003. Tomales Bay Watershed Stewardship Plan: A Framework for Action. July. http://www.tomalesbaywatershed.org/stewardship_framework.pdf - Page 66

Water Quality & Wildlife Habitat:

N/A. Information is housed with Marin RCD and is the sum of COW grant funds received for phases I-III of the program. Funding has been provided by Prop 50, 84, CWA 319(h), ARRA, USDA NRCS EQIP, MALT, USFWS.

Water Quality:

California Regional Water Quality Control Board, San Francisco Bay Region. 2005. Pathogens in Tomales Bay Watershed Total Maximum Daily Load (TMDL). http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/tomalespathogens/12-21-05finalstaffreport.pdf - Page 104

Lennox, M., N. Scolari, and D. Lewis. 2010. Riparian Zone Monitoring Plan. Prepared by University of California Cooperative Extension for Marin Resource Conservation District, Point Reyes Station CA. 75 p.

Marin Resource Conservation District. 2010. Initial Study and Mitigated Negative Declaration for Marin Coastal Watersheds Permit Coordination Program. November.

University of California Cooperative Extension. 2011. *A Half Century of Stewardship: programmatic review of conservation by Marin RCD & partner organizations (1959-2009)*. University of California, Davis.

Project 7 – Oakland Sausal Creek Restoration Project

The Oakland Sausal Creek Restoration Project will address issues of erosion, water quality, flood capacity, and ecosystem restoration by stabilizing channel configuration, reducing stream velocities, improving flood capacity, and improving native rainbow trout habitat. Current conditions are incising the creek bed (lowering the channel elevation), which undermines the left and right banks of the creek. In some cases the resulting banks are near vertical. Riparian vegetation is limited along the creek where there is a mix of native and invasive tree, shrub, and groundcover species. Little to no streamside vegetation canopy overhangs the creek, and few tree roots are providing cover for habitat. As a result of the streamside erosion, trees have fallen into the creek, threatening both park improvements on the left bank and private property on the right bank.

The project will recreate a natural creek meander with pools and riffles, restore native vegetation and create 47,000 square feet of new habitat, stabilize creek banks, improve sight lines to the creek from Dimond Park, create an ADA-accessible walking path adjacent to the creek with interpretive features to raise awareness of the creek, reduce erosion and downstream sedimentation, create educational and recreational opportunities, and improve flood capacity, water quality, and fish habitat. The channel restoration design and engineering are founded on detailed analysis of the existing conditions and local creeks reference reaches. Project proponents successfully restored an upstream reach of Sausal Creek in 2001 and have restored numerous analogous creeks in the East Bay region. In addition to empirical knowledge of local creek geomorphology, project proponents relied on in-depth research and analysis.

Project 7 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Quality Improvement	**Urban Runoff Management:** Planted riparian areas and soil amendments will filter stormwater pollutants in stormwater runoff from adjacent urban area such as heavy metals, hydrocarbons, pesticides, fertilizers, and surfactants and reduce pollutant concentrations flowing into and downstream of project site. **Improved Temperature and Dissolved Oxygen:** Healthy and sustainable riparian corridor and mature canopy will lower water temperatures and increase dissolved oxygen concentrations.	1,600 linear feet of vegetated banks will be created or restored to filter runoff. 2,200 ft^2 of bioretention will be created to intercept runoff prior to entering the creek 12,300 ft^2 of lawn that drains to the creek will be removed
Reduce erosion and sedimentation	Stabilize stream banks through grading and installation of brush layering, staking, and installation of native plants, shrubs, and trees.	38,360 ft^2 of graded channel and banks are being stabilized. 12.5 cu yards sedimentation prevented annually. Measured from existing and proposed 3d models. Proposed channel used as surrogate to 1957 conditions.

Project 7 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Improve riparian habitat	Improve native plant diversity Improve stability of channel banks	Creation of 47,000 square feet of new native plant habitat by removing non-native vegetation and replanting newly graded creek banks with 3,655 new native riparian trees, shrubs, and perennials grown primarily from watershed specific seed stock and cuttings.
Improve Native Trout habitat	Creation of pools and shelter for the trout Reduce barriers to upstream movement Installation of Large Woody Debris	11 pools to be created 800 linear feet of restored channel removal of 250+ feet of culvert and spillway, removal of vertical barriers to upstream movement 10 tree rootwads installed along the channel as Large Woody Debris features
Flood Protection	Reduce flood risk for neighboring properties Lower water surface elevations Increase channel flood flow capacity	0.6ft average reduction in WSE for the 50 year recurrence interval peak annual discharge.
Increased groundwater infiltration	Reduction of impervious surfaces	Removal of 2,408 ft^2 of impervious channel bottom Reduce impervious cover within park by 2,335 ft^2
Reduced impact on downstream infrastructure	Reduction in velocity and volume of flows leaving the site as a result of wider stream channel and greater uptake of water by plants in the riparian corridor	2,600 cu yds of additional channel volume created.
Increase duration and volume of year-round flows downstream of project site	Reduction in impervious surface to increase the amount of infiltration and increase year-round flows	Removal of 2,408 ft^2 of impervious channel bottom

Project 7 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Estimates of no-project conditions in consideration of other planned projects	No project would result in continuation of existing deleterious conditions including no day-lighting of existing culvert, barriers to fish migration upstream, stream bank erosion, likely collapse of stream bank in certain areas resulting in damage to adjacent roadway and private property, threats to public safety, sedimentation, lack of diverse riparian corridor, lack of site access and recreational and educational opportunities, and limited visibility to creek from park further contributing to public safety issues
Methods used to Estimate Physical Benefits	1. Improve Water quality 2. Reduce erosion and sedimentation 3. Improve riparian habitat 4. Improve native trout/salmonid habitat and passage 5. Improve Flood protection 6. Increase groundwater infiltration 7. Reduce impact on downstream infrastructure 8. Increase duration and volume of year-round flows downstream of project site
New facilities, policies, and actions required to obtain the physical benefits	Project will demolish existing bathroom to create space for the culvert daylighting. A new restroom will be built in a new location near the project site. The daylighting will also require construction of a new culvert exit and headwall.
Uncertainty of benefits and contributing factors	The anticipated benefits of the project are based on knowledge of benefits achieved through the implementation of other similar projects and also through modeling exercises and technical memos that predict the anticipated outcome of project components. The City of Oakland draws upon in-house expertise as well as the experience and knowledge of the consultant team to develop projections to quantitatively and qualitatively predict the project outcomes. Every project has unique characteristics that cause variation in the range of benefits that will be realized. Monitoring and adaptive management procedures will inform and guide physical adjustments to the project as the site matures in order to maximize achievable benefits.
Potential adverse effects	CEQA potential impacts (nesting birds, temporary loss of habitat, temporary increase in noise, etc.). All mitigated.
Estimates of no-project conditions in consideration of other planned projects	No project would result in continuation of existing deleterious conditions including no day-lighting of existing culvert, barriers to fish migration upstream, stream bank erosion, likely collapse of stream bank in certain areas resulting in damage to adjacent roadway and private property, threats to public safety, sedimentation, lack of diverse riparian corridor, lack of site access and recreational and educational opportunities, and limited visibility to creek from park further contributing to public safety issues

Project 7 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Methods used to Estimate Physical Benefits	1. Improve Water quality 2. Reduce erosion and sedimentation 3. Improve riparian habitat 4. Improve native trout/salmonid habitat and passage 5. Improve Flood protection 6. Increase groundwater infiltration 7. Reduce impact on downstream infrastructure 8. Increase duration and volume of year-round flows downstream of project site
New facilities, policies, and actions required to obtain the physical benefits	Project will demolish existing bathroom to create space for the culvert daylighting. A new restroom will be built in a new location near the project site. The daylighting will also require construction of a new culvert exit and headwall.
Uncertainty of benefits and contributing factors	The anticipated benefits of the project are based on knowledge of benefits achieved through the implementation of other similar projects and also through modeling exercises and technical memos that predict the anticipated outcome of project components. The City of Oakland draws upon in-house expertise as well as the experience and knowledge of the consultant team to develop projections to quantitatively and qualitatively predict the project outcomes. Every project has unique characteristics that cause variation in the range of benefits that will be realized. Monitoring and adaptive management procedures will inform and guide physical adjustments to the project as the site matures in order to maximize achievable benefits.
Potential adverse effects	CEQA potential impacts (nesting birds, temporary loss of habitat, temporary increase in noise, etc.). All mitigated.

Table 9 – Annual Benefit: Project 7 – Oakland Sausal Creek Restoration Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2020-2069 [1]	Stormwater and Dry Weather Nuisance Runoff Treatment Capacity	Gallons	0	18,688,000	18,688,000
2016-2065 [1]	Riparian Habitat Restoration	Acres	0	1.08	1.08
Comments: [1] Benefits counted over 50-year period, starting in 2020.					

References Cited:

City of Oakland. 2008. City of Oakland Measure DD Implementation Project Environmental Impact Report (State Clearinghouse #2006122048). January.

City of Oakland. 2012. Project Plans for the Sausal Creek Restoration Project in Dimond Park. L-2.1, L-2.2, L-5.1, L-5.2, L-5.3.

Hagar, J. 2011. "Sausal Creek Restoration Project at Dimond Canyon": Letter evaluating fish habitat to Kristin Hathaway, CSM, City of Oakland Watershed Program Specialist, City of Oakland Public Works Agency. Prepared for Restoration Design Group by Hagar Environmental Science. April 12.

Hagar, J. 2011. "Sausal Creek Restoration Project at Dimond Canyon": Letter evaluating fish habitat to Kristin Hathaway, CSM, City of Oakland Watershed Program Specialist, City of Oakland Public Works Agency. Prepared for Restoration Design Group by Hagar Environmental Science. April 12.

Restoration Design Group, LLC. 2011. *Sausal Creek Restoration Project in Dimond Park, Design Basis Memorandum*. Prepared by Erik Stromberg, RDG, for City of Oakland. April 29.

Restoration Design Group, LLC. 2012. *Sausal Creek Restoration Project in Dimond Park, Final Review Hydraulic Memorandum*. Prepared by Erik Stromberg, RDG, for City of Oakland. April 16. Figure 4, Page 11 shows WSE comparison plot.

Project 12 – Richmond Breuner Marsh Restoration Project

East Bay Regional Park District (EBRPD) proposes to create, restore, enhance, and protect 164 acres of crucial habitat in Breuner Marsh at Point Pinole Regional Shoreline Park in the city of Richmond on the San Francisco Bay shoreline, Contra Costa County, California. The goal of this wetland restoration project is to provide long-term, self-sustaining tidal wetlands, seasonal wetlands, and coastal prairie to create valuable habitat for special-status species and for public access for compatible passive recreation and public education. It provides water resource-related recreational opportunities to lower income residents in Richmond. It is adjacent to the high-density underserved neighborhoods of Parchester Village, Bayview-Montalvin, Tara Hills, Rollingwood, and the Iron Triangle in Richmond.

Much of Richmond's historic shoreline has been lost to industrial uses and is no longer accessible to the public. Marshes have been filled, invaded by non-native species, polluted and fragmented. However, the seven-mile stretch of shoreline from Point San Pablo to Point Pinole represents one of the last remaining shorelines still largely intact. This wetland complex contains an estimated 540 acres of tidal marsh and more than 900 acres of tidal flat. Lying just offshore is the largest eelgrass bed in the entire San Francisco Bay, all of which helps to support a diverse population of waterbirds, fish, and other wildlife.

Project 12 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Water Supply	The project will reduce potable water demand through encouraging use of rainwater harvesting practices city-wide.	N/A
Water Quality Improvement	Planted wetland vegetation and soil amendments will improve the quality of Stormwater runoff from urban areas.	N/A
Habitat or Ecosystem Improvement	The project will create and protect rare tidal and seasonal wetland habitat along the San Francisco Bay shoreline.	Tidal Wetlands 61.4 Seasonal Wetlands 7
Flood Protection	N/A	N/A
Recreation or Open Space Improvement	The project goal is to develop a link of the San Francisco Bay Trail (the Bay Trail) between Goodrick Avenue on the south side of Breuner Marsh with Point Pinole in the north. All the features with the Breuner Bay Trail project will be fully ADA compliant. The recreational goals include: • Accommodate planned local trail connections • Site public access trails and features to not fragment habitats • Employ appropriate public access and wildlife compatibility design, as well as management	The public access facilities of the proposed project include a new 20-car parking area with a small restroom, a new segment of the Bay Trail, a picnic area on an earthen overlook located toward the eastern edge of the property, and a spur trail system. Access to 164 open space site.

Project 12 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
	techniques to reduce use and habitat conflicts • Provide sustainable day use facilities in terms of design and material selection • Provide views to the San Francisco Bay • Provide access for fishing • Provide exhibits and/or programs to inform visitors about natural and cultural resources on the site	
Greenhouse Gas Reduction	1.5 miles of Bay Trail	1.27 tons of emissions per mile of Class 1 trail for a total reduction of 1.91 tons

Project 12 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Despite its natural beauty, the North Richmond Shoreline has been a dumping ground for East Bay communities for years. Large swaths of marshland have been illegally filled, causing severe environmental damage. The West County Landfill, a 235-foot-tall "garbage mountain," has finally been stuffed to capacity after more than 50 years of dumping. South of the dump, near Wildcat Creek Marsh, are sewage treatment plants. Chevron expelled contaminated refinery wastewater into Castro Cove (west of Wildcat Creek Marsh) for nearly a century. Neighbors have been denied access to a healthy shoreline. Hundreds of years ago, the North Richmond Shoreline consisted of a large, broad mudflat that extended all the way from Point Pinole to Point San Pablo. The area also included a massive tidal marsh that extended for more than 2,000 acres along most of the Shoreline and all the way to Richmond's south shoreline. Wildcat, San Pablo, Rheem, and Castro Creeks meandered slowly through the broad flat land between the East Bay hills and the San Pablo Bay supplying clean water and clean sediment that helped keep the marshes and mudflats healthy.
Estimates of no-project conditions in consideration of other planned projects	The site has been thoroughly investigated for the presence of hazardous materials and only a small amount of hazardous materials, associated with historic uses of the property, has been found. This consists of approximately 1,000 cubic yards of arsenic-contaminated soils that would be excavated, stockpiled, tested, removed from this area, and transported to a Class II Special Category waste disposal facility such as Altamont Pass Landfill near Livermore, in accordance with applicable regulatory standards.

Project 12 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Relation of Project to other Proposed Projects	Breuner Marsh is not related to any other project, but it connects to an provided new trail entrance and access to Point Pinole with: • 2,532 acres of open space • Fishing at the 1,225 foot long Point Pinole fishing pier • Overnight camping in a former dynamite bunker • 5.5 miles of Shoreline • 12 miles of trails • Migratory birds along the Pacific Flyway • Raptors nesting/roosting in eucalyptus woods • Influence of Hayward Fault (runs along the western shore) on Bay Area landforms • Inter-tidal life along rocky shore, mudflats, tidal marshes • Native bunchgrasses in open grasslands • Freshwater pond ecology • History of the site as a dynamite factory • Monarch butterfly over-wintering in the eucalyptus woods • Unique coastal prairie habitat and grassland fire ecology (site has ongoing grassland restoration by using prescribed fire.)
Methods used to Estimate Physical Benefits	Site and Regional habitat evaluations (see references cited).
New facilities, policies, and actions required to obtain the physical benefits	See proposed project description in Attachment 3.
Uncertainty of benefits and contributing factors	Monitoring and restorative action plans will ensure project success.
Potential adverse effects	No Significant and Unavoidable Impacts were found.

Table 9 – Annual Benefit: Project 12 – Richmond Breuner Marsh Restoration Project					
(a)	(b)	(c)	(d)	(e)	(f)
Year	Type of Benefit	Measure of Benefit (Units) [1]	Without Project	With Project	Change Resulting from Project (e) – (d)
In Perpetuity, starting 2016	Outdoor Recreation	Visitor Days	0	10,000	10,000
In Perpetuity, starting 2016	Seasonal Wetland	Acres	0.0	7.0	7.0
In Perpetuity, starting 2016	Tidal Wetland	Acres	0.0	25.9	25.9

References Cited:

Bay Area Air Quality Management District. Bicycle Facility Program. Page 2.

East Bay Regional Park District. 2012. *Breuner Marsh Restoration and Public Access Improvement Project 60% Plans. Richmond, California*. November 1, 2012.

East Bay Regional Park District. 2013. "Point Pinole Regional Shoreline." http://www.ebparks.org/parks/pt_pinole

North Richmond Shoreline Open Space Alliance. 2013. "A Vision for the North Richmond Shoreline." http://www.northrichmondshoreline.org/

The Planning Center DC&E. 2012. *Draft Environmental Impact Report: Breuner Marsh Restoration and Public Access Project for the East Bay Regional Park District.* March 9. SCH #2011072011. Page 2-6, 3-26, 3-25, and 3-45.

The Planning Center DC&E. 2012. *Final Environmental Impact Report: Breuner Marsh Restoration and Public Access Project for the East Bay Regional Park District.* June 12. SCH #2011072011.

Project 17 – San Pablo Rheem Creek Wetlands Restoration Project

The San Pablo-Rheem Creek Wetland Restoration Project will create seasonal wetlands on a ten-acre parcel adjacent to Rheem Creek and Breuner Marsh, located in the City of Richmond. The project will also improve the quality of stormwater that ultimately flows to San Pablo Bay. In addition, the project will lower potential flood impacts from Rheem Creek in neighborhoods within the cities of San Pablo and Richmond.

The San Pablo-Rheem Creek Wetlands Restoration Project will support ecosystem restoration and floodplain management. A portion of the wetlands being established/created will support the mitigation requirements by the San Francisco District United States Army Corps of Engineers and San Francisco Bay Regional Water Quality Control Board. The Project will benefit the adjacent DAC within the cities of San Pablo and Richmond. The project allows for the protection of open space along Rheem Creek within a highly urbanized area and will be located just upstream of the East Bay Regional Park District (EBRPD) Bruener Marsh Restoration Project. If the project is not implemented, it is likely that the site will be commercially developed. Once the site is commercially developed, it will no longer be possible to restore it as wetlands.

Project 17 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Wetland Mitigation Credits	Creation and establishment of wetland benefits to satisfy the requirements of the SF USACE and SF RWQCB to compensate for wetland impacts at the CCWD Shortcut Pipeline(SCPL) Improvement Project.	There are no mitigation credits (or mitigation banks) that are available to compensate for wetland impacts in the area where the SCPL Improvement Project is to be undertaken. Any mitigation plan is subject to the approval of the USACE and the SFRWQCB. The only site they will consider is the San Pablo-Rheem Creek mitigation site. The CCWD SCPL wetland mitigation ratio has not been fully confirmed at this time. However, the best estimate of the requirements are for 3.11 acres. This leaves a balance of 1.71 acres. The cost of the 4.82 acres of wetlands is $1.75 million or approximately $363,000 per acre. The San Francisco Bay Wetland District has available wetlands with an $800,000 per credit price.
Wetland Mitigation Credits Continued	Creation and establishment of wetland benefits to satisfy the requirements of the SF USACE and SF RWQCB to compensate for wetland impacts at the CCWD Shortcut Pipeline(SCPL) Improvement Project.	There are no mitigation credits (or mitigation banks) that are available to compensate for wetland impacts in the area where the SCPL Improvement Project is to be undertaken. Any mitigation plan is subject to the approval of the USACE and the SFRWQCB. The only site they will consider is the San Pablo-Rheem Creek mitigation site. The CCWD SCPL wetland mitigation ratio has not been fully confirmed at this

Project 17 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
		time. However, the best estimate of the requirements are for 3.11 acres. This leaves a balance of 1.71 acres. The cost of the 4.82 acres of wetlands is $1.75 million or approximately $363,000 per acre. Newark Mitigation Site. CCWD contacted Wildlands Inc and they are developing the Newark Mitigation site for sale of wetland banked credit. The Newark site does not have regulatory approvals. However USACE staff advised CCWD that they were willing to consider this site as possible mitigation for the SCPL Improvement Project. The posted price from Wildlands will be $650,000 per acre. Wildlands offered CCWD a special deal at $500,000 per acre. The District attempted to negotiate a lower price, however Wildlands was not willing to consider this arrangement.
Wetland Mitigation Credits	Creation and establishment of wetland benefits to satisfy the requirements of the SF USACE and SF RWQCB to compensate for wetland impacts at the CCWD Shortcut Pipeline(SCPL) Improvement Project.	There are no mitigation credits (or mitigation banks) that are available to compensate for wetland impacts in the area where the SCPL Improvement Project is to be undertaken. Any mitigation plan is subject to the approval of the USACE and the SFRWQCB. The only site they will consider is the San Pablo-Rheem Creek mitigation site. The CCWD SCPL wetland mitigation ratio has not been fully confirmed at this time. However, the best estimate of the requirements are for 3.11 acres. This leaves a balance of 1.71 acres. The cost of the 4.82 acres of wetlands is $1.75 million or approximately $363,000 per acre. Pavon Creeks and Scow Canyon. Pavon Creeks and Scow Canyon are two restoration projects undertaken by EBMUD. The two projects both involved the restoration of wetlands/ponds and streams. Based on EBMUD cost information the project cost is $1.65 million excluding staff time for an average restoration cost of $755,000 per acre.
Wetland Habitat Restoration	The project will restore 4.82 acres of seasonal wetland habitat for endangered and threatened species (salt marsh harvest mouse)	4.82 acres of seasonal wetland habitat and 5.2 acres of upland watershed habitat.
Ability to permit the CCWD Shortcut Pipeline Improvement Project	Absent project permits from the USACE and SFRWQCB that depend on mitigation credits at the San Pablo Rheem Creek site, improvements to the SCPL cannot be completed at this time. The longer the delay in the project due to no available mitigation credits or insufficient funding	The SCPL is the primary untreated water supply source for the City of Martinez and the Shell Oil Refinery as well as the Foster Wheeler Power Plant. The cost of the SCPL Improvement Project that will be enabled by having the available grant funding is $2 million. The customer usage of the SCPL is approximately 25% of CCWD's total water deliveries or approximately 25,000 acre feet per year. Assuming $600 per acre foot for

Project 17 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
	then the pipeline cannot be maintained fully. The pipeline is located in a locally low lying area that is subject to liquefaction during an earthquake. The pipeline failed in 1989 following the Loma Prieta Earthquake. The proposed improvements are intended to allow the pipeline to be upgraded and for maintenance to be performance on an ongoing basis. This should support more reliable water service to the City of Martinez, the Foster Wheeler Power Plant within the Tesoro Refinery and the Shell Oil Refinery in Martinez.	25,000 acre feet represent annual revenue associated with the SCPL of $15,000,000 per year. A disruption in untreated water availability due to a pipeline disruption as a result of not being able to implement improvements could be expected to result in significant lost revenue for CCWD.
Water Quality Improvement	Seasonal wetlands will improve the quality of stormwater runoff from urban areas in Rheem Creek prior to release to the Bay	Amount of water treated or improved Types and amounts of constituents removed Amount of water quality improvement
Sea Level Rise Buffer	The project site is situated adjacent to the Breuner Marsh property. Elevation on the property are outside the predicted 55-inch increase in sea level rise over the next 100 years. The wetland habitat would be available as a buffer to Breuner Marsh if sea level rise due reach the estimated amount.	The federally listed salt marsh harvest mouse occurs on the Breuner Marsh property. Assumed increases in sea level would have a detrimental effect on this species if not for higher elevational habitat. The proposed project would provide up to 10 acres of refugia habitat for this species.
Flood Protection	Increasing the available flood plain downstream at the Rheem Creek project site will result in flood protection within the City's of Richmond and San Pablo	
Other Physical Benefits	The project would provide for the restoration of wetlands and wildlife habitat in an area currently approved for commercial development.	The communities of Richmond and San Pablo would receive needed open space in an urbanized setting through the implementation of the 10 acre project.

Project 17 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Urbanization since the 1950s led to degradation of ecosystem functioning. Rheem Creek has been modified over its entire length. A large flood control project on the lower watershed substantially altered the channel. Small patches of the original seasonal wetlands remain interspersed in the lower watershed.
Estimates of no-project conditions in consideration of other planned projects	Levels of physical benefit that may occur in the future without the project.
Relation of Project to other Proposed Projects	The project is part of the restoration of Breuner Marsh, by creating wetland habitat adjacent to the Breuner Marsh restoration.
Methods used to Estimate Physical Benefits	A review of recent aerial photography illustrates the current setting.
New facilities, policies, and actions required to obtain the physical benefits	See proposed project description in Attachment 3.
Uncertainty of benefits and contributing factors	Monitoring and restorative action plans will ensure project success.
Potential adverse effects	Temporary environmental impacts during project construction.

Table 9 – Annual Benefit: Project 17 – San Pablo Rheem Creek Wetlands Restoration Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
In Perpetuity	Restored Seasonal Wetland	Acres	0	1.69	1.69
In Perpetuity	Supporting Upland Habitat	Acres	0	5.2	5.2

References Cited:

CCWD and Wildlands. 2012. Electronic mail correspondence regarding cost of Newark Mitigation site wetlands. Starting October 12.

East Contra Costa County HCP/NCCP 2011 Mitigation Fee Update. 2011. EPS Memo to John Kopchik, Contra Costa County regarding East Contra Costa County HCP/NCCP 2011 Mitigation Fee Update. July 15.

Kamman Hydrology & Engineering. 2012. *Hydrologic Sufficiency Analysis Rheem Creek Mitigation Bank, Richmond CA*. October.

Natural Heritage Institute. 2007. *Rheem Creek Watershed Assessment and Conceptual Restoration Plan*.

Olberding Environmental. 2013. *Baseline Mitigation and Monitoring Report 2013 for the Parkway Commerce Center Property*. Contra Costa County, California. January.

Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project

York Creek is documented by CDFW to be one of the most viable spawning and rearing streams for federally listed as threatened Central California Coast steelhead in the Napa River Basin. Currently, the Upper York Creek Dam (UYCD) prohibits access to 1.7 miles of high quality spawning and rearing habitat that surveys by the Napa County Resource Conservation District document would support 825-1,811 juvenile steelhead annually. Project implementation would result in creation of almost 1.5 acres of aquatic habitat (0.30 acres of pool, 0.33 acres of flatwater, and 0.85 acres of riffle), as well as 2.0 acres of riparian habitat (0.4 acres of streambank, 0.5 acres of terrace, and 1.1 acres of riparian zone).

The area above the dam contains 63% of the watershed's coarse sediment supply. A limiting factors analysis of the Napa River Basin found that dams throughout the system intercept coarse sediment and, thereby, reduce delivery to downstream reaches, which has caused bed coarsening and channel incision; other studies report that disruption of sediment transport has serious geomorphic, ecological, and economic consequences. Removal of UYCD will allow sediment from in the upper watershed to be transported through the lower reaches to the sediment-starved Napa River.

The project provides a unique opportunity to address global climate change in a positive way. Extensive revegetation of creek banks and reservoir area with a multi-story palette of native species is included in the design. Carbon sequestration estimates indicate that new vegetation in the project area will sequester ±280 metric tons CO2 by 2100. Further, UYCD traps 1,000 to 5,000 cubic yards of sediment per year depending on the magnitude of winter storm events. On-going maintenance activities, which will be eliminated by removal of the dam, contribute to global climate change impacts both through emissions from construction equipment and disturbance to vegetation that interrupts growth to maturity and optimal carbon sequestration.

Project implementation will also eliminate potential for future downstream habitat degradation and fish kills. Downstream release of fine sediments trapped behind Upper York Creek Dam pose significant risk to aquatic species. Prior to 1993 when annual maintenance and periodic dredging were begun, there were four recorded sediment releases (1965, 1973, 1975, 1992) that resulted in devastating downstream fish kills and legal action by CDFW.

Finally, dam removal will eliminate substantial annual costs for both maintenance ($125,738) and an assessment from NMFS ($20,000) for blocking steelhead migration. The City of St. Helena has participated in project planning and conceptual design with the U.S. Army Corps of Engineers, National Marine Fisheries Service, U.S. Fish and Wildlife Service, CDFW, Regional Water Quality Control Board, and Napa County since 2001. The City Council, as early as October of 2000, documented their position that the dam should be removed.

Project 18 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Restore anadromous fish passage	By removing UYC dam and reservoir sediments, the project will restore upstream passage to spawning and rearing habitat for steelhead and restore aquatic and riparian connectivity.	1.7 miles of spawning and rearing habitat that can support 825-1811 juvenile steelhead annually
Restore sediment delivery to lower York Creek and Napa River	UYCD traps all the coarse sediment delivered from the watershed upstream of the dam – 63% of the watershed's sediment source area. Removal of UYCD will allow sediment produced in the upper watershed to be transported through the lower reaches to the Napa River. Salmonid spawning and macroinvertebrate habitat will be improved within lower York Creek and the Napa River by the restoration of coarse sediment delivery from Upper York Creek. Lower York Creek is sediment starved and the channel bed is hardened.	1,000 to 5,000 cubic yards per annum
Restore aquatic habitat	The project will restore the channel buried beneath the dam and reservoir sediments to its pre-dam location, form and aquatic habitat conditions.	825 feet below existing dam and reservoir; in total, almost 1.7 miles (8,855 feet) of aquatic habitat would become available to CCC steelhead, including 0.30 acres of pool, 0.33 acres of flatwater, and 0.85 acres of riffle habitat, totaling 1.5 acres.
Restore riparian habitat	The project will re-establish native riparian and upland forest habitat in upper dam and reservoir area.	2.0 acres
Sequester carbon	The area beneath the dam and reservoir sediments will be revegetated with a diverse, multi-story species mix.	By 2100, the project will sequester 280 metric tons Carbon Dioxide equivalent and will still be continuing to sequester more.
Eliminate potential for future downstream habitat degradation and fish kills, as well as annual costs for dam maintenance and NOAA assessment for blocking salmonid migration	Eliminate ongoing annual expenditures by City on dam and sediment maintenance and an annual assessment to NOAA Fisheries of $20,000 for ongoing salmonid passage impacts from UYCD.	$145,783 in savings

Project 18 – Support for Project Benefits		
Background		**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Restore anadromous fish passage	York Creek is one of the most significant spawning and rearing streams for federally listed as threatened Central California Coast steelhead within the Napa Basin. Removing the reservoir will allow access to over 1.7 miles of aquatic habitat. The upper reaches of York Creek offer high quality rearing and spawning habitat, and creating access to these areas will benefit the Napa River watershed steelhead population as a whole.
	Restore sediment delivery to lower York Creek and Napa River	The reservoir traps most of the annual supply of gravel produced by the watershed above Upper York Creek Dam. Sediment accumulates in the reservoir at a rate of 1,000 to 5,000 cubic yards per year depending on the magnitude of winter storm events. With total sediment storage potential of 28,000 cubic yards of material, the reservoir pool area is filled every 15-20 years. Sediment trapping is reasoned to be a contributing factor to bed incision that has occurred in the Napa River over the last century (Stillwater Sciences 2002).
	Restore aquatic habitat	Currently, most of the project area is covered with accumulated sediments. A small stream channel generally forms across the top of the reservoir between the upstream creek entrance to the reservoir and the drop inlet. The project will remove accumulated sediments, the drop-inlet structure, and dam materials and will create a high-gradient, cobble channel that is consistent with historic conditions both at the project site and up- and downstream. In the area between the drop-inlet and the foot of the dam, a movable bed and bank channel will be created.
	Restore riparian habitat	While riparian habitat currently exists at the project site, it has been periodically destroyed by maintenance activities. The dam and sediment removal will open up 2.0 acres of land to create stable riparian habitat, planted with a diverse mix of multi-story riparian species.
	Sequester carbon	The project site supports a variety of plants; however, as a result of dam maintenance and sediment removal activities, they have been repeatedly disturbed. Thus, mature woody plants that would sequester large amounts of carbon have been unable to develop. In addition, there has been no opportunity for build-up of soil carbon that occurs in stable systems. Discontinuance of regular maintenance activities and planting of native riparian trees and shrubs will allow the process of carbon storage to occur naturally in the project area.

Project 18 – Support for Project Benefits		
Background		**Brief Description of the Project's Expected Physical Benefits**
	Eliminate annual costs for dam maintenance and annual NOAA assessment for blocking salmonid migration	Regular maintenance of the dam is required, including annual debris removal from the drop-inlet and spillway to maintain storm water passage and may include periodic removal of accumulated sediment. Since the California Department of Fish and Wildlife (CDFW), previously the Department of Fish and Game, has been collecting records there are recorded 4 sediment releases (1965, 1973, 1975, 1992) resulting in downstream fish kills (CDFG 1992). In 1993, CDFW and the Napa County District Attorney's Office obtained an injunction in Superior Court ordering the City to remove York Creek Dam. In 1993, the City agreed to a settlement that mandated the removal of Upper York Creek Dam. The Court dismissed the injunction in 2000; however, NOAA National Marine Fisheries continues to level an annual assessment of $20,000 for interference with salmonid migration (St. Helena 2002). Since 1993, the City has not used the upper reservoir as a water source, but it has been periodically dredged. In order to prevent sediment releases during maintenance, additional care has been taken, resulting in increased project costs. The reservoir was last dredged in 2006, at a project cost of $207,000 and substantial City employee time (Broussard, pers. comm., 2013).
Estimates of no-project conditions in consideration of other planned projects	Restore anadromous fish passage	Under the No Project Alternative, the historic Upper St. Helena Dam would not be altered from its current configuration and will continue to constitute a complete barrier to fish passage.
	Restore sediment delivery to lower York Creek and Napa River	Negligible quantities of coarse sediment will be delivered past the dam unless the City trucks it out or there is catastrophic dam failure.
	Restore aquatic habitat	No additional aquatic habitat would be replaced. Fish passage and habitat connectivity would not be restored, and no ecosystem restoration measures would be implemented.
	Restore riparian habitat	Without the project, riparian habitat will continue to recover slowly between maintenance actions and then be set back. No additional connectivity will develop.
	Sequester carbon	The site is unlikely to sequester substantial quantities carbon without the project because ongoing maintenance will prevent the development of large trees or thick layers of soil.
	Eliminate annual costs for dam maintenance and annual NOAA assessment for blocking salmonid migration	City of St. Helena will continue to maintain the dam and pay for blocking salmonid migration.
Methods used to	Restore anadromous fish passage	Upper York Creek was assessed for potential spawning habitat by direct observation, snorkel surveys, water quality monitoring, and gravel permeability studies as part of the Central Napa River Watershed Project.

Project 18 – Support for Project Benefits		
Background		**Brief Description of the Project's Expected Physical Benefits**
Estimate Physical Benefits	Restore sediment delivery to lower York Creek and Napa River	Logic dictates that sediment yielded from the upper watershed will not be trapped by the reservoir if the dam and reservoir are removed. The quantity of sediment was estimated by comparison of periodic surveys of the gravel surfaces within the reservoir, literature review of sediment yield analysis in analogous watersheds, and review of gravel removal timelines associated with dam history.
	Restore aquatic habitat	Restoration area measurements were taken conceptual from project plans.
	Restore riparian habitat	Restoration area measurements were taken from conceptual project plans.
	Sequester carbon	Carbon sequestration was estimated using tables for Northwest, West Alder/Maple forests from Smith et. al. 2006. Only live tree sequestration was included.
	Eliminate annual costs for dam maintenance and annual NOAA assessment for blocking salmonid migration	Dam maintenance costs were estimated using professional judgment based upon site experience of the level of effort required for dam maintenance and current St. Helena salary schedule; cost of the existing NOAA assessment was then added.
New facilities, policies, and actions required to obtain the physical benefits		No new facilities or policies are required for any project benefit.
Uncertainty of benefits and contributing factors	Restore anadromous fish passage	Steelhead are documented in York Creek immediately below the dam, as well as farther downstream, and rainbow trout are known to occur in the upstream habitat. Removal of the Upper York Creek Dam, which is a complete barrier to aquatic migration, will result in new access to 1.7 miles of spawning and rearing habitat for steelhead and potential downstream migration opportunities for resident rainbow trout. Revegetation with a multi-story palette of native species will provide shade to cool water temperatures, cover from predation, and nutrients needed to support salmonids, such as macroinvertebrates.
	Restore gravel delivery to lower York Creek and Napa River	The gravel-starved condition of the Napa River and the ability of the upper watershed to deliver gravel (St. Helena 2007), make the delivery of gravel to lower York Creek highly likely. It is less certain how the sediment will move through the lower watershed. It may spend some time in lower York Creek before large storm events move it toward the river.
	Restore aquatic habitat	The existing condition is the pipe through the earthen embankment. The proposed condition is a natural channel. Ecological reasoning dictates that the natural channel will provide appreciable aquatic habitat whereas the aquatic habitat associated with the pipe is negligible.
	Restore riparian habitat	The existing condition is an earthen embankment with a pipe buried in it. The proposed condition is a natural channel with no earthen embankment within the natural channel. Native riparian vegetation will be established along the channel and its banks. Ecological reasoning is used to conclude that the riparian plant community will provide appreciable habitat whereas no riparian habitat is provided by the embankment.

Project 18 – Support for Project Benefits		
Background		**Brief Description of the Project's Expected Physical Benefits**
	Sequester carbon	The project will certainly sequester carbon. Whether it will sequester as much as indicated, more, or less, will depend upon growing conditions in the Napa Valley as the climate changes, the final plant mix selected, and the possibility of stochastic events, such as wildfire and large storms.
	Eliminate annual costs for dam maintenance and annual NMFS assessment for blocking salmonid migration	Annual maintenance and NMFS assessment costs will be eliminated once there is no reservoir to clean out or dam to block fish passage.
Potential adverse effects	Potential adverse effects were evaluated for the entire project rather than per benefit.	The draft EIR for the project identified less-than-significant, short-term impacts from construction on air quality, habitat, aquatic species, greenhouse gases, noise, traffic, and water quality. All of these impacts would also occur without the project, but with repeating impacts, since similar activities would be required for dam maintenance every 15 – 20 years. The draft EIR identified three potentially significant and unavoidable impacts of project implementation: ▪ Potential short-term adverse effects at the Lower York Creek Reservoir during placement of spoils from UYCD were identified in the DEIR as potentially significant and unavoidable. However, use of the lower reservoir area for spoils placement is longer proposed by the City. Spoils will be taken to Spring Mtn. Vineyard, 0.5 miles away on Spring Mtn. Road. ▪ Sediment transport in lower York Creek is likely to be affected by removal of the dam. Sediment deposition may increase, with subsequent increases to lowland flooding; however, hydraulic modeling does not clearly predict whether flooding would increase or decrease. ▪ The dam is a historic structure – part of the original settling of St. Helena and development of the wine industry in the Napa Valley. While photographs and text memorializing the dam will be installed in St. Helena, the dam itself will be removed.

Table 9 – Annual Benefit: Project 18 – St. Helena Upper York Creek Dam Removal and Ecosystem Restoration Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units) [1]**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
100-Yrs, Starting 2016	Steelhead Spawning and Rearing Habitat	Adult Returning Fish	0	264	263.6
100-Yrs, Starting 2016	Restored Riparian Habitat	Acres	0	2	2
100-Yrs, Starting 2016	Carbon Sequestration [1]	Dollars	0	$702	$702
Comments: [1] The amount and value of carbon sequestration vary through time. To fit within the format of the table and economize on space, rather than show the annual quantity and unit value for each year in the forecast period, the value of carbon sequestration is shown in terms of annualized value.					

References Cited:

Broussard, Clare. 2013. Design and Construction Cost Estimate Summary Sheet 1/25/2013, Upper York Creek Dam Removal Cost Estimate. Personal communication from Prunuske Chatham, Inc. accounting records.

California Department of Fish and Game. 1992. Brian Hunter Letter to City of St. Helena, July 30, 1992.

California Department of Fish and Game. 2005. *Central Napa River Watershed Project, Salmonid Habitat Form and Function*. Prepared by Napa County Resource Conservation District. Pgs. 113-115

City of St. Helena. 2002. *Initial Study/Proposed Mitigated Negative Declaration For the York Creek Dam Removal and Stream Restoration Project, Napa County, California.* Pg. 2

City of St. Helena. 2007. *Draft Environmental Impact Report, Upper York Creek Ecosystem Restoration Project, Napa County, California.* Prepared by Prunuske Chatham, Inc. April 20, 2007. SCH #2006092096. Pgs. ES-1-ES-6, 1, 15, 16, 75, 86, 134

Department of Water Resources (DWR). 2004. *Final Environmental Impact Report for the City of St. Helena York Creek Diversion Modification Project.* January 14, 2004.

Eastman, B. 2003. *Historical Resources Evaluation Report for the Proposed Removal of an Earthen Dam and Diversion Structure on York Creek near the City of St. Helena in Napa County, California*. Prepared for the City of St. Helena by Bright Eastman, Anthropological Studies Center, Sonoma State University, Rohnert Park, California.

Prunuske Chatham, Inc. 2013. Memo to File: Upper York Creek Dam Annual No Project Alternative Costs. January 24. Pg. 2

Smith, James E., Linda S. Heath, Kenneth E. Skog, Richard A. Birdsey. 2006. *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States.* United States Department of Agriculture, Forest Service, Northeastern Research Station. General Technical Report NE-343. Appendix A, Table B21.

Stillwater Sciences and William Dietrich. 2002. Napa River Basin Limiting Factors Analysis Final Technical Report. June 14, 2002. Pg. 36

U.S. Army Corps of Engineers (Corps). 2005. *Upper York Creek Dam Removal Project Proposed Grading Plan- Alternative 2B*. U.S. Army Corps of Engineers, San Francisco District, South Pacific Division. July 27, 2005. Sheet 5.

U.S. Army Corps of Engineers (Corps). 2006. Rev. 2007. Final Draft Detailed Project Report: Upper York Creek Ecosystem Restoration Project, Napa County, California (DPR). U.S. Army Corps of Engineers, San Francisco District, South Pacific Division. December 15, 2006. Page E-10

Flood Protection

Project 5 – Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal

This project is a flood damage reduction priority for Napa County as demonstrated by a hydraulic study completed in 2007 (HSI, 2007) following flooding that occurred in December 31, 2005. Approximately 40 homes in a subdivision of 56 homes suffered damages during the 2005 event, which was characterized as approximately a 25-year flood return frequency. In 1997, Napa County voters passed Measure "A" which created a half cent sales tax to fund flood reduction and watershed improvement projects. This project has been approved by the Napa County Board of Supervisors as an approved project to utilize Measure "A" funding as the source of match funding for the IRWMP grant.

Subsequent to the 2007 hydraulic study, the County commissioned a feasibility study (RSA, 2011) to determine the most cost effective solutions to reducing the flooding threat to this residential area. The feasibility study indicated that three improvements are needed to protect homes up to and including the 100-year flood event: Removal of an old in-stream impoundment dam, creation of a floodwater bypass for an existing detention area and strategic grading to prevent floodwaters from overtopping the detention area.

Project 5 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Flood Protection	Prevent flooding of houses along Kaanapali Drive and reduce street flooding.	52 houses will be protected from flooding in a 100-year storm, 24 in a 50-year storm, and 13 in a 25-year storm[1] as compared to existing conditions.

[1] The fewer houses protected in smaller storms reflects the fact that fewer houses are inundated in such storms in the first place.

Project 5 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	Historically, overflow from Milliken Creek flowed through the golf course east of Kaanapali Drive, and the golf course served as a flood detention area. At some point after construction of houses along Kaanapali Drive in the 1960s, the natural outflow from the area was impeded. In recent years, high flows in the golf course detention area have led to flooding of homes as well as street flooding.
Estimates of no-project conditions in consideration of other planned projects	The winter storm of 2005 caused severe flooding of several houses along Kaanapali Drive as well as road flooding. Besides residential repair carried out by homeowner, the County and golf course had to employ crews to clear the road and golf course of debris. The 2005 storm was a 25-year storm and the flood model that has been developed has been calibrated and accurately describes the least amount of damage that would be experienced in this and storms larger than a 25-year storm.
Methods used to Estimate Physical Benefits	An unsteady state HEC-RAS model was used to estimate Water Surface Elevations (WSELs) for 25-, 50-, and 100-year storms. The resulting WSEL was compared with finished floor elevations (FFEs) and ground surface elevations to determine which houses and roads would be affected in the without- and with-project scenarios.
New facilities, policies, and actions required to obtain the physical benefits	Physical benefits will primarily be derived from removal of the in-stream obstruction. A new bypass weir channel will be installed to help limit the water surface elevation in the golf course detention area.
Uncertainty of benefits and contributing factors	Several factors can influence the severity of flooding; however the flood reduction benefits have been estimated using DWR accepted methodologies.
Potential adverse effects	The existing dam likely serves to some degree as grade control for the stream. During design of the stream channel restoration this issue will be addressed. In addition, the re-establishment of flood outflow from the golf course detention area, while returning the flooding conditions to those that existed historically, will result in a slight water surface increase along the County roadway. The final design will address and mitigate this water surface increase.

Table 9 – Annual Benefit: Project 5 – Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2016-2066	Flood Protection	# of residential structures protected at 100-yr flood elevation	0	52	52

References Cited:

Napa Milliken Creek Flood Damage Reduction and Fish Passage Barrier Removal F-RAM Model Inputs. (2012 dollars.)

HSI Hydrologic Systems. 2007. *Milliken Creek Flood Mitigation and Restoration Analysis*. December.

Riechers and Spence Associates. 2011. *Final Cost-Benefit Evaluation for Milliken Creek Flood Mitigation Measures*. December 22.

Project 9 – Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek

The Petaluma Flood Reduction, Water & Habitat Quality, and Recreation Project for Capri Creek consists of defined site treatments for over 1,400 lineal feet of creek, over 3,200 lineal feet of creek frontage along upland areas, linked to upper sections of Capri Creek that exist in a more natural corridor within an urban setting, including a section through the Santa Rosa Junior College Campus (second photo below) and downstream across North McDowell Boulevard as it flows to the Petaluma River. This site was selected for the potential to significantly reduce existing flooding in the surrounding neighborhood including a mobile home park, which provides affordable housing. This is the fourth City-managed project in an incremental flood reduction effort, incorporating policies and programs from multiple planning documents and studies.

The project involves construction of flood terraces and channel reconfiguration to address flooding and water quality issues, increase groundwater recharge; improve upland and riparian habitat; increase recreational and public education opportunities; and sequester carbon in improved riparian and upland habitats. Approximately 11,000 cubic yards of excess cut will be removed from the site, the remodeled flood terrace, and the upper banks of the existing low flow channel; and new banks of the wider flood terrace, containing approximately five acres, will be planted with a combination of native grasses and mid- and tall-canopy trees. Clusters of native shrubs will be provided, where deemed appropriate, in relationship to the trail, benches, and educational kiosks. The majority of recreational activity will be passive in nature, including walking along the restored creek corridor; bird watching; informal group activity such as picnics, educational field trips from the two elementary schools within close proximity of the site (Meadow and Corona Schools), and hopefully some field biology projects from the Kenilworth Junior High and Casa Grande High School, which has been very active in the restoration of another Petaluma waterway, Adobe Creek. The existing neighborhood garden adjacent to the corridor will also allow ancillary activities associated with growing riparian plants by neighborhood families. An example of an educational kiosk on another flood terrace project, and similar to what will be provided on this project, is provided below.

The project meets the core objectives identified in the City of Petaluma's 2025 General Plan, Petaluma River Access and Enhancement Plan, Petaluma River Watershed Enhancement Plan, and the Upper Petaluma River Watershed Flood Control Project Scoping Study, currently underway.

If the proposal is not implemented, environmental and economic impacts from flooding will continue unabated. For example, the New Year's 2005-2006 flood caused an estimated $56 million in damages within the Petaluma Watershed from that single event. This section of Capri Creek has out-of-bank flows even at low-intensity storm events. Groundwater levels will continue to decline and opportunities to slow, spread, and sink flows will be missed. Impaired water quality parameters will continue to persist while local stakeholder groups wait for the TMDL process to move forward in Petaluma. Opportunities for implementing in-stream and riparian enhancements that benefit recovery of the local riparian species will be missed without the project.

Project 9 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Flood Protection and Stormwater Management	Reductions in peak flow from channel recontouring, bank stabilization and construction of flood terraces.	Peak flow reduction of 60, 81, and 58 cubic feet per second in 10-year, 25-year, 100-year storm, respectively. Land uses protected from flooding include single family residences and a mobile home park.
Water Quality	Water quality improvements from redirecting deposition of trash, sediment and pollutants into reconnected floodplain, sediment capture in sediment removal basin, and riparian and emergent wetland vegetation from in-stream habitat structures.	The project site is downstream from residential areas, a community park, and a junior college campus. Beyond the campus is agricultural lands utilized for cattle grazing. No quantification has been obtained of the debris and pollutants from these land uses but science has shown that it exists in all communities. Recreation of a flood terrace will allow these materials and minerals to settle out of the slowly flowing water onto the flood terrace, thereby improving water quality of the Petaluma River.
Recreation or Open Space Improvement	Five acres of weeds will be restored to a riparian corridor with educational and passive recreational opportunities throughout.	The Sunrise Parkway open space is presently used primarily as a dog run area, no habitat exists for people to observe or learn from. Restoration of the five acres into a functional riparian corridor will allow people to enjoy and learn about watershed management and riverine habitats.

Project 9 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	The significant storms of New Year's Eve and Day, 2005-2006 resulted in significant out of bank flooding as reflected on the FEMA map excerpt on page 8. Significant reduction of out of bank flows, equal to elimination of flows for the 10-year storm, and 63 and 58 cfs reduction for the 25 and 100 year storms, respectively. These reductions will help maintain out of bank sheet flows within the public right-of-way and out of residential units.
Estimates of no-project conditions in consideration of other planned projects	Future peak flows equal or greater to the existing 60, 144 and 249 cfs (10, 25 and 100 year, respectively) will continue to adversely affect the neighborhood and public streets.
Relation of Project to other Proposed Projects	This project is the fourth flood terracing restoration project in the City of Petaluma flood reduction effort, incorporating policies and programs from City, County and watershed plans. The project is related to the physical benefit from the larger project because it provides a reduction in peak flow at the neighborhood scale and improves water quality at a community and regional scale for the Petaluma River, which flows to the Bay.
Methods used to Estimate Physical Benefits	HEC-RAS and XP-SWMM (Surface Water Management Model)
New facilities, policies, and actions required to obtain the physical benefits	Flood terrace and restored riparian habitat

Project 9 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Uncertainty of benefits and contributing factors	Uncertainty lies within the assumptions used in the model.
Potential adverse effects	None

Table 9 – Annual Benefit: Project 9 – Petaluma Flood Reduction, Water & Habitat Quality, and Recreation for Capri Creek					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2015-2064	Flood Protection	# of residential structures protected at 100-yr flood elevation	0	102	102
Comments: See Attachment 8 for further details					

References Cited:

City of Petaluma. 2008. *City of Petaluma: General Plan 2025.* May. Available: http://cityofpetaluma.net/cdd/plan-general-plan.html

City of Petaluma. 1996. *Petaluma River Access and Enhancement Plan.* Available: http://cityofpetaluma.net/pubworks/fp-river-enhancement.html

Hammond, Tom. 2011. *Capri Creek Flood Terrace Hydrologic Analysis Report, Maria Drive to N. McDowell Boulevard*. November.

Sonoma County Permits and Resource Management Department. 2008. *County of Sonoma General Plan 2020*. Adopted by Resolution No. 08-0808 of the Sonoma County Board of Supervisors, September 23, 2008.

The Southern Sonoma County Resource Conservation District and the people of the Petaluma Watershed. 1999. *Petaluma Watershed Enhancement Plan.* July. Available: http://www.sscrcd.org/publications.php#pwep

Waxman Environmental Consulting & Services, Questa Engineering Corporation, and City of Petaluma, Planning Department. 1996. *Restoration Design and Management Guidelines for the Petaluma River Watershed: Volume I and Volume II, Restoration and Revegetation Design*. July.

WEST Consultants, Inc. 2013. Capri Creek Terracing XP-Storm Evaluation Results Summary. February 13. To Pamela Tuft and Kent Carothers, City of Petaluma.

Project 10 – Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project

This project proposes to route flood flows from the Bayfront Canal and Atherton Channel into managed ponds that are part of the Ravenswood Pond Complex and the South Bay Salt Ponds Restoration project. With the project, flood flows from the Bayfront Canal will bypass around the Flood Slough tide gate and be routed into Ponds S5 and R5 of the Ravenswood pond complex. Stormwater flows will enable the development of seasonal freshwater wetlands habitat in Ponds S5 and R5 and support the restoration goals of the South Bay Salt Ponds project. The project will mitigate chronic and widespread flooding in the Bayfront Canal (Redwood City) and Atherton Channel (Menlo Park) neighborhoods.

If the project is not implemented the neighborhoods in Redwood City, Menlo Park, and unincorporated San Mateo County will continue to experience chronic and widespread flooding. In addition, the Ravenswood salt ponds will not have a source of fresh water to enhance wetland habitat, which can potentially hinder habitat restoration goals.

Project 10 – List of Project Benefits		
Benefit	**Brief Description of the Project Benefit**	**Amount of Benefit** (units of measure)
Flood Protection	Flood mitigation will occur when flood flows are routed into the Ravenswood Pond Complex and the South Bay Salt Ponds Restoration project.	Reduces the area of flooding from a 1-yr Storm event by 5 acres (55% reduction), 5-yr event by 13 acres (60% reduction), and a 25-yr event by 47 acres (30% reduction). The predominate land use in the Bayfront Canal area is Mobile-home communities and industrial properties. For the 1-yr event, 23 mobile homes and 90 sq. ft. of industrial property would be relieved of flooding. For the 5-yr event, 25 mobile homes and 10,000 sq. ft. of industrial property. For the 25-yr event, 258 mobile homes and 20,000 sq. ft. of industrial property.
Water Quality Improvement	Stormwater detained in ponds will improve the quality of runoff before discharge into the Bay from urban areas.	The 1-year rainfall event (statistically occurs every year) would route 62 ac-ft of flows into Ponds S5/R5 with a peak flow rate of roughly 300 cfs.
Habitat or Ecosystem Improvement	Providing freshwater to augment the managed pond habitat	Ponds S5/R5 constitute 66 acres of restored habitat that will be managed ponds. The 1-year rainfall event (statistically occurs every year) would route 62 ac-ft of flows into Ponds S5/R5 with a peak flow rate of roughly 300 cfs.
Other Physical Benefits	N/A	

Project 10 – Support for Project Benefits	
Background	**Brief Description of the Project's Expected Physical Benefits**
Recent and historical conditions	The properties adjacent to Bayfront Canal have a 60 year history of repetitive flood events, with 38 significant flood events from 1951 through 2011. 38 flood events in 60 years corresponds to significant flooding about every 1.6 years on average. All of these events involved substantial street flooding with road closures. 13 of the 38 flood events were larger events that also included flood damage to homes. The 1983 flood, the flood of record, was approximately a 100-year event.
Estimates of no-project conditions in consideration of other planned projects	Continued frequent flooding in Bayfront Canal area, and the Ravenswood Ponds would remain as unused salt ponds.
Relation of Project to other Proposed Projects	The restoration objective for Ravenswood Ponds S5/R5 is to enhance habitat value. While originally proposed as a managed pond to benefit birds, this area may provide significant opportunity to alleviate flooding concerns and improve runoff water quality from nearby Bayfront Canal neighborhoods and has potential to support additional recreational trails. The re-routing of Bayfront Canal flows would allow freshwater to augment the habitat of the managed ponds in the S5/R5 Ravenswood Ponds. The 5th Ave Station Pump Project cannot proceed until the downstream hydraulic constraint of Bayfront Canal is remedied. This project would therefore improves flooding on either side of HWY-101.
Methods used to Estimate Physical Benefits	FRAM Modeling
New facilities, policies, and actions required to obtain the physical benefits	The required culvert infrastructure for the project.
Uncertainty of benefits and contributing factors	Uncertainty lies within the assumptions used in the model.
Potential adverse effects	CEQA or NEPA impact assessments will be performed for the project.

Table 9 – Annual Benefit: Project 10 – Redwood City Bayfront Canal and Atherton Channel Flood Improvement and Habitat Restoration Project					
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**
2015-2064	Flood Protection	# of structures impacted at 100-yr flood elevation	948 Residential 340,782 Industrial	681 Residential 329,806 Industrial	# of structures Protected: 267 Residential 10,976 Industrial
Comments: See Attachment 8 for further details					

References Cited:

F-RAM Bayfront Canal Project calculations. (See Attachment 8)

Goettel, K. 2011. *5th Avenue Stormwater Pump Station Upgrade Project: Benefit Cost Analysis Report.* Redwood City, CA: City of Redwood City. October 16.

Moffatt & Nichol (M&N). 2012. *Bayfront Canal and South Bay Salt Ponds S5/R5 Flood Mitigation Feasibility Study*. Prepared for City of Redwood City. May 22.

URS. 2012. Opportunities and Constraints for Ravenswood Pond Complex, South Bay Salt Ponds Restoration, Phase II. June 28.