Attachment 8

Benefits and Cost Analysis

Cosumnes, American, Bear & Yuba River
Integrated Regional Water Management

ATTACHMENT 8: BENEFITS AND COST ANALYSIS

INTRODUCTION

CABY is a collaborative planning effort that adopted an Integrated Regional Water Management Plan (IRWMP) in December 2006. Diverse stakeholder involvement was a priority from its inception, and today CABY comprises 42 organizations representing water districts, government agencies, and agricultural, tribal, environmental, and community groups. The CABY region is made up of four watersheds—the Cosumnes, American, Bear, and Yuba--which combine to form a major drainage area of the western slope of the Sierra Nevada range, from the range crest to the Central Valley.

The CABY region contains vast forests and other natural, cultural and historic resources that support recreation, hydropower generation, tourism, agriculture, and species/habitats of localized and statewide significance. The collective streams, rivers, lakes, and reservoirs of these watersheds flow into the Sacramento River and contribute over 60 percent of the State's domestic water supply (DWR 2009). The future well-being of Californians depends heavily on the management and quality of water supply and infrastructure within this relatively small region.

Since 1849, with the discovery of gold in the heart of the CABY region, the area has experienced extensive alteration of its natural systems as a result of intense human activity. Rivers and creeks were dammed and diverted. Mountain meadows were utilized for grazing and livestock. Forests were logged, mining activities deposited thousands of pounds of elemental mercury and other heavy metals across the region, and anadromous fisheries (once plentiful across all regional creeks and rivers) were largely extinguished. Tribal resource management strategies were abandoned and Tribes disenfranchised.

CABY members selected the seven projects in this Proposal to demonstrate their commitment to retaining and restoring the physical infrastructure and ecological health of the region, and with it, building the resilience and the economic wellbeing of the residents of the region and the rest of California.

This attachment presents an economic analysis of the benefits and costs of each of the projects included within the Proposition 84 Round 2 funding proposal for the CABY Integrated Regional Water Management Plan. After describing the analytical framework, we include a complete, stand-alone assessment of each project's benefits and costs. For each project, we present a non-monetized benefits analysis (Section D2 and Table 12), followed by a monetized benefits analysis (Section D3 and Tables 15 and 16 as appropriate), which also details the costs of the project (Table 19).[1] Following the project-level economic analyses, we summarize the economic benefits and costs of the proposal package as a whole (Section D5 and Table 20).

FRAMEWORK

This benefit-cost analysis follows the instructions outlined in Exhibit D of the *Proposition 84 Proposal Solicitation Package* (DWR 2012). It follows the "DWR Method" for conducting the economic analysis. We analyze each of the seven projects included in the proposal package using a benefit-cost approach.

[1] None of the projects in this proposal package are assessed with a cost-effectiveness analysis (Section D1) or have flood reduction as their primary benefit, requiring a Flood Damage Reduction Benefit Analysis (Section D4).

The projects would yield economic benefits to the extent that they increase the value of goods and services available to Californians. The projects have the potential to increase the value of these goods and services in three ways:

1. By lowering the cost of providing a given good or service
   (e.g., by distributing water more efficiently through new pipes)
2. By increasing the supply of a given good or service
   (e.g., by creating new habitat for endangered species)
3. By increasing the demand for a given good or service
   (e.g., by educating consumers about the importance of cleaner rivers)

The projects would produce few goods and services directly; instead, they primarily would enhance the supply of capital necessary to provide goods and services.[2] Thus, the projects would produce benefits to the extent that they increase the region's stock of capital, and the quantity or types of goods and services that flow from it. The projects may also produce benefits to the extent that they affect the demand for, and, hence, the value of certain goods and services.

Consistent with widely accepted professional standards, we consider a broad suite of goods and services in the analysis, including those whose value comes from indirect or non-use of resources (U.S. Environmental Protection Agency 2009, National Research Council 2004, U.S. Environmental Protection Agency 2010). Economic benefits arising from some types of goods and services, especially those derived from changes in the supply of natural capital, human capital and social capital, are often difficult to quantify in monetary terms, because they are not traded in markets and cannot be measured using price data and price-dependent techniques. This does not mean that their value is zero.

Where data are unavailable to quantify the economic benefit in physical terms, monetary terms, or both, we describe the underlying change in relevant conditions with the project (versus without) and identify the sources of demand and illustrations of value related to the benefit. Our presentation of non-monetizable benefits is consistent with Section D2–*Non-Monetized Benefits Analysis.*

Where sufficient data are available to estimate the physical change in the stock or flow of goods and services *and* quantify the economic value of that change, we value the economic benefit in monetary terms, consistent with the instructions outlined in Section D3–*Monetized Benefits Analysis*. Our estimates reflect the marginal, net willingness of Californians to pay, measured in dollars of 2012, for the goods and services that the projects would increase.

In the following sections, we describe our methodology for estimating and describing non-monetized benefits, monetized benefits, and costs. For a few projects, we are only able to describe their economic importance in non-monetized terms. For most projects, however, we describe some benefits in monetized terms, and others in non-monetized terms. To understand the total economic value arising

[2] Economists use the term ***capital*** to describe resources commonly used to produce things people value (e.g., different types of goods and services). Classifications vary, but most economists generally recognize four types of capital: natural, human-built, human, and social. Natural capital refers to the components of nature, e.g., water, trees, and soil, and the interactions between these components. Human-built capital refers to water-delivery infrastructure, roads, and other tangible goods and infrastructure. Human capital refers to the knowledge and skills embodied in people. Social capital refers to social networks, cultural norms, laws, and political systems.

from each project, both monetized and non-monetized benefits must be considered together, then compared to the costs of the project.

Section D2. Non-Monetized Benefits Analysis

For each project, we describe the economic importance of the effects for which sufficient information does not exist to quantify in monetary terms. From an economic perspective, these effects improve the well-being of Californians, so should be accounted for in the benefit-cost analysis. Ignoring them or discounting their importance relative to the monetized benefits would result in an incomplete and biased analysis. To support the argument that these effects have economic importance, we provide a narrative description for each benefit that includes these categories of information:

- The project's marginal effect on each category of benefit presented in Table 12, comparing the without-project conditions to the with-project conditions. Where applicable, we rely on information presented in Attachment 7 to understand the physical changes arising from the project.
- Evidence of the economic importance of the effect. A biophysical effect is only important from an economic perspective if it provides something people want (and are willing to pay for). This is true even if the effect cannot be quantified in monetary terms. Thus, we describe the demand for the effect or the goods and services it might generate, including direct use, indirect use, and non-use demands. Wherever possible, we use local information to substantiate evidence of local demand. When local information does not exist, we provide evidence from the economic literature that demonstrates the value of the effect.
- When the benefit might materialize and how long it might persist.
- Who would benefit, and how the benefit would be distributed across stakeholders.
- Sources of uncertainty and how uncertainty might affect how or when the benefit materializes.

In some categories, the project may generate positive effects on biophysical parameters as described in Attachment 7 that have no additional effects from an economic perspective. These effects are not included separately in Table 12 or the accompanying narrative.

Section D3. Monetized Benefits Analysis

Benefits are monetizable only if sufficient data are available to quantify the physical effect *and* to determine an appropriate economic value. To estimate the value of monetizable benefits, we followed these steps:

- Used a with-vs.-without framework to describe the expected outcome of the project in terms of the expected net marginal increase in the supply of different types of goods and services, the marginal avoided costs of project-related activities, and/or the marginal change in the demand for goods and services. In some cases, this information is presented in biophysical terms in Attachment 7.
- Worked with project proponents and other individuals to identify project-specific information that would help us value the goods and services and avoided costs of the projects. Where project-specific or local information was not directly available, we reviewed the existing

economic literature to identify relevant studies that identify the marginal value to Californians of each type of good and service. We used benefit-transfer guidelines expressed by the U.S. Environmental Protection Agency (2010) to apply these values derived from studies conducted elsewhere to value the changes resulting from the project.[3]

- Adjusted each estimate of per-unit value of a good or service or avoided cost to its equivalent value in 2012 dollars, using the update factors provided in Table 14 of the *Proposition 84 Proposal Solicitation Package* (DWR 2012, pg. 50). For updating values before 2007, we use the Consumer Price Index.
- Estimated the annual value of the expected increase in the supply of each type of good or service by multiplying the expected annual increase in the supply times the per-unit value, in 2012 dollars. For avoided costs, we placed expenditures in the appropriate years they would have occurred or calculated an expected annual value based on the annual probability of occurrence.
- Assessed the uncertainty embodied in each estimate of annual value for each type of good or service, and determined if it is reasonable to conclude that it offers an unbiased representation of the true value of the good or service. In all cases, we selected an estimate of per-unit value that more likely than not yields an *underestimate of the true value* of a project's benefits.
- Completed an internal review process, to ensure the information we provide gives a reasonable description of the benefits and costs for each project.

To support the quantification in the tables, we provide a narrative description for each monetizable benefit that outlines the analytical assumptions, beneficiaries, and sources of uncertainty.

Section D3. Cost Analysis

To estimate costs—for example, projected expenditures on capital, operations, and maintenance activities—we relied on information provided by project proponents, following the guidelines presented in Section D3 (DWR 2012, pg. 48). Consistent with those guidelines, the cost estimates represent the full cost of the project, inclusive of capital, operations, and maintenance costs, and the opportunity cost of any volunteer labor, land, and other donated inputs required to implement the project.

[3] Insofar as possible, whenever project-specific estimates of value are not available, we have strived to identify estimates from settings with similar economic and ecological characteristics. We anticipate that the real value of some goods and services, such as high-quality water in streams, healthy riparian forests, and robust salmon populations, will increase over time, all else equal. However, we lack defensible forecasts of the rates of increase and, hence, have not folded these increases into our estimates.

CABY Integrated Regional Water Management Plan
Proposition 84, Round 2 Implementation Grant

1 Camptonville Water System Improvement Project

1. Camptonville Water System Improvement Project

Project Description

Conditions Without the Project
Camptonville Community Service District (CCSD) operates a water system that serves the community of Camptonville, a historic foothills community with a population of 188 and a mean household income of $27,031. The surface water in the Camptonville Water System (CWS) originates from Campbell's Gulch at an elevation of 3,100 feet and enters a slow-sand filter system at an elevation 3,036 feet. Water flows through the treatment plant under a head pressure of about 25 psi to the distribution system and continues to travel downhill to a flush valve elevation at 2,750 feet.

Surface water diversion into the plant is a constant non-managed flow and this results in needless diversions of surface water and treatment throughout the year. If customer demands diminish the plant still filters and treats diverted surface waters. Once the storage tank is full, excess water escapes the tank via a buried overflow pipe, where it returns to Campbell's Gulch.

The water system does not meet Federal Surface Water Treatment Rules nor state Title 22 water treatment standards. The slow-sand filter cannot meet the max daily demand without exceeding the design flow rate. The treatment plant lacks adequate instrumentation, warning systems, and process controls. Plant records indicate that the tank volume has fallen below the minimum needed to ensure chlorine "contact time" 30 times in the last two years.

The existing 64,000 gallon storage tank does not meet the max daily demand of 100,000 gallons and provides no reserve for fire flow. If a large fire occurs in Camptonville and water is taken from the fire hydrants for suppression, the tank level is drawn below the critical volume needed to treat the water for chlorine. When fire fighting occurs, it compromises water quality.

In times of drought, the surface water source, Campbell's Gulch, can see diminished flows of about 10 gpm, compared to normal summertime use of 40-65 gpm. During these times, operators must supplement the surface source with groundwater, from two wells. Both wells produce poor quality water intermittently: the well water is high in iron and manganese and well production diminishes rapidly due to rapid drawdown. Also, both wells lie at 2,800 feet and the water must be pumped to the slow-sand filter system at 3,036 feet, which requires additional energy for pumping.

Conditions With the Project
The project would retrofit the existing water treatment plant, construct a new water storage tank, and develop and institute significantly improved operational procedures, expand educational resources for its customers, and develop baseline information about groundwater resources.

Treatment plant improvements include increasing the size of the slow-sand filter and adding a process of implementation, data logging, warning systems, and refined controls. The new 220,000 gallon water storage tank would supplement the existing 64,000 gallon tank and provide reliability for the system to meet maximum daily demands and fire flow reserves. The project would install an additional slow-sand filter bed. Modifications to the plant would preserve the gravity fed system. The energy demands resulting from modifications would be minimal. The project would update its operations manual and operator training protocols to ensure complete implementation.

The project would also develop a geologic study of the Camptonville groundwater system, to identify potential sources of groundwater in and around Camptonville that would substitute for the low-quality wells the District currently relies on. Developing these wells would happen in later phases of system upgrades.

Finally, the project would support a “Water Efficiency Education” program to reduce consumption at the consumer level by promoting conservation and recycling practices in the service area.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-1 identifies the non-monetized benefits the project would likely generate.

Table 12-1. Non-monetized Benefits Checklist 1. Camptonville Water System Improvement Project		
No.	Will the proposal…	Response
Community/Social Benefits		
1	Provide education or technology benefits? Enhance customer knowledge about conservation	Yes
2	Provide social recreation or access benefits?	No
3	Help avoid, reduce or resolve various public water resources conflicts?	Yes
4	Promote social health and safety? Improved drinking water quality and Reduced risk of injury and death from improved fire protection	Yes
5	Have other social benefits? Reduce costs of fire insurance protection and/or increased property values	Yes
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7?	No
7	Improve water quality in ways that were not quantified in Attachment 7? Reduce discharges of chlorinated water	Yes
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	No
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	No
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7? Enhance supply capacity and support studies to identify alternate sources of groundwater	Yes
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)? Avoided costs and improved water-supply reliability associated with reduced probability of water system damage associated with wildfire	Yes

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

1. Provide education or technology benefits: Enhance customer knowledge about conservation

Underlying change. The project would support a "Water Efficiency Education" program to foster customer behavior changes that would promote conservation and reduce water consumption.

Evidence for demand and value. The CCSD's water supplies from Campbell's Gulch are limited, even with the project's supply capacity improvements. Reducing customer demand, especially during peak periods, would help CCSD avoid shortages when flows diminish during the summer months in Campbell's Gulch, improving the reliability of the system. Reducing demand could also delay the need to

develop additional supplemental groundwater supplies and reduce the costs associated with depending on them if they are developed. Data are unavailable to estimate the effect the education components of this project would have on customer demand, or the extent to which they'd result in cost savings for CCSD, but conservation is recognized as a highly effective mechanism to increase the efficiency and reduce the cost of operating municipal water systems (Gleick et al. 2003).

Timing and duration. The project would begin conferring these benefits as soon as conservation programs are in place. They would potentially persist for the life of the people who receive the information and change their behavior as a result.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD. Camptonville is a disadvantaged community.

Sources of uncertainty. To the extent that customers respond positively to educational efforts by CCSD and change their behavior, this project would produce benefits described above.

3. Help avoid, reduce, or resolve various public water resources conflicts

For the reasons described in monetized benefit #5 (Avoided costs associated with water-quality violations) below, the project confers this benefit. By demonstrating progress toward fixing violations, the CCSD would ease regulatory pressure and potentially avoid additional regulatory fines and penalties until it reaches full compliance with state and federal rules.

***4. Promote social health and safety:* Improved drinking water quality and fire protection**

Underlying change. The project provides safe drinking water by improving plant process instrumentation and controls to better adjust treatment processes, increasing the area of the slow-sand filter, and increase the size of the water storage tank to ensure the volume of water is kept above the minimum threshold needed to achieve adequate contact time. When water is needed for fire protection, water in the storage tank drops to levels where water quality is compromised. Construction of the additional slow-sand filter would allow the plant to meet maximum daily demand of 100,000 gallons without exceeding the design flow rate of 0.065 gpm/sf. The warning systems and refined controls would also allow operators to detect emerging treatment issues. The project would also ensure adequate fire flows for all residents of Camptonville, even when the system is at peak demand.

Evidence for demand and value. Maintaining adequate flows that ensure both safe drinking water and sufficient flows for fire protection would protect public health and safety. As described in monetized benefit #5 (Avoided cost of violations) below, by avoiding water quality violations, the project would reduce system operations costs. To the extent that people are willing to pay to enjoy water that meets all state and federal drinking water regulations, the benefit could be greater than the avoided cost of fines. To the extent that insufficiently chlorinated water produces health impacts, the project would also avoid medical costs and lost productivity resulting from illness. By the same logic, to the extent that the project is able to better-protect the properties in Camptonville from fire damage, it would avoid costs and potential injuries or loss of life. Data are unavailable to characterize these costs in monetary terms.

Timing and duration. The project would begin conferring these benefits when construction is complete, in 2015. These benefits would persist for the lifespan of the project, at least 25 years.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD and property owners and residents who depend on the water system to supply water for fire protection. Camptonville is a disadvantaged community.

Sources of uncertainty. This benefit depends on the project's success at preventing the water quality and fire protection deficiencies the system currently experiences. If demand for water increases beyond the design capacity of this project before the end of its expected lifespan, benefits could be smaller than described here.

5. Other social benefits: **Reduce costs of fire insurance protection and/or increased property values**

Underlying change. The project would provide minimum fire flow reserves without compromising contact time, providing wild fire suppression reserves in the State Responsibility Area (SRA) for a DAC with "Very High Fire Hazard Severity Zone" ranking. While we do not have sufficient data to predict how the project would change the insurance services office (ISO) rating for Camptonville, the project would increase the number of gallons of water available for fire protection by 120,000 gallons.

Evidence for demand and value. If the project reduces Camptonville's ISO rating, it could result in a direct benefit for residents and property owners in the community. The literature has documented examples of reductions in residential hazard insurance premiums as a result of changes in fire protection ratings. A study of the impacts of changes in the ISO ratings in North Monterey County found that improvements in operations and planning involving fire protection can result in reductions in insurance premiums for residents and businesses. The study found that after the North County Fire District implemented training programs, and began documenting and improving pump tests, training, and hose pressure tests, insurance premiums for businesses and residents decreased between 15 and 30 percent (Orman 2006).

Improved fire protection could also impact property values. The body of literature surrounding hedonic pricing effects of fire risks supports the conclusion that an increase in fire risk (or the number of recent fires), results in a decrease in the home prices in that area. One study found that multiple fires reduced home prices: the first fire reduced house prices by around 10 percent, and the second fire reduced house prices by about 23 percent (Mueller, Loomis, and Gonzalez-Caban). Studies have also found a connection between the perceived risk of a hazard and the values of the homes in the potentially affected area (Huggett 2003). This implies that mitigation efforts may have a subjective effect on the perception of the hazards, which may consequently affect home values.

While enhanced fire protection, in and of itself, likely wouldn't reduce the probability that fires occur, it could reduce the severity of the fire, and thus the associated damage and the perception in the community that fires are a problem.

Timing and duration. The project would begin conferring these benefits when construction is complete, in 2015. These benefits would persist for the lifespan of the project, at least 25 years.

Beneficiaries. The beneficiaries would include the property owners in Camptonville, particularly those whose hazard insurance rates would be reduced by a lower ISO rating. Camptonville is a disadvantaged community.

Sources of uncertainty. This benefit depends on the ability of the project to reduce Camptonville's fire protection rating. If the project does not result in this reduction, this benefit would not materialize. Improvements in fire flows such as the ones the project would support have had an effect on other community ISO ratings in California.

7. Improve water quality: **Reduce discharges of chlorinated water**

Underlying change. By increasing storage capacity, the project would eliminate discharges of chlorinated water into Campbell's Gulch, which would promote soil health, plant health, and animal health in the area of the discharge. Data are not sufficient to estimate the project's impact on the change in concentrations of chlorination in Campbell's Gulch.

Evidence for demand and value. Data are not available to accurately estimate the adverse impacts of chlorinated water discharged into Campbell's Gulch, or its immediate or long-run effects on fish, wildlife, or environmental quality. However, all forms of chlorine are hazardous to aquatic life even at extremely low levels (Peterka 2002). To the extent that chlorinated water harms downstream environmental resources that people care about, especially scare resources, such as threatened and endangered salmonids, curtailing its release would produce economic benefits.

Timing and duration. The project would begin conferring these benefits when construction is complete, in 2015. These benefits would persist for the lifespan of the project, at least 25 years.

Beneficiaries. The beneficiaries would include the citizens of California who care about and value natural resources that could be adversely affected by chlorine discharges into the environment.

Sources of uncertainty. While a substantial body of research indicates that chlorine at the level in treated water can harm the environment, data on its direct effects on the biotic resources in Campbell's Gulch and downstream receiving waters is unavailable. To the extent that the discharges from the Camptonville system produce adverse effects, this benefit would materialize.

14. Improve water supply reliability in ways not quantified in Attachment 7: **Enhance supply capacity and support studies to identify alternate sources of groundwater**

Underlying change. In the past, during low flow / high demand periods, CCSD has been unable to meet short-term needs when the treatment plant could not supply sufficient water. In these cases, CCSD has purchased treated water and paid for transport by tanker truck. In times of drought operators have also supplemented with groundwater from two wells. Both wells produce poor quality water intermittently: the well water is high in iron and manganese and well production diminishes rapidly due to rapid drawdown. The project would fund studies to identify better-quality wells to serve as supplemental water sources.

Evidence for demand and value. The improvements to system capacity would reduce the costs customers of CCSD incur when supplies are insufficient to meet demands. To the extent that the project's groundwater studies support future groundwater supply development, the project would also improve supply reliability and reduce the risk of future shortages. Studies have shown that people are willing to pay to improve reliability. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

Timing and duration. The project would begin conferring these benefits when construction is complete, in 2015. These benefits would persist for the lifespan of the project, at least 25 years.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD. Camptonville is a disadvantaged community.

Sources of uncertainty. The value of this benefit would depend on the likelihood of supply disruptions without the project and the degree to which improvements mitigate the problem. Although actual disruptions in service have occurred infrequently in the past, future conditions may increase the risk that they would occur. The project's improvements to supply and contribution toward developing additional groundwater supplies in the future that would enhance reliability, it is likely to confer these benefits.

15. Other Avoided costs and improved water-supply reliability associated with reduced probability of water system damage associated with wildfire

Underlying change. The water treatment plant sits on 3.9 acres of timbered land, in an area zoned "Very High" fire severity by the California Department of Forestry and Fire Protection (California Department of Forestry and Fire Protection 2007). The plant is at risk of damage and loss due to wildfire, and currently hazardous fuel lie within 25 feet of the slow-sand filter structure. The proposed fuels treatment is removal of ladder fuels, increased spacing of trees and brush, and compliance with PRC 4291. The project would target 2 acres, providing fuels treatment within 200 feet of the plant and the tank structure.

Evidence for demand and value. Regular fuels treatment around critical infrastructure is standard practice in wildlife-prone areas. If a wildfire occurred, extensive damage to the water treatment plant could occur. The CCSD would incur costs associated with emergency repairs and, perhaps, customers would experience disruption in water service, perhaps for an extended time. Data are insufficient to describe the costs associated with damage to the water treatment plant in the even of a wildfire or the annual probability that the wildfire would threaten it.

Timing and duration. The project would begin conferring these benefits when treatment is complete, in 2015. These benefits would persist for about 5 years, when treatment would need to occur again.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD, agencies and individuals responsible for fire protection who would depend on the water delivery infrastructure to fight fire, and nearby property owners potentially affected by wildfires. Camptonville is a disadvantaged community.

Sources of uncertainty. Reducing fuel loads would reduce the risk of fire damage to the water system, but it would not eliminate it. The degree to which CCSD would avoid costs during a wildfire would depend not only on its own fuels treatment practices, but also on the severity and location of a wildfire event and the forest conditions on nearby and adjacent property. Conditions conducive to wildfires have been increasing in California with climate change, and based on recent modeling efforts, are especially likely to increase in the Sierra foothills northeast of Sacramento (Westerling and Bryant 2008). To the extent that fire risk increases, the value of this benefit would increase in the future.

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $167,123. The calculations for each monetized benefit are shown in Tables 15-1 through 15-5 at the end of this section.

1. Increased instream flows for environmental purposes

Underlying change. The project would include instrumentation, online data collection, and process controls that would manage the flow to the treatment plant / storage tank, reducing treated water overflows to Campbell's Gulch. The project proponents' goal is to reduce net diversions from Campbell's Gulch by 3,000,000 gallons per year (9.21 acre-feet per year). The Gulch is a year-round spring fed creek. In the summer season, flows downstream of the diversion can diminish significantly.

Evidence for demand and value. Additional instream flows in Campbell's Gulch would help support ecosystem goods and services that people value, including improved habitat for species and clean water for recreation and other uses. This region of the Sierra serves as a critical source of water that ultimately sustains demands in the Central Valley and beyond. A recent study that included information on the lease rates paid for water rights in the Central Valley found that the average leases rate for instream flows environmental purposes between 2000 and 2009 was $128 per acre foot (*WestWater Research in* Aylward and Merrill 2012). We use this value to measure the value of additional water for in-stream flows to enhance ecosystems, water-quality and fish and other affected species. Using this value, the annual, undiscounted value of increasing surface flows to Campbell's Gulch by 9.21 acre-feet per year would be $1,179 per year.

Timing and duration. The project would begin conferring these benefits when construction and implementation is complete, in 2015. These benefits would persist for the lifespan of the project, 25 years.

Beneficiaries. The beneficiaries of this benefit would include several groups of stakeholders including commercial fishermen and recreational anglers in both marine and freshwater fisheries, and the people of California insofar as they value an increase in fish populations. It would also benefit other recreational users of water, such as kayakers and wildlife watchers, Californians who place a non-use value on maintaining sufficient instream flows for environmental purposes, and other water users, such as irrigators, who bear increased regulatory pressure and costs to increase instream flows by reducing their own use of water.

Sources of uncertainty. The value we derive from the data provided by WestWater Research, as presented in the findings of Aylward and Merrill (2012) embodies the uncertainty inherent in the individual study as well as from applying results from past research to future conditions. There is, however, no obvious reason to conclude that the estimate systematically overestimates the true marginal value of water for environmental purposes from the CABY region. As human populations and incomes grow in California, the marginal value of wild salmonid populations and other benefits derived from instream flows for environmental purposes is likely to increase, as will the value of stream flows that support their continued existence. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates we apply in this analysis underestimate—perhaps substantially—the true value of future increases in water supplies that would result from the projects.

2. Reduced water treatment costs

Underlying change. The project would reduce the amount of water treated in the plant by 20-30 percent, on an annual basis, about 3,000,000 gallons (9.21 acre-feet) per year. As a result, Camptonville would avoid costs related to lower chemical costs and lower filter media replacement costs.

Evidence for demand and value. Project proponents estimate it costs roughly $3.80 to treat 1,000 gallons of raw water; however, much of that includes fixed costs. Project proponents estimate treatment costs for water produced in excess of water consumed includes $0.78 per 1,000 gallons for labor and $0.36 per 1,000 gallons for maintenance, repairs, energy, and chemicals. Therefore the total variable costs associated with water treatment are $1.14 per 1,000 gallons. The total, undiscounted value of this benefit is therefore $3,420 per year.

Timing and duration. The project would begin conferring these benefits when construction and implementation is complete, in 2015. These benefits would persist for the lifespan of the project, 25 years.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD. Camptonville is a disadvantaged community.

Sources of uncertainty. To the extent that the price of treatment chemicals increases over time in real terms over the lifespan of the project, we would underestimate the value of this benefit. These costs are based on recent past treatment demands for the water system. To the extent that future operations require more or less inputs to maintain adequate water quality, we would be underestimating or overestimating the value of this benefit.

3. Reduced operation and maintenance costs

Underlying change. The project would eliminate treatment of excess water discharged to waste, which will reduce the frequency of filter maintenance operations. In addition, by the filter cell flush valves will allow more efficient ranking of the Schmutzdecke. With these changes, project proponents expect to reduce labor costs by 10 percent.

Evidence for demand and value. In fiscal year 2011-2012, CCSD operator labor was 1,128 hours for a total of $20,420 (this calculation includes two different salary rates). Assuming a 10 percent reduction, the project would save 113 man-hours and approximately $2,042 per year.

Timing and duration. The project would begin conferring these benefits when construction and implementation is complete, in 2015. These benefits would persist for the lifespan of the project, 25 years.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD. Camptonville is a disadvantaged community.

Sources of uncertainty. These costs are based on recent past labor demands for the water system. To the extent that future operations require more or less inputs to maintain adequate water quality, we would be underestimating or overestimating the value of this benefit.

4. Avoided costs associated with bulk water purchases

Underlying change. In the past, during low flow / high demand periods, CCSD has been unable to meet short-term needs when the treatment plant could not supply sufficient water. In these cases, CCSD has purchased treated water and paid for transport by tanker truck.

Evidence for demand and value. In July of 2011, the one-day cost of treated water purchase and transport was $1,742 using the H2O To Go vendor. These costs have only occurred once in the past 15 years. Preventing these types of system failures depend on operator skill and devotion, neither of which are affordable for the district. Given expected environmental trends and available capacity and skills of operators, the project proponents expect it is reasonable to assume that, without the project, these types of water shortages would occur once every five years. Assuming an outage would last 3 days, the total cost every five years is $5,226.

Timing and duration. Without the project, these costs would occur for 3 days every five years. The project would begin conferring avoided costs related to bulk water purchases when construction and implementation is complete, in 2015. These benefits would persist for the lifespan of the project, 25 years.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD. Camptonville is a disadvantaged community.

Sources of uncertainty. The value of this benefit depends on the extent to which the project helps CCSD improve its ability to meet short term demands and therefore avoids costs associated with bulk water purchases. It also depends on the frequency and duration of water shortages in the baseline conditions.

5. Avoided costs associated with water-quality violations

Underlying change. The CCSD incurs approximately 15 violations per year related to non-compliance with state drinking water requirements (specified in Title 22 of California's Code of Regulations). Construction of the additional slow-sand filter would allow the plant to meet maximum daily demand of 100,000 gallons without exceeding the design flow rate of 0.065 gpm/sf, as stipulated in Title 22. The warning systems and refined controls would also allow operators to detect emerging treatment emergencies in compliance with Title 22. As a result of the project, CCSD would avoid these violations.

Evidence for demand and value. Subpart (d) and (e) of Section 116650, Chapter 7 of the California Health and Safety Code (Title 22) imposes civil penalties up to $200 per day once a compliance date has been set. The Yuba County Environmental Health would also bill CCSD at the rate of $119 per hour for all "enforcement costs." While we cannot estimate the exact amount of labor Yuba County for which CCSD would bill, project proponents estimate they would charge a lump sum for approximately 8 hours of

labor per month of enforcement action. In total, the undiscounted value of this benefit is $7,000 per month of violation status. We assume that the water system incurs one month of violation per year for a total annual cost of $7,000.

Timing and duration. We assume that, without the project, these violations would occur approximately once a year, for one month. The project would begin to confer these benefits in 2015 and they would persist for the lifespan of the project.

Beneficiaries. The beneficiaries would include the customers and ratepayers of the CCSD. Camptonville is a disadvantaged community. Beneficiaries would also include Yuba County's enforcement officers, who would be able to dedicate scare resources to addressing other issues in the County.

Sources of uncertainty. This benefit assumes that Yuba County enforcement officials would enforce fines without the project as described above. To the extent that they are more lenient or strict, these benefits would be underestimated or overestimated. As long as CCSD is demonstrating good faith toward fixing sources of violations, fines and penalties would be more lenient. However, if this project is not implemented, evidence of a "good faith" effort may diminish and heavier penalties may arise.

Table 15-1 Increased instream flows for environmental purposes
(All benefits should be in 2012 dollars)

Project: Camptonville Water System Improvement Project

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	Type of Benefit	Measure of Benefit (Units)	Without Project	With Project	Change Resulting from Project (e) – (d)	Unit $ Value (1)	Annual $ Value (1) (f) x (g)	Discount Factor (1)	Discounted Benefits (1) (h) x (i)
2012	Reduced water overflows	acre-feet	0	0	0	$ 1 28.00	$ -	1.000	$ -
2013	Reduced water overflows	acre-feet	0	0	0	$ 1 28.00	$ -	0.943	$ -
2014	Reduced water overflows	acre-feet	0	0	0	$ 1 28.00	$ -	0.890	$ -
2015	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.840	$ 9 90
2016	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.792	$ 9 34
2017	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.747	$ 8 81
2018	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.705	$ 8 31
2019	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.665	$ 7 84
2020	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.627	$ 7 40
2021	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.592	$ 6 98
2022	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.558	$ 6 58
2023	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.527	$ 6 21
2024	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.497	$ 5 86
2025	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.469	$ 5 53
2026	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.442	$ 5 21
2027	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.417	$ 4 92
2028	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.394	$ 4 64
2029	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.371	$ 4 38
2030	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.350	$ 4 13
2031	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.331	$ 3 90
2032	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.312	$ 3 68
2033	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.294	$ 3 47
2034	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.278	$ 3 27
2035	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.262	$ 3 09
2036	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.247	$ 2 91
2037	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.233	$ 2 75
2038	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.220	$ 2 59
2039	Reduced water overflows	acre-feet	0	9.21	9.21	$ 1 28.00	$ 1 ,178.88	0.207	$ 2 44
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	$ 1 3,412.28

Comments: Improvements would reduce the treated water overflows to Campbeel's Gulch by 3 million gallons or 9.21 acre-feet/years

Table 15-2 Reduced water treatment costs

(All benefits should be in 2012 dollars)

Project: Camptonville Water System Improvement Project

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduction of treated water	'000 gallons	0	0	0	$ 1.14	$ -	1.000	**$ -**
2013	Reduction of treated water	'000 gallons	0	0	0	$ 1.14	$ -	0.943	**$ -**
2014	Reduction of treated water	'000 gallons	0	0	0	$ 1.14	$ -	0.890	**$ -**
2015	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.840	**$ 2,871**
2016	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.792	**$ 2,709**
2017	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.747	**$ 2,556**
2018	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.705	**$ 2,411**
2019	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.665	**$ 2,274**
2020	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.627	**$ 2,146**
2021	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.592	**$ 2,024**
2022	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.558	**$ 1,910**
2023	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.527	**$ 1,802**
2024	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.497	**$ 1,700**
2025	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.469	**$ 1,603**
2026	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.442	**$ 1,513**
2027	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.417	**$ 1,427**
2028	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.394	**$ 1,346**
2029	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.371	**$ 1,270**
2030	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.350	**$ 1,198**
2031	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.331	**$ 1,130**
2032	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.312	**$ 1,066**
2033	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.294	**$ 1,006**
2034	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.278	**$ 9 49**
2035	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.262	**$ 8 95**
2036	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.247	**$ 8 45**
2037	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.233	**$ 7 97**
2038	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.220	**$ 7 52**
2039	Reduction of treated water	'000 gallons	0	3000	3000	$ 1.14	$ 3,420.00	0.207	**$ 7 09**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 38,909.82**

Comments:

Table 15-3 – Reduced operation and maintenance costs
(All benefits should be in 2012 dollars)

Project: Camptonville Water System Improvement Project

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced man-hours	hours	0	0	0	$ 18.10	$ -	1.000	**$ -**
2013	Reduced man-hours	hours	0	0	0	$ 18.10	$ -	0.943	**$ -**
2014	Reduced man-hours	hours	0	0	0	$ 18.10	$ -	0.890	**$ -**
2015	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.840	**$ 1,717**
2016	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.792	**$ 1,620**
2017	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.747	**$ 1,528**
2018	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.705	**$ 1,442**
2019	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.665	**$ 1,360**
2020	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.627	**$ 1,283**
2021	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.592	**$ 1,211**
2022	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.558	**$ 1,142**
2023	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.527	**$ 1,077**
2024	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.497	**$ 1,016**
2025	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.469	**$ 959**
2026	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.442	**$ 905**
2027	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.417	**$ 853**
2028	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.394	**$ 805**
2029	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.371	**$ 760**
2030	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.350	**$ 717**
2031	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.331	**$ 676**
2032	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.312	**$ 638**
2033	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.294	**$ 602**
2034	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.278	**$ 568**
2035	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.262	**$ 535**
2036	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.247	**$ 505**
2037	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.233	**$ 477**
2038	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.220	**$ 450**
2039	Reduced man-hours	hours	0	113	113	$ 18.10	$ 2,045.30	0.207	**$ 424**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 23,269.67**

Comments: The project would reduce the need for man hours by 10%, or 113 man hours. The average cost per man hour given the total expenditure on CCSD operators in fiscal year 2011-2012 is $18.10/hour.

Table 15-4 – Avoided costs associated with bulk water purchases

(All benefits should be in 2012 dollars)

Project: Camptonville Water System Improvement Project

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced bulk water purchases	reduced probability of failure	0	0	0	$ 5,226.00	$ -	1.000	**$ -**
2013	Reduced bulk water purchases	reduced probability of failure	0	0	0	$ 5,226.00	$ -	0.943	**$ -**
2014	Reduced bulk water purchases	reduced probability of failure	0	0	0	$ 5,226.00	$ -	0.890	**$ -**
2015	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.840	**$ 878**
2016	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.792	**$ 828**
2017	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.747	**$ 781**
2018	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.705	**$ 737**
2019	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.665	**$ 695**
2020	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.627	**$ 656**
2021	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.592	**$ 619**
2022	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.558	**$ 584**
2023	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.527	**$ 551**
2024	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.497	**$ 519**
2025	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.469	**$ 490**
2026	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.442	**$ 462**
2027	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.417	**$ 436**
2028	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.394	**$ 411**
2029	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.371	**$ 388**
2030	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.350	**$ 366**
2031	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.331	**$ 345**
2032	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.312	**$ 326**
2033	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.294	**$ 307**
2034	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.278	**$ 290**
2035	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.262	**$ 274**
2036	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.247	**$ 258**
2037	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.233	**$ 244**
2038	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.220	**$ 230**
2039	Reduced bulk water purchases	reduced probability of failure	0	0.2	0.2	$ 5,226.00	$ 1,045.20	0.207	**$ 217**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 11,891.39**

Comments: Bulk water purchases are assumed to be required once every five years under the without project conditions with a 20% probability of occurance in each of the five years. These purchases typically last 3 days at a cost of $1,742/day.

Table 15-5 – Avoided costs associated with water-quality violations
(All benefits should be in 2012 dollars)

Project: Camptonville Water System Improvement Project

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced Fines and Fees	Dollars	0	0	0	$ 7,000.00	$ -	1.000	**$ -**
2013	Reduced Fines and Fees	Dollars	0	0	0	$ 7,000.00	$ -	0.943	**$ -**
2014	Reduced Fines and Fees	Dollars	0	0	0	$ 7,000.00	$ -	0.890	**$ -**
2015	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.840	**$ 5,877**
2016	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.792	**$ 5,545**
2017	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.747	**$ 5,231**
2018	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.705	**$ 4,935**
2019	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.665	**$ 4,655**
2020	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.627	**$ 4,392**
2021	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.592	**$ 4,143**
2022	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.558	**$ 3,909**
2023	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.527	**$ 3,688**
2024	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.497	**$ 3,479**
2025	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.469	**$ 3,282**
2026	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.442	**$ 3,096**
2027	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.417	**$ 2,921**
2028	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.394	**$ 2,756**
2029	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.371	**$ 2,600**
2030	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.350	**$ 2,452**
2031	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.331	**$ 2,314**
2032	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.312	**$ 2,183**
2033	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.294	**$ 2,059**
2034	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.278	**$ 1,943**
2035	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.262	**$ 1,833**
2036	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.247	**$ 1,729**
2037	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.233	**$ 1,631**
2038	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.220	**$ 1,539**
2039	Reduced Fines and Fees	Dollars	0	1	1	$ 7,000.00	$ 7,000.00	0.207	**$ 1,452**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 79,639.99**

Comments: The calculations assume that there will be one month worth of violation fines and fees each year. Project proponents valued one such month at $7000.

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2039, is $888,544 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[4]

The water treatment plant will require ongoing operations and maintenance, including one daily visit, which we estimate at one hour per day. The District would not staff the plant during all operating hours as a result of fiscal constraints. The fuels treatment plant would also require periodic maintenance, estimated as 16 hours per year of plant operator time. We value both of these staff costs using the Bureau of Labor Statistics most recent estimates of wages for maintenance and repair workers, $17.75 per hour.

CCSD is an all-volunteer agency and will contribute effort to the project. That time is factored into the budget, using an hourly rate of $25.00/hour, demonstrated as in-kind matching funds. The project would also use volunteer time to produce the "water efficiency education" materials. We include 32 hours of volunteer time for that task. This labor is not specialized, so we value it using California's current minimum wage, $8.00 per hour.

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: Camptonville Water System Improvement Project

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 239,220.00							$ 239,220	0.943	$ 225,679
2014	$ 658,084.52		$ 256.00					$ 658,341	0.890	$ 585,921
2015				$ 6,763.00				$ 6,763	0.840	$ 5,678
2016				$ 6,763.00				$ 6,763	0.792	$ 5,357
2017				$ 6,763.00				$ 6,763	0.747	$ 5,054
2018				$ 6,763.00				$ 6,763	0.705	$ 4,768
2019				$ 6,763.00				$ 6,763	0.665	$ 4,498
2020				$ 6,763.00				$ 6,763	0.627	$ 4,243
2021				$ 6,763.00				$ 6,763	0.592	$ 4,003
2022				$ 6,763.00				$ 6,763	0.558	$ 3,776
2023				$ 6,763.00				$ 6,763	0.527	$ 3,563
2024				$ 6,763.00				$ 6,763	0.497	$ 3,361
2025				$ 6,763.00				$ 6,763	0.469	$ 3,171
2026				$ 6,763.00				$ 6,763	0.442	$ 2,991
2027				$ 6,763.00				$ 6,763	0.417	$ 2,822
2028				$ 6,763.00				$ 6,763	0.394	$ 2,662
2029				$ 6,763.00				$ 6,763	0.371	$ 2,512
2030				$ 6,763.00				$ 6,763	0.350	$ 2,369
2031				$ 6,763.00				$ 6,763	0.331	$ 2,235
2032				$ 6,763.00				$ 6,763	0.312	$ 2,109
2033				$ 6,763.00				$ 6,763	0.294	$ 1,989
2034				$ 6,763.00				$ 6,763	0.278	$ 1,877
2035				$ 6,763.00				$ 6,763	0.262	$ 1,771
2036				$ 6,763.00				$ 6,763	0.247	$ 1,670
2037				$ 6,763.00				$ 6,763	0.233	$ 1,576
2038				$ 6,763.00				$ 6,763	0.220	$ 1,487
2039				$ 6,763.00				$ 6,763	0.207	$ 1,402
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										$ 888,544

Comments:

[4] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

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CABY Integrated Regional Water Management Plan
Proposition 84, Round 2 Implementation Grant

2 City of Placervlle Waterline Replacement Project

2. City of Placerville Waterline Replacement

Project Description

Conditions Without the Project
The City of Placerville has a population of 10,383 with 2,257 residential and 626 commercial water connections. The water distribution system in the City of Placerville is aging, some sections date back to the early 1900s, and suffer from significant leakages. These leakages contribute significantly to the City's 20 percent rate of unaccounted water, twice the 10 percent expected rate for urban water systems.

City maintenance staff have observed water surfacing along a "cross country pipeline" and estimate this pipeline is contributing significantly to the unaccounted for water. The system provides minimum flow requirements for fire protection for local resources, properties, and people. This system reduces water supply reliability of portions of the City. For example, the connections that this project addresses, which represent about 80 people, suffer from complete water outages about once per year. These last about 24 hours. They also reduce the City's capacity to deliver water supplies for fire flow.

The City also must conduct increased operations and maintenance and emergency repair activities as a result of the leaks. They also face significant risks associated with increased likelihood of bursting pipes.

Conditions With the Project
The Pardi/Big Cut/Sacramento Street Waterlines Replacement Project would replace and relocate the water distribution pipeline sections that are: 1) deteriorated and leaking, 2) undersized for domestic and fire protection needs, and/or 3) poorly located for maintenance due to inaccessibility.

The project would install approximately 3,700 feet of 8-inch and 12-inch replacement pipeline within existing road rights-of-way and utility easements. This would include the waterlines A and AA located on Pardi Way, B on Big Cut Road, C on Gilmore Street, and D on Sacramento Street.

With these changes, the project would improve the water supply reliability of 24 connections; reduce operations and maintenance costs; and reduce emergency repair costs.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-2 identifies the non-monetized benefits the project would likely generate.

Table 12-2. Non-monetized Benefits Checklist 2. City of Placerville Waterline Replacement		
No.	Will the proposal…	Response
Community/Social Benefits		
1	Provide education or technology benefits?	No
2	Provide social recreation or access benefits?	No
3	Help avoid, reduce or resolve various public water resources conflicts?	No
4	Promote social health and safety? Reduced risk of injury and death from improved fire protection	Yes
5	Have other social benefits? Reduce costs of fire insurance protection and/or increased property values from better fire protection	Yes
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7?	No
7	Improve water quality in ways that were not quantified in Attachment 7? Avoided costs associated with reduced probability of sediment delivery	Yes
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	No
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	No
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7? Reduced risk of outage from pipe failure, improve overall supply reliability by increasing system efficiency	Yes
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

4. Promote social health and safety: Reduced risk of injury and death from improved fire protection

Underlying change. Placerville's water distribution pipelines are undersized for fire protection needs. The project would improve public health and safety by improving the pressure and reliability of system operations to support flows for fire protection.

Evidence for demand and value. The improvements in fire protection would improve the public health and safety of residents in Placerville, by reducing the likelihood and degree of damage from fire, which would also reduce the risk of injuries and death. While we cannot quantify the value of these improvements, they are likely significant. The U.S. Environmental Protection Agency estimates the value of a statistical life is $8.14 million, based on willingness to pay for small reductions in mortality risk (EPA

2012). We discuss the effects of improved capability to fight fires on property values in non-monetized benefit #5 (Reduce costs of fire insurance) below.

Timing and duration. The project would begin conferring these benefits after construction is complete in 2014. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit would be the residents and property owners in the City of Placerville.

Sources of uncertainty. The value of this benefit depends on the degree to which the project effectively improves water supply reliability for fire flow delivery.

5. Other social benefits: **Reduce costs of fire insurance protection**

Underlying change. As we describe above, Placerville's water distribution pipelines are undersized for fire protection needs. The project would improve the pressure and reliability of system operations to support flows for fire protection, which would reduce the risk of property loss from a catastrophic fire.

Evidence for demand and value. If the project reduces Placerville's ISO rating, it could result in a direct benefit for residents and property owners in the community. The literature has documented examples of reductions in residential hazard insurance premiums as a result of changes in fire protection ratings. A study of the impacts of changes in the ISO ratings in North Monterey County found that improvements in operations and planning involving fire protection can result in reductions in insurance premiums for residents and businesses. The study found that after the North County Fire District implemented training programs, and began documenting and improving pump tests, training, and hose pressure tests, insurance premiums for businesses and residents decreased between 15 and 30 percent (Orman 2006).

Improved fire protection could also impact property values. The body of literature surrounding hedonic pricing effects of fire risks supports the conclusion that an increase in fire risk (or the number of recent fires), results in a decrease in the home prices in that area. One study found that multiple fires reduced home prices: the first fire reduced house prices by around 10 percent, and the second fire reduced house prices by about 23 percent (Mueller, Loomis, and Gonzalez-Caban). Studies have also found a connection between the perceived risk of a hazard and the values of the homes in the potentially affected area (Huggett 2003). This implies that mitigation efforts may have a subjective effect on the perception of the hazards, which may consequently affect home values.

While enhanced fire protection, in and of itself likely wouldn't reduce the probability that fires occur, it could reduce the severity of the fire, and thus the associated damage and the perception in the community that fires are a problem.

Timing and duration. The project would begin conferring these benefits after construction is complete in 2014. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit would be property owners in the City of Placerville.

Sources of uncertainty. The reduced insurance benefit depends on the ability of the project to reduce the City's fire protection rating or change perception about fire risk in Placerville, and mechanism by

which that translates to changes in the prices of hazard insurance policies in Placerville. If the project does not result in a reduction in cost to property owners or a change in perceptions, this benefit would not materialize. The extent to which improved fire protection would increase property values would depend on perceptions of fire risk and overall market conditions. There is no obvious reason why the results of the studies of fire occurrence and home value would not apply to the properties in Placerville.

7. Improve water quality: **Avoided costs associated with reduced probability of sediment delivery**

Underlying change. By replacing the water pipelines, the project would reduce the risk of a catastrophic pipe failure, which could cause structural damage and erosion and deliver sediment to nearby streams. Data are unavailable to estimate the amount of sediment erosion a pipe failure would cause to estimate the magnitude of this benefit.

Evidence for demand and value. Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the counties in CABY region, which is about $9 per ton, to estimate the benefits derived from the prevention of sediment deposition.

Timing and duration. The project would begin reducing the probability of catastrophic failure and sediment delivery after construction is complete in 2014. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit are water users downstream of sediment deposition including agricultural and municipal users, recreational users, and people who care about damage to fish and wildlife habitat from increased sedimentation.

Sources of uncertainty. The value of this benefit depends on the probability of catastrophic failure of pipelines in the without project conditions, as well as the physical effects of that failure. Data are unavailable to characterize these effects.

14. Improve water supply reliability in ways not quantified in Attachment 7? **Reduced risk of outage from pipe failure, improve overall supply reliability by increasing system efficiency**

We quantify the avoided costs to the City of providing bulk water when water shortages occur under monetized benefit #6 (Avoided costs associated with bulk water purchases). To the extent that water shortages generate costs for customers, for instance if the City issues mandatory conservation orders while it is supplying bulk water, or if the system's operation changes in response to shortages in ways that customers notice (e.g., reduced pressure), this value would underestimate the full value of improving water supply reliability. Studies have shown that people are willing to pay to improve reliability. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $760,385. The calculations for each monetized benefit are shown in Tables 15-1 through 15-6 at the end of this section.

1. Increased instream flows for environmental purposes

Underlying change. By reducing leakages of treated water, the project would reduce the City's total water demand by 70 acre-feet of water per year.

Evidence for demand and value. Additional instream flows would help support ecosystem goods and services that people value, including improved habitat for species and clean water for recreation and other uses. This region of the Sierra serves as a critical source of water that ultimately sustains demands in the Central Valley and beyond. A recent study that included information on the lease rates paid for water rights in the Central Valley found that the average leases rate for instream flows environmental purposes between 2000 and 2009 was $128 per acre foot (*WestWater Research in* Aylward and Merrill 2012). We use this value to measure the value of additional water for in-stream flows to enhance ecosystems, water-quality and fish and other affected species. Using this value, the annual, undiscounted value of offsetting 70 acre-feet per year of diverted surface flows would be $8,960 per year.

The project would also help meet the State Water Resources Control Board 20x2020 Water Conservation plan by reducing water leakages caused by deteriorating water pipelines, thereby contributing to the City of Placerville's overall water savings.

Timing and duration. The project would begin reducing the probability of catastrophic failure and sediment delivery after construction is complete in 2014. To reduce the risk that we overestimate benefits, we assume the benefits would begin to accrue in 2015. The benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit would include several groups of stakeholders including commercial fishermen and recreational anglers in both marine and freshwater fisheries, and the general public insofar as they value an increase in fish populations regardless of any potential future direct use or exposure to the impacted fish populations. It would also benefit other recreational users of water, such as kayakers and wildlife watchers, Californians who place a non-use value on maintaining sufficient instream flows for environmental purposes, and other water users, such as irrigators, who bear increased regulatory pressure and costs to increase instream flows by reducing their own use of water.

Sources of uncertainty. The value we derive from the data provided by WestWater Research, as presented in the findings of Aylward and Merrill (2012) embodies the uncertainty inherent in the individual study as well as from applying results from past research to future conditions. There is, however, no obvious reason to conclude that the estimate systematically overestimates the true marginal value of water for environmental purposes from the CABY region. As human populations and incomes grow in California, the marginal value of wild salmonid populations and other benefits derived from instream flows for environmental purposes is likely to increase, as will the value of stream flows that support their continued existence. Because we found no reliable estimate of the rate of increase,

we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates we apply in this analysis underestimate—perhaps substantially—the true value of future increases in water supplies that would result from the projects.

2. Reduced operation and maintenance costs

Underlying change. By installing approximately 3,700 feet of 8-inch and 12-inch replacement pipeline within existing road rights-of-way and utility easements, the project would save costs associated with operations and maintenance (O&M).

Evidence for demand and value. Project proponents estimate the value of the O&M savings from the improvements is $10,000 per year in labor and materials costs for making repairs.

Timing and duration. The project would begin conferring benefits related to reduced O&M costs after construction is complete in 2014. To reduce the risk that we've overestimated this benefit, we assume it would begin to accrue in 2015. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit would be the taxpayers and ratepayers of the City of Placerville.

Sources of uncertainty. The estimate of value is based on the best expert judgment of the water system's operators, based on the cost of recent pipe repairs and the frequency of failures. To the extent that costs would differ in the future without the project this would over or under-estimate the value of the benefit.

3. Avoided costs associated with reduced energy costs

Underlying change. By reducing leakages of treated water, the project would reduce water demands by 70 acre-feet of water per year. Using the U.S. EPA's Pollution Prevention Program Greenhouse Gas calculator, we estimate the City would reduce energy demands associated with water distribution and pumping by 75,273 kwh per year.

Evidence for demand and value. The average electricity costs for medium general demand metered service customers of PG&E range from $0.10959 to $0.14335 per kWh in the summer months (these vary by secondary, primary, and transmission voltage). Using the low end of this range to remain conservative, we estimate the City would save $8,249 per year from reduced energy demand.

Timing and duration. The project would begin conferring benefits related to reduced energy costs after construction is complete in 2014. To reduce the risk that we're overestimating this benefit, we assume this benefit would begin to accrue in 2015. This benefit would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit would be the taxpayers and ratepayers of the City of Placerville.

Sources of uncertainty. This benefit is more likely to underestimate than overestimate the value of the reduced electricity use since we're using a lower estimate for the cost of electricity. To the extent that electricity rates increase in real terms in the future, we would also be underestimating the value of this benefit. Additional uncertainty arises from the differences between the assumptions EPA's calculator uses to estimate electricity use per unit of water compared to the City's actual costs. Data aren't available to determine if our value is an over or underestimate.

4. Avoided costs of climate change from reduced carbon emissions

Underlying change. By reducing energy consumption, the project would avoid the social costs associated with greenhouse gas emissions. Using the U.S. EPA's Pollution Prevention Program Greenhouse Gas calculator, we estimate the project would reduce greenhouse gas emissions (including CO_2, CH_4 and N_2O) by 34 tons per year.

Evidence for demand and value. The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[5] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

[5] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. The annual, undiscounted value of this benefit is $442. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change.

Timing and duration. The project would begin conferring benefits related to reduced carbon emissions after construction is complete in 2014. To reduce the risk of overestimating this benefit, we assume it would begin to accrue in 2015. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit are all residents of California.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. If the true cost of carbon dioxide lies closer to the upper or lower end of the range we presented above, our unit value would represent an under or overestimate.

5. Avoided costs associated with reduced air quality pollutants

Underlying change. Using a tool created by the US Environmental Protection Agency to calculate emissions based on avoided electricity consumption, by reducing energy consumption, the project would reduce emissions of air borne pollutants. The project would reduce air quality pollutants by 61 pounds per year. This includes 50 pounds per year of CO; 4 pounds per year of PM, 1.2 pounds per year of VOC, and 6.7 pounds per year of TOC.

Evidence for demand and value. Air pollution has been linked to several societal costs including health-related costs associated air quality-related illnesses as well as environmental costs such as those associated with acid rain. To quantify the value of associated with the decrease in air emissions from the project-induced decrease in energy generation from fossil fuel facilities, we apply a set of pollutant-specific avoided costs from the literature. The U.S. Forest Service has estimated the California-specific value of avoided costs associated with reductions in carbon monoxide emissions ($0.85/lb) and particulate matter ($4.00/lb) (U.S. Forest Service 2013). Using these values, we estimate the project would reduce costs associated with these air pollutants by an annual, undiscounted value of about $60.

These values could significantly underestimate the actual value of reducing pollutants. The California Environmental Protection Agency compiled market prices paid for emission reduction offsets for NOx, PM_{10}, CO, and SOx. (California Environmental Protection Agency 2011). The average value for a pound of PM_{10} was $20-$26, while average price paid per pound of CO was $2.70-$3.10.

Timing and duration. The project would begin conferring benefits related to reduced carbon emissions after construction is complete in 2014. To reduce the risk of overestimating this benefit, we assume it would begin to accrue in 2015. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit are all residents of California.

Sources of uncertainty. These values reflect the uncertainty of the underlying studies that estimate the average value paid for reducing emissions. However, by not valuing two of the pollutants, we have likely underestimated the overall value of reducing pollution from electricity production.

6. Avoided costs associated with bulk water purchases

Underlying change. By replacing and relocating sections of the water distribution system, the project would avoid costs related to bulk water purchases. Project proponents estimate that, under current conditions, the City experiences at least one outage per year, which lasts for 24 hours, and affects about 80 customers. The City also faces intermittent shortfalls in water supply throughout the year. When these shortfalls occur, the City purchases bulk treated water for its residents. With the project, the City would have sufficient supply to avoid these water purchases.

Evidence for demand and value. Project proponents estimate the City of Placerville spends about $20,000 per year to purchase treated water during shortages and shortfalls. This is the undiscounted, annual value from avoided bulk water purchases.

Timing and duration. The project would begin conferring benefits related to reduced bulk water purchases after construction is complete in 2014. To avoid the risk of overestimating this benefit, we assume these benefits would begin to accrue in 2015. These benefits would persist for the lifespan of the infrastructure, 25 years.

Beneficiaries. The beneficiaries of this benefit would be the taxpayers and ratepayers of the City of Placerville.

Sources of uncertainty. To the extent that pipe failures and system shortages would increase over time, increasing the demand for bulk water, these costs would underestimate the value the project would provide.

Table 15-1 – Increased instream flows for environmental purposes
(All benefits should be in 2012 dollars)

Project: City of Placerville Waterline Replacement

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Reduced water leakage	acre-feet	0	0	0	$ 128.00	$ -	1.000	**$ -**
2013	Reduced water leakage	acre-feet	0	0	0	$ 128.00	$ -	0.943	**$ -**
2014	Reduced water leakage	acre-feet	0	0	0	$ 128.00	$ -	0.890	**$ -**
2015	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.840	**$ 7,523**
2016	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.792	**$ 7,097**
2017	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.747	**$ 6,695**
2018	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.705	**$ 6,316**
2019	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.665	**$ 5,959**
2020	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.627	**$ 5,622**
2021	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.592	**$ 5,303**
2022	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.558	**$ 5,003**
2023	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.527	**$ 4,720**
2024	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.497	**$ 4,453**
2025	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.469	**$ 4,201**
2026	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.442	**$ 3,963**
2027	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.417	**$ 3,739**
2028	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.394	**$ 3,527**
2029	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.371	**$ 3,327**
2030	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.350	**$ 3,139**
2031	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.331	**$ 2,961**
2032	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.312	**$ 2,794**
2033	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.294	**$ 2,636**
2034	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.278	**$ 2,486**
2035	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.262	**$ 2,346**
2036	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.247	**$ 2,213**
2037	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.233	**$ 2,088**
2038	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.220	**$ 1,969**
2039	Reduced water leakage	acre-feet	0	70	70	$ 128.00	$ 8,960.00	0.207	**$ 1,858**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 101,939.19**

Comments: The average lease rate for instream flows for environmental purposes is $128/acre-foot

Table 15-2 – Reduced operation and maintenance costs
(All benefits should be in 2012 dollars)

Project: City of Placerville Waterline Replacement

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Reduced O&M Cost	Dollars	0	0	0	$ 10,000.00	$ -	1.000	**$ -**
2013	Reduced O&M Cost	Dollars	0	0	0	$ 10,000.00	$ -	0.943	**$ -**
2014	Reduced O&M Cost	Dollars	0	0	0	$ 10,000.00	$ -	0.890	**$ -**
2015	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.840	**$ 8,396**
2016	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.792	**$ 7,921**
2017	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.747	**$ 7,473**
2018	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.705	**$ 7,050**
2019	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.665	**$ 6,651**
2020	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.627	**$ 6,274**
2021	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.592	**$ 5,919**
2022	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.558	**$ 5,584**
2023	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.527	**$ 5,268**
2024	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.497	**$ 4,970**
2025	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.469	**$ 4,688**
2026	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.442	**$ 4,423**
2027	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.417	**$ 4,173**
2028	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.394	**$ 3,936**
2029	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.371	**$ 3,714**
2030	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.350	**$ 3,503**
2031	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.331	**$ 3,305**
2032	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.312	**$ 3,118**
2033	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.294	**$ 2,942**
2034	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.278	**$ 2,775**
2035	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.262	**$ 2,618**
2036	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.247	**$ 2,470**
2037	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.233	**$ 2,330**
2038	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.220	**$ 2,198**
2039	Reduced O&M Cost	Dollars	0	1	1	$ 10,000.00	$ 10,000.00	0.207	**$ 2,074**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 113,771.41**

Comments: Savings are conferred through replaced pipeline that requires lower O&M

Table 15-3 – Avoided costs associated with reduced energy costs
(All benefits should be in 2012 dollars)

Project: City of Placerville Waterline Replacement

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Reduced electricity costs	kWh	0	0	0	$ 0 .11	$ -	1.000	**$ -**
2013	Reduced electricity costs	kWh	0	0	0	$ 0 .11	$ -	0.943	**$ -**
2014	Reduced electricity costs	kWh	0	0	0	$ 0 .11	$ -	0.890	**$ -**
2015	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.840	**$ 6 ,926**
2016	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.792	**$ 6 ,534**
2017	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.747	**$ 6 ,164**
2018	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.705	**$ 5 ,815**
2019	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.665	**$ 5 ,486**
2020	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.627	**$ 5 ,176**
2021	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.592	**$ 4 ,883**
2022	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.558	**$ 4 ,606**
2023	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.527	**$ 4 ,346**
2024	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.497	**$ 4 ,100**
2025	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.469	**$ 3 ,868**
2026	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.442	**$ 3 ,649**
2027	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.417	**$ 3 ,442**
2028	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.394	**$ 3 ,247**
2029	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.371	**$ 3 ,063**
2030	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.350	**$ 2 ,890**
2031	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.331	**$ 2 ,726**
2032	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.312	**$ 2 ,572**
2033	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.294	**$ 2 ,427**
2034	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.278	**$ 2 ,289**
2035	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.262	**$ 2 ,160**
2036	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.247	**$ 2 ,037**
2037	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.233	**$ 1 ,922**
2038	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.220	**$ 1 ,813**
2039	Reduced electricity costs	kWh	0	75273	75273	$ 0 .11	$ 8 ,249.17	0.207	**$ 1 ,711**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 93,851.95**

Comments: Reduced water leakage leads to reduced water distribution and pumping, t hereby reducing energy costs. kWh estimates are based on calculations of the US EPA's Pollution Prevention Program Greenhouse Gas calculator

Table 15-4 – Avoided costs of climate change from reduced carbon emissions
(All benefits should be in 2012 dollars)

Project: City of Placerville Waterline Replacement

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Reduced greenhouse gas emissions	tons	0	0	0	$ 13.00	$ -	1.000	**$ -**
2013	Reduced greenhouse gas emissions	tons	0	0	0	$ 13.33	$ -	0.943	**$ -**
2014	Reduced greenhouse gas emissions	tons	0	0	0	$ 13.66	$ -	0.890	**$ -**
2015	Reduced greenhouse gas emissions	tons	0	34	34	$ 14.00	$ 475.99	0.840	**$ 400**
2016	Reduced greenhouse gas emissions	tons	0	34	34	$ 14.35	$ 487.89	0.792	**$ 386**
2017	Reduced greenhouse gas emissions	tons	0	34	34	$ 14.71	$ 500.08	0.747	**$ 374**
2018	Reduced greenhouse gas emissions	tons	0	34	34	$ 15.08	$ 512.58	0.705	**$ 361**
2019	Reduced greenhouse gas emissions	tons	0	34	34	$ 15.45	$ 525.40	0.665	**$ 349**
2020	Reduced greenhouse gas emissions	tons	0	34	34	$ 15.84	$ 538.53	0.627	**$ 338**
2021	Reduced greenhouse gas emissions	tons	0	34	34	$ 16.24	$ 552.00	0.592	**$ 327**
2022	Reduced greenhouse gas emissions	tons	0	34	34	$ 16.64	$ 565.80	0.558	**$ 316**
2023	Reduced greenhouse gas emissions	tons	0	34	34	$ 17.06	$ 579.94	0.527	**$ 306**
2024	Reduced greenhouse gas emissions	tons	0	34	34	$ 17.48	$ 594.44	0.497	**$ 295**
2025	Reduced greenhouse gas emissions	tons	0	34	34	$ 17.92	$ 609.30	0.469	**$ 286**
2026	Reduced greenhouse gas emissions	tons	0	34	34	$ 18.37	$ 624.53	0.442	**$ 276**
2027	Reduced greenhouse gas emissions	tons	0	34	34	$ 18.83	$ 640.15	0.417	**$ 267**
2028	Reduced greenhouse gas emissions	tons	0	34	34	$ 19.30	$ 656.15	0.394	**$ 258**
2029	Reduced greenhouse gas emissions	tons	0	34	34	$ 19.78	$ 672.56	0.371	**$ 250**
2030	Reduced greenhouse gas emissions	tons	0	34	34	$ 20.28	$ 689.37	0.350	**$ 242**
2031	Reduced greenhouse gas emissions	tons	0	34	34	$ 20.78	$ 706.60	0.331	**$ 234**
2032	Reduced greenhouse gas emissions	tons	0	34	34	$ 21.30	$ 724.27	0.312	**$ 226**
2033	Reduced greenhouse gas emissions	tons	0	34	34	$ 21.83	$ 742.38	0.294	**$ 218**
2034	Reduced greenhouse gas emissions	tons	0	34	34	$ 22.38	$ 760.93	0.278	**$ 211**
2035	Reduced greenhouse gas emissions	tons	0	34	34	$ 22.94	$ 779.96	0.262	**$ 204**
2036	Reduced greenhouse gas emissions	tons	0	34	34	$ 23.51	$ 799.46	0.247	**$ 197**
2037	Reduced greenhouse gas emissions	tons	0	34	34	$ 24.10	$ 819.44	0.233	**$ 191**
2038	Reduced greenhouse gas emissions	tons	0	34	34	$ 24.70	$ 839.93	0.220	**$ 185**
2039	Reduced greenhouse gas emissions	tons	0	34	34	$ 25.32	$ 860.93	0.207	**$ 179**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 6,875.24**

Comments:

Table 15-5 - Avoided costs associated with reduced air quality pollutants

(All benefits should be in 2012 dollars)

Project: City of Placerville Waterline Replacement

(a)	(b)	(c)	(d)	(e)	(d)	(e)	(f)	(g)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project - PM**	**With Project - PM**	**Without Project - CO**	**With Project - CO**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Reduced air borne pollutants	pounds	0	0	0	0	0	$ 4.00	$ 0.85	$ -	1.000	**$ -**
2013	Reduced air borne pollutants	pounds	0	0	0	0	0	$ 4.00	$ 0.85	$ -	0.943	**$ -**
2014	Reduced air borne pollutants	pounds	0	0	0	0	0	$ 4.00	$ 0.85	$ -	0.890	**$ -**
2015	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.840	**$ 49**
2016	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.792	**$ 46**
2017	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.747	**$ 44**
2018	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.705	**$ 41**
2019	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.665	**$ 39**
2020	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.627	**$ 37**
2021	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.592	**$ 35**
2022	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.558	**$ 33**
2023	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.527	**$ 31**
2024	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.497	**$ 29**
2025	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.469	**$ 27**
2026	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.442	**$ 26**
2027	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.417	**$ 24**
2028	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.394	**$ 23**
2029	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.371	**$ 22**
2030	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.350	**$ 20**
2031	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.331	**$ 19**
2032	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.312	**$ 18**
2033	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.294	**$ 17**
2034	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.278	**$ 16**
2035	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.262	**$ 15**
2036	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.247	**$ 14**
2037	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.233	**$ 14**
2038	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.220	**$ 13**
2039	Reduced air borne pollutants	pounds	0	4	0	50	54	$ 4.00	$ 0.85	$ 58.50	0.207	**$ 12**
										Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 665.56**

Comments: VOCs and TOCs are not included in this calculation. Columns E & G are the reduced tonnage of PM_10 and CO each year. These amounts correspond to two different per ton values in columns I & J, respectively.

Table 15-6 – Reduced bulk water purchases
(All benefits should be in 2012 dollars)

Project: City of Placerville Waterline Replacement

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Bulk water purchases	dollars	0	0	0	$ 20,000.00	$ -	1.000	**$ -**
2013	Bulk water purchases	dollars	0	0	0	$ 20,000.00	$ -	0.943	**$ -**
2014	Bulk water purchases	dollars	0	0	0	$ 20,000.00	$ -	0.890	**$ -**
2015	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.840	**$ 16,792**
2016	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.792	**$ 15,842**
2017	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.747	**$ 14,945**
2018	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.705	**$ 14,099**
2019	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.665	**$ 13,301**
2020	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.627	**$ 12,548**
2021	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.592	**$ 11,838**
2022	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.558	**$ 11,168**
2023	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.527	**$ 10,536**
2024	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.497	**$ 9,939**
2025	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.469	**$ 9,377**
2026	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.442	**$ 8,846**
2027	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.417	**$ 8,345**
2028	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.394	**$ 7,873**
2029	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.371	**$ 7,427**
2030	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.350	**$ 7,007**
2031	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.331	**$ 6,610**
2032	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.312	**$ 6,236**
2033	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.294	**$ 5,883**
2034	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.278	**$ 5,550**
2035	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.262	**$ 5,236**
2036	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.247	**$ 4,940**
2037	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.233	**$ 4,660**
2038	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.220	**$ 4,396**
2039	Bulk water purchases	dollars	0	1	1	$ 20,000.00	$ 20,000.00	0.207	**$ 4,147**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 227,542.83**

Comments: The City experiences, on average, one outage per year, which requires a bulk water purchase at an average price of $20,000.

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2014, is $1,291,794 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[6]

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: City of Placerville Waterline Replacement

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 158,840.00							$ 158,840	0.943	$ 149,849
2014	$ 1,283,089.00							$ 1,283,089	0.890	$ 1,141,945
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										$ 1,291,794

Comments:

[6] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

CABY Integrated Regional Water Management Plan
Proposition 84, Round 2 Implementation Grant

3 El Dorado County Small Hydroelectric Development Program

3. El Dorado County Small Hydroelectric Development Program

Project Description

Conditions Without the Project
State policies and regulations to respond to climate change have increased the demand in California for electricity generated from non-carbon, renewable resources. These demands are expected to grow as other states and the federal government enact new policies and regulations over the next few years to respond to climate change. California's Renewable Portfolio Standard requires that California utilities purchase or generate 33 percent of their electricity from non-carbon, renewable sources by 2020.

Conditions With the Project
Project sponsors would install a 590 kW in-conduit hydroelectric facility in one of El Dorado Irrigation District's existing water storage tanks, which would generate 1,585 MWh of electricity per year. The facility would act as a pressure-reducing station within the District's existing system, and would generate electricity while reducing pipeline pressure. The electricity the facility generates would be purchased by PG&E, and transmitted to the grid (near Pleasant Valley Road, less than 50 feet from the site).

While overall electricity demand in California would not change with the project, the distribution of electricity would increase incrementally by the 1,585 MWh the project would generate each year. Since the project would help support the State's efforts to supply 33 percent of its electricity from non-carbon, renewable energy sources, we assume that it would replace electricity generated by natural gas facilities. Since PG&E would pay market rates for the electricity the project would generate, there would be no change in the electricity rates PG&E charges its ratepayers.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-3 identifies the non-monetized benefits the project would likely generate.

Table 12-3. Non-monetized Benefits Checklist 3. El Dorado County Small Hydroelectric Development Program		
No.	Will the proposal…	Response
Community/Social Benefits		
1	Provide education or technology benefits? Demonstrate an innovative way to produce renewable electricity with existing resources and build momentum for future projects	Yes
2	Provide social recreation or access benefits?	No
3	Help avoid, reduce or resolve various public water resources conflicts?	No
4	Promote social health and safety? Improved air quality and reduced health impacts	Yes
5	Have other social benefits?	No
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7?	No
7	Improve water quality in ways that were not quantified in Attachment 7?	No
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	No
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	Yes
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	Yes
14	Improve water supply reliability in ways not quantified in Attachment 7? Enhance reliability and resiliency of local electricity grid	Yes
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

1. Provide education or technology benefits **Demonstrate an innovative way to produce renewable electricity with existing resources and build momentum for future projects**

Underlying change. The project would represent El Dorado Irrigation District's first in-conduit small hydroelectric facility.

Evidence for demand and value. The project would provide valuable information regarding the potential future implementation of similar projects. To the extent that this project provides efficiencies in future, similar efforts, it would provide a benefit in the form of avoided costs and risks undertaken in future efforts.

Timing and duration. The project would provide benefits related to its demonstration qualities immediately after implementation begins, and these benefits would persist for the lifespan of the project and through future projects.

Beneficiaries. The beneficiaries of this benefit would include the citizens of California, and other agencies and entities that would benefit from the lessons learned on this project.

Sources of uncertainty. This project would likely provide valuable information whether it succeed or fails. The value of the information depends on how well and extensively it is communicated to people who would gain something from understanding the lessons learned from the project.

4. Promote social health and safety

For reasons described below in monetized benefit #1 (Reduction in greenhouse gas emissions) and monetized benefit #2 (Reduction in emissions of airborne pollutants), the project has the potential to improve air quality and mitigate potentially harmful effects of climate change by supplying non-carbon, renewable energy to California's electricity grid.

12. Provide a long-term solution in place of a short-term one

For reasons described below in monetized benefit #1 (Reduction in greenhouse gas emissions) and monetized benefit #2 (Reduction in emissions of airborne pollutants), the project has the potential to provide a long-term solution to California's mission to generate 33 percent of its energy from non-carbon, renewable resources by 2020.

13. Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources

For reasons described below in monetized benefit #1 (Reduction in greenhouse gas emissions) and monetized benefit #2 (Reduction in emissions of airborne pollutants), the project would replace fossil fuel based energy sources with non-carbon, renewable energy.

14. Improve water supply reliability in ways not quantified in Attachment 7: **Enhance reliability and resiliency of local electricity grid**

Relevant change. Distributed renewable energy projects support local community electrical grids in many ways. One key benefit is having local sources of power that can support the grid regionally and especially in rural areas when large, central station power generating stations go off-line or power transmission lines fail due to weather, fire, or other cause. Because water treatment and distribution depend on a continuous power supply for operations, having energy facilities located in the vicinity of water system facilities makes water system operations less likely to experience interruptions in power supply and therefore be more reliable.

Evidence for demand and value. While sufficient data are unavailable to quantify this benefit, research suggests that households prefer non-drought conditions to drought conditions and are willing to pay for increased water supply and water reliability. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

Timing and duration. Project sponsors anticipate completing the installation process by the end of 2014, which means that benefits from the project would begin in 2015. The anticipated agreement with PG&E is expected to last at least 40 years, although contract extensions beyond the period are likely. Assuming that the facility remains in use, these benefits would persist for the lifetime of the project, 50 years.

Beneficiaries. The beneficiaries of this benefit would be El Dorado Irrigation District's water users.

Sources of uncertainty. The value of this benefit would depend on the degree to which this energy project makes water system operations less likely to experience interruptions in power supply and therefore be more reliable.

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $245,873. The calculations for each monetized benefit are shown in Tables 15-1 and 15-2 at the end of this section.

1. Reduction in greenhouse gas emissions

Underlying change. According to project sponsors, the project would generate 1,585 MWh of non-carbon, renewable energy each year. This electricity would replace 1,585 MWh worth of electricity that PG&E currently generates from other sources each year. Since the project would help support the State's efforts to supply 33 percent of its electricity from non-carbon, renewable energy sources, we assume that it would replace electricity generated by natural gas facilities. According the calculations completed by the project sponsor with a tool created by the US Environmental Protection Agency, the project's electricity generation would reduce annual greenhouse gas emissions by 716 metric tonnes of carbon dioxide equivalent.

Evidence for demand and value. The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[7] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

[7] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. Furthermore, we inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change. After applying this value to the 716 metric tonnes of carbon dioxide equivalent (789 tons of carbon dioxide equivalent) associated with the project, the annual, undiscounted value of this benefit would be $10,257, increasing at a real rate of 2.5 percent per year.

Timing and duration. Project sponsors anticipate completing the installation process by the end of 2014, which means that benefits from the project would begin in 2015. The anticipated agreement with PG&E is expected to last at least 40 years, although contract extensions beyond the period are likely. Assuming that the facility remains in use, these benefits would persist for the lifetime of the project, 50 years.

Beneficiaries. The beneficiaries of this benefit would be all residents of California.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. If the true cost of carbon dioxide lies closer to the upper or lower end of the range we presented above, our unit value would represent an under or overestimate.

2. Reduction in emissions of airborne pollutants

Underlying change. The project would generate 1,585 MWh of non-carbon, renewable energy each year. This electricity would replace 1,585 MWh worth of electricity that PG&E currently generates from other sources. Since the project would help support the State's efforts to supply 33 percent of its electricity from non-carbon, renewable energy sources, we assume that it would replace electricity generated by natural gas facilities, which emit harmful airborne pollutants into the atmosphere. By replacing energy created with fossil fuels, it would decrease the volume of harmful air pollutants emitted into the atmosphere. According the calculations completed by the project sponsor with a tool created by the US Environmental Protection Agency, the project's electricity generation would reduce annual emissions of carbon monoxide by 1,060 lbs, particulate matter by 85 lbs, volatile organic carbon by 27 lbs, and total organic carbon by 142 lbs.

Evidence for demand and value. Air pollution has been linked to several societal costs including health-related costs associated air quality-related illnesses as well as environmental costs such as those associated with acid rain. To quantify the value of associated with the decrease in air emissions from the project-induced decrease in energy generation from fossil fuel facilities, we apply a set of pollutant-specific avoided costs from the literature. The U.S. Forest Service has estimated the California-specific value of avoided costs associated with reductions in carbon monoxide emissions ($0.85/lb) and particulate matter ($4.00/lb) (U.S. Forest Service 2013). By applying these values to the 1,060 lbs of carbon monoxide and 85 lbs of particulate matter associated with the project, the annual, undiscounted value of this benefit would be $1,242. Data are not sufficient to quantify the value associated with the reduction in volatile and total organic carbon emissions.

These values could significantly underestimate the actual value of reducing pollutants. The California Environmental Protection Agency compiled market prices paid for emission reduction offsets for NOx, PM_{10}, CO, and SOx. (California Environmental Protection Agency 2011). The average value for a pound of PM_{10} was $20-$26, while average price paid per pound of CO was $2.70-$3.10.

Timing and duration. Project sponsors anticipate completing the installation process by the end of 2014, which means that benefits from the project would begin in 2015. The anticipated agreement with PG&E is expected to last at least 40 years, although contract extensions beyond the period are likely. Assuming that the facility remains in use, these benefits would persist for the lifetime of the project, 50 years.

Beneficiaries. The beneficiaries of this benefit would be all residents of California.

Sources of uncertainty. These values reflect the uncertainty of the underlying studies that estimate the average value paid for reducing emissions. However, by not valuing two of the pollutants, we have likely underestimated the overall value of reducing pollution from electricity production.

Table 15-1 – Reduction in greenhouse gas emissions
(All benefits should be in 2012 dollars)

Project: El Dorado County Small Hydroelectric Development Program

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced Carbon Dioxide Emissions	tons	0	0	0	$ 13.00	$ -	1.000	**$ -**
2013	Reduced Carbon Dioxide Emissions	tons	0	0	0	$ 13.33	$ -	0.943	**$ -**
2014	Reduced Carbon Dioxide Emissions	tons	0	0	0	$ 13.66	$ -	0.890	**$ -**
2015	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 14.00	$ 11,045.67	0.840	**$ 9,274**
2016	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 14.35	$ 11,321.81	0.792	**$ 8,968**
2017	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 14.71	$ 11,604.85	0.747	**$ 8,672**
2018	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 15.08	$ 11,894.98	0.705	**$ 8,385**
2019	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 15.45	$ 12,192.35	0.665	**$ 8,109**
2020	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 15.84	$ 12,497.16	0.627	**$ 7,841**
2021	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 16.24	$ 12,809.59	0.592	**$ 7,582**
2022	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 16.64	$ 13,129.83	0.558	**$ 7,332**
2023	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 17.06	$ 13,458.07	0.527	**$ 7,090**
2024	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 17.48	$ 13,794.52	0.497	**$ 6,855**
2025	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 17.92	$ 14,139.39	0.469	**$ 6,629**
2026	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 18.37	$ 14,492.87	0.442	**$ 6,410**
2027	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 18.83	$ 14,855.19	0.417	**$ 6,199**
2028	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 19.30	$ 15,226.57	0.394	**$ 5,994**
2029	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 19.78	$ 15,607.24	0.371	**$ 5,796**
2030	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 20.28	$ 15,997.42	0.350	**$ 5,605**
2031	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 20.78	$ 16,397.35	0.331	**$ 5,420**
2032	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 21.30	$ 16,807.29	0.312	**$ 5,241**
2033	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 21.83	$ 17,227.47	0.294	**$ 5,068**
2034	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 22.38	$ 17,658.16	0.278	**$ 4,900**
2035	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 22.94	$ 18,099.61	0.262	**$ 4,738**
2036	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 23.51	$ 18,552.10	0.247	**$ 4,582**
2037	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 24.10	$ 19,015.90	0.233	**$ 4,431**
2038	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 24.70	$ 19,491.30	0.220	**$ 4,284**
2039	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 25.32	$ 19,978.58	0.207	**$ 4,143**
2040	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 25.95	$ 20,478.05	0.196	**$ 4,006**
2041	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 26.60	$ 20,990.00	0.185	**$ 3,874**
2042	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 27.27	$ 21,514.75	0.174	**$ 3,746**
2043	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 27.95	$ 22,052.62	0.164	**$ 3,622**
2044	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 28.65	$ 22,603.93	0.155	**$ 3,503**
2045	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 29.37	$ 23,169.03	0.146	**$ 3,387**
2046	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 30.10	$ 23,748.26	0.138	**$ 3,275**
2047	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 30.85	$ 24,341.97	0.130	**$ 3,167**
2048	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 31.62	$ 24,950.51	0.123	**$ 3,062**
2049	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 32.41	$ 25,574.28	0.116	**$ 2,961**
2050	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 33.22	$ 26,213.63	0.109	**$ 2,864**
2051	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 34.05	$ 26,868.98	0.103	**$ 2,769**
2052	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 34.91	$ 27,540.70	0.097	**$ 2,678**
2053	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 35.78	$ 28,229.22	0.092	**$ 2,589**
2054	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 36.67	$ 28,934.95	0.087	**$ 2,504**
2055	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 37.59	$ 29,658.32	0.082	**$ 2,421**
2056	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 38.53	$ 30,399.78	0.077	**$ 2,341**
2057	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 39.49	$ 31,159.77	0.073	**$ 2,264**
2058	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 40.48	$ 31,938.77	0.069	**$ 2,189**
2059	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 41.49	$ 32,737.24	0.065	**$ 2,117**
2060	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 42.53	$ 33,555.67	0.061	**$ 2,047**
2061	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 43.59	$ 34,394.56	0.058	**$ 1,979**
2062	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 44.68	$ 35,254.42	0.054	**$ 1,914**
2063	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 45.80	$ 36,135.78	0.051	**$ 1,851**
2064	Reduced Carbon Dioxide Emissions	tons	0	789	789	$ 46.94	$ 37,039.18	0.048	**$ 1,790**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 228,464.65**

Comments: The social cost of carbon is assumed to increase at 2.5% a year from a base of $13 in 2012.

Table 15-2 – Reduction in emissions of airborne pollutants

(All benefits should be in 2012 dollars)

Project: El Dorado County Small Hydroelectric Development Program

(a)	(b)	(c)	(d)	(e)	(d)	(e)	(f)	(g)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project - CO**	**With Project - CO**	**Without Project - PM**	**With Project - PM**	**Change Resulting from Project (e) – (d)**	**Unit $ Value - CO (1)**	**Unit $ Value - particulate (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Reduced emissions	pounds	0	0	0	0	0	$ 0.85	$ 4.00	$ -	1.000	**$ -**
2013	Reduced emissions	pounds	0	0	0	0	0	$ 0.85	$ 4.00	$ -	0.943	**$ -**
2014	Reduced emissions	pounds	0	0	0	0	0	$ 0.85	$ 4.00	$ -	0.890	**$ -**
2015	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.840	**$ 1,042**
2016	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.792	**$ 983**
2017	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.747	**$ 927**
2018	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.705	**$ 875**
2019	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.665	**$ 825**
2020	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.627	**$ 779**
2021	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.592	**$ 735**
2022	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.558	**$ 693**
2023	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.527	**$ 654**
2024	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.497	**$ 617**
2025	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.469	**$ 582**
2026	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.442	**$ 549**
2027	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.417	**$ 518**
2028	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.394	**$ 489**
2029	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.371	**$ 461**
2030	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.350	**$ 435**
2031	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.331	**$ 410**
2032	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.312	**$ 387**
2033	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.294	**$ 365**
2034	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.278	**$ 344**
2035	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.262	**$ 325**
2036	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.247	**$ 307**
2037	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.233	**$ 289**
2038	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.220	**$ 273**
2039	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.207	**$ 257**
2040	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.196	**$ 243**
2041	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.185	**$ 229**
2042	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.174	**$ 216**
2043	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.164	**$ 204**
2044	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.155	**$ 192**
2045	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.146	**$ 181**
2046	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.138	**$ 171**
2047	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.130	**$ 161**
2048	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.123	**$ 152**
2049	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.116	**$ 144**
2050	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.109	**$ 136**
2051	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.103	**$ 128**
2052	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.097	**$ 121**
2053	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.092	**$ 114**
2054	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.087	**$ 107**
2055	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.082	**$ 101**
2056	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.077	**$ 96**
2057	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.073	**$ 90**
2058	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.069	**$ 85**
2059	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.065	**$ 80**
2060	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.061	**$ 76**
2061	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.058	**$ 71**
2062	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.054	**$ 67**
2063	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.051	**$ 64**
2064	Reduced emissions	pounds	0	1060	0	85	1145	$ 0.85	$ 4.00	$ 1,241.00	0.048	**$ 60**
										Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 17,408.75**

Comments:

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2064, is $1,642,446 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[8]

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: El Dorado County Small Hydroelectric Development Program

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 246,628.00							$ 246,628	0.943	$ 232,668
2014	$ 1,457,932.00							$ 1,457,932	0.890	$ 1,297,554
2015				$ 4,000.00	$ 4,000.00			$ 8,000	0.840	$ 6,717
2016				$ 4,000.00	$ 4,000.00			$ 8,000	0.792	$ 6,337
2017				$ 4,000.00	$ 4,000.00			$ 8,000	0.747	$ 5,978
2018				$ 4,000.00	$ 4,000.00			$ 8,000	0.705	$ 5,640
2019				$ 4,000.00	$ 4,000.00			$ 8,000	0.665	$ 5,320
2020				$ 4,000.00	$ 4,000.00			$ 8,000	0.627	$ 5,019
2021				$ 4,000.00	$ 4,000.00			$ 8,000	0.592	$ 4,735
2022				$ 4,000.00	$ 4,000.00			$ 8,000	0.558	$ 4,467
2023				$ 4,000.00	$ 4,000.00			$ 8,000	0.527	$ 4,214
2024				$ 4,000.00	$ 4,000.00			$ 8,000	0.497	$ 3,976
2025				$ 4,000.00	$ 4,000.00			$ 8,000	0.469	$ 3,751
2026				$ 4,000.00	$ 4,000.00			$ 8,000	0.442	$ 3,538
2027				$ 4,000.00	$ 4,000.00			$ 8,000	0.417	$ 3,338
2028				$ 4,000.00	$ 4,000.00			$ 8,000	0.394	$ 3,149
2029				$ 4,000.00	$ 4,000.00			$ 8,000	0.371	$ 2,971
2030				$ 4,000.00	$ 4,000.00			$ 8,000	0.350	$ 2,803
2031				$ 4,000.00	$ 4,000.00			$ 8,000	0.331	$ 2,644
2032				$ 4,000.00	$ 4,000.00			$ 8,000	0.312	$ 2,494
2033				$ 4,000.00	$ 4,000.00			$ 8,000	0.294	$ 2,353
2034				$ 4,000.00	$ 4,000.00			$ 8,000	0.278	$ 2,220
2035				$ 4,000.00	$ 4,000.00			$ 8,000	0.262	$ 2,094
2036				$ 4,000.00	$ 4,000.00			$ 8,000	0.247	$ 1,976
2037				$ 4,000.00	$ 4,000.00			$ 8,000	0.233	$ 1,864
2038				$ 4,000.00	$ 4,000.00			$ 8,000	0.220	$ 1,758
2039				$ 4,000.00	$ 4,000.00			$ 8,000	0.207	$ 1,659
2040				$ 4,000.00	$ 4,000.00			$ 8,000	0.196	$ 1,565
2041				$ 4,000.00	$ 4,000.00			$ 8,000	0.185	$ 1,476
2042				$ 4,000.00	$ 4,000.00			$ 8,000	0.174	$ 1,393
2043				$ 4,000.00	$ 4,000.00			$ 8,000	0.164	$ 1,314
2044				$ 4,000.00	$ 4,000.00			$ 8,000	0.155	$ 1,240
2045				$ 4,000.00	$ 4,000.00			$ 8,000	0.146	$ 1,169
2046				$ 4,000.00	$ 4,000.00			$ 8,000	0.138	$ 1,103
2047				$ 4,000.00	$ 4,000.00			$ 8,000	0.130	$ 1,041
2048				$ 4,000.00	$ 4,000.00			$ 8,000	0.123	$ 982
2049				$ 4,000.00	$ 4,000.00			$ 8,000	0.116	$ 926
2050				$ 4,000.00	$ 4,000.00			$ 8,000	0.109	$ 874
2051				$ 4,000.00	$ 4,000.00			$ 8,000	0.103	$ 824
2052				$ 4,000.00	$ 4,000.00			$ 8,000	0.097	$ 778
2053				$ 4,000.00	$ 4,000.00			$ 8,000	0.092	$ 734
2054				$ 4,000.00	$ 4,000.00			$ 8,000	0.087	$ 692
2055				$ 4,000.00	$ 4,000.00			$ 8,000	0.082	$ 653
2056				$ 4,000.00	$ 4,000.00			$ 8,000	0.077	$ 616
2057				$ 4,000.00	$ 4,000.00			$ 8,000	0.073	$ 581
2058				$ 4,000.00	$ 4,000.00			$ 8,000	0.069	$ 548
2059				$ 4,000.00	$ 4,000.00			$ 8,000	0.065	$ 517
2060				$ 4,000.00	$ 4,000.00			$ 8,000	0.061	$ 488
2061				$ 4,000.00	$ 4,000.00			$ 8,000	0.058	$ 460
2062				$ 4,000.00	$ 4,000.00			$ 8,000	0.054	$ 434
2063				$ 4,000.00	$ 4,000.00			$ 8,000	0.051	$ 410
2064				$ 4,000.00	$ 4,000.00			$ 8,000	0.048	$ 387
								Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries		$ 1,642,446

[8] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

CABY Integrated Regional Water Management Plan
Proposition 84, Round 2 Implementation Grant

4 Water Effieciency, Water Quality and Supply Reliability in the CABY Region

4. Water Efficiency, Water Quality and Supply Reliability in the CABY Region

Project Description

Conditions Without the Project

The Nevada Irrigation District supplies both raw and treated water to 25,000 homes, farms, and businesses in Nevada and Placer counties. The Placer County Water Agency serves raw and treated water to more than 38,000 accounts in several water service zones in Placer County. Together, NID and PWCA use 600 miles of canals to distribute water, much of which originates in high mountain elevations and gravity conveys to the service areas. Both NID and PWCA serve north Auburn, a disadvantaged community in Placer County.

NID and PWCA do not have emergency back-up water sources. Two recent emergency incidents have demonstrated the risks and potential economic costs associated with this deficiency. In April of 2011, a landslide resulted in the complete failure of PG&E's Bear River Canal, the primary source of water to PCWA's Zone 1 system. PG&E restored normal water service after 48 days, during which PCWA operated under severe water shortage conditions.

Similarly, in 2009, a catastrophic fire destroyed 63 homes and burned 343 acres near NID's North Auburn water treatment plant. The fire cut off power to the treatment plant, limiting its ability to meet critical fire flow demands. NID depleted its water in storage, and faced difficulties in supplying water to residents and businesses.

NID and PWCA distribute water to agricultural, industrial, and municipal users over 600 miles of mostly open, earthen canals. In 2005, PCWA conducted a study of the entire canal system to identify soil types and permeability rates for the spills that the canals traverse. From this study, PCWA has been able to estimate the water losses due to seepage for defined reaches of the canal are between 10 and 20 percent as a result of evaporation, seepage, and other factors.

Without the project, PCWA and NID would continue to deliver separate water agency programs and materials, including brochures and videos, with different messages for customers.

Conditions With the Project

The project would provide NID and PCWA with the ability to move water from one system to another to alleviate shortages by constructing water system interties between NID and PCWA's raw and treated water systems. NID and PCWA would construct these interties at two locations: Locksley Lane and Mt. Vernon. These interties will ensure water supply reliability, even in emergency situations, for the disadvantaged residents and consumers in the north Auburn community.

With the project, NID and PCWA would line approximately four miles of strategic portions of earthen canals to reduce losses from seepage and failing canal banks, improve water quality, and reduce system losses. With the project, NID would also install gaging stations in prioritized locations along its raw water distribution system. These stations would calculate hydrologic data, allowing NID to more effectively measure water use, improve water conservation and efficiency through accurate measurement of water and improved leak detection.

Finally, the project also includes an education program that would target residential, commercial, institutional, and agricultural water users using regional outreach materials, at least six outreach events, and six combined irrigation and efficiency workshops and seminars. The project would also coordinate information about water use and conservation for customers of NID and PCWA by providing one common message.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-4 identifies the non-monetized benefits the project would likely generate.

Table 12-4. Non-monetized Benefits Checklist 4. Water Efficiency, Water Quality and Supply Reliability in the CABY Region		
No.	Will the proposal…	Response
Community/Social Benefits		
1	Provide education or technology benefits? Enhanced water conservation education	Yes
2	Provide social recreation or access benefits?	No
3	Help avoid, reduce or resolve various public water resources conflicts?	No
4	Promote social health and safety? Reduce the risk of injury and death by improving fire flow reliability and protect public health by reducing the risk of outages	Yes
5	Have other social benefits? Reduce costs of fire insurance protection and/or increased property values	Yes
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7?	No
7	Improve water quality in ways that were not quantified in Attachment 7?	No
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	No
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	No
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7? Enhance supply capacity and system redundancy	Yes
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)? Reduced costs for providing conservation education	No

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

1. Provide education or technology benefit: Enhanced water conservation education

Underlying change. The project would educate residential, commercial, institutional, and agricultural water users about water efficiency. The project would also create a common conservation program between customers of PCWA and NID, reducing confusion and increasing effectiveness.

Evidence for demand and value. Improving the effectiveness of water conservation education would have the potential to produce long-run reductions in demand for water that would contribute to additional benefits in many of the categories of benefits discussed below. Both districts currently provide conservation education, so they may be capturing some of these benefits already. However, the uncoordinated approach, with different messages reaching customers in the same neighborhoods could

lead to reduced level of effectiveness, as people misunderstand what they are supposed to do and lose trust in the districts and stop paying attention. The coordinated approach could improve its credibility and yield higher benefits in the long-run.

Timing and duration. NID and PCWA would complete implementation of the educational program between July of 2014 and October of 2016; education benefits would therefore begin to accrue in 2014.

Beneficiaries. The direct beneficiaries of this benefit are the residential, commercial, institutional, and agricultural water users who participate in the program. To the extent that the project improves water use efficiency, it would also benefit a broad array of water users in the region.

Sources of uncertainty. If managers are unable to effectively coordinate efforts, the value of this benefit would not materialize. It is also possible that the action would increase costs in the short-run, but decrease costs in the long-run as people begin to restore their trust and attention.

4. Promote social health and safety: **Reduce the risk of injury and death by improving fire flow reliability and protect public health by reducing the risk of outages**

Underlying change. The project would improve water supply reliability, particularly during an emergency and for fire flows. With the project, PCWA or NID would be able to supplement local water supplies with additional flows through the interties to enhance the volume and flow to secure adequate levels of fire protection throughout the region. In cases where a fire or landslide cuts off one source of water, the interties would provide redundancy and increase reliability of water during emergencies. During wildfire events, this is especially important as water is needed to fight the fire.

Evidence for demand and value. The improvements in fire protection would improve the public health and safety of residents in the PCWA and NID service areas by reducing the likelihood and degree of damage from fire, which would also reduce the risk of injuries and death. While we cannot quantify the value of these improvements, they are likely significant. The U.S. Environmental Protection Agency estimates the value of a statistical life is $8.14 million, based on willingness to pay for small reductions in mortality risk (EPA 2012). We discuss the effects of improved capability to fight fires on property values in non-monetized benefit #5 below.

The improvements in system redundancy and reliability would reduce the adverse health effects associated with interrupted potable and sanitary water supply. The benefits associated with this increase in reliability from the customer's perspective are address in more detail below in non-monetized benefit #14.

Timing and duration. NID would complete construction of the Mt. Vernon Intertie by October of 2016, and PCWA would complete construction of the Locksley Lane Intertie by October of 2016. We therefore assume the project would begin conferring these benefits in 2017. They would persist for the lifetime of the project, at least 25 years.

Beneficiaries. The beneficiaries of this benefit would include residents and property owners in Nevada and Placer counties. Both NID and PWCA serve north Auburn, a disadvantaged community in Placer County.

Sources of uncertainty. The value of this benefit depends on the degree to which the project effectively improves water supply reliability for fire flow delivery, and results in reduced risk of injury and death from fire events.

5. Other social benefits: **Reduce costs of fire insurance protection and/or increased property values**

Underlying change. As described in non-monetized benefit #4 (Reduce the risk of injury and death by improving fire flow reliability and protect public health by reducing the risk of outages), the project would improve the risk associated with a fire reaching catastrophic levels by enhancing flows for fire protection.

Evidence for demand and value. If the project reduces the ISO ratings of communities in the PWCA and NID service areas, it could result in a direct benefit for residents and property owners in the communities. The literature has documented examples of reductions in residential hazard insurance premiums as a result of changes in fire protection ratings. A study of the impacts of changes in the ISO ratings in North Monterey County found that improvements in operations and planning involving fire protection can result in reductions in insurance premiums for residents and businesses. The study found that after the North County Fire District implemented training programs, and began documenting and improving pump tests, training, and hose pressure tests, insurance premiums for businesses and residents decreased between 15 and 30 percent (Orman 2006).

Improved fire protection could also impact property values. The body of literature surrounding hedonic pricing effects of fire risks supports the conclusion that an increase in fire risk (or the number of recent fires), results in a decrease in the home prices in that area. One study found that multiple fires reduced home prices: the first fire reduced house prices by around 10 percent, and the second fire reduced house prices by about 23 percent (Mueller, Loomis, and Gonzalez-Caban). Studies have also found a connection between the perceived risk of a hazard and the values of the homes in the potentially affected area (Huggett 2003). This implies that mitigation efforts may have a subjective effect on the perception of the hazards, which may consequently affect home values.

While enhanced fire protection, in and of itself, likely wouldn't reduce the probability that fires occur, it could reduce the severity of the fire, and thus the associated damage and the perception in the community that fires are a problem.

Timing and duration. NID would complete construction of the Mt. Vernon Intertie by October of 2016, and PCWA would complete construction of the Locksley Lane Intertie by October of 2016. We therefore assume the project would begin conferring these benefits in 2017. They would persist for the lifetime of the project, at least 25 years.

Beneficiaries. The beneficiaries of this benefit would include residents and property owners in Nevada and Placer counties. Both NID and PWCA serve north Auburn, a disadvantaged community in Placer County.

Sources of uncertainty. This benefit depends on the ability of the project to reduce fire risk ratings. If the project does not result in this reduction, this benefit would not materialize. Improvements in fire flows such as the ones the project would support have had an effect on other community ISO ratings in California.

14. Improve water supply reliability in ways not quantified in Attachment 7? **Enhance supply capacity and system redundancy**

Underlying change. The project would add two interties that would allow the water systems of PWCA and NID to provide backup supplies for each other in the case of emergencies. Such emergencies have disrupted potable and sanitary water service to customers several times in the past few years. The project would also reduce seepage in canals, install equipment to identify leaks, monitor flows, and improve overall system efficiency, which could improve the availability of water available for meeting demands during shortages and droughts.

Evidence for demand and value. The improvements to system capacity would reduce the costs customers of the water districts incur when emergencies occur that disrupt water delivery. During times of emergency, having access to adequate water supplies is especially valuable. See the discussion of public health and safety benefits. By reducing the amount of water lost to seepage, the project would potentially improve the capacity to withstand droughts. Studies have shown that people are willing to pay to reduce the probability of experiencing water shortages. Research conducted for the California Urban Water Agencies found that households were willing to pay, on average, $213 per year to avoid a 10-percent shortage once every three years and $222 per year to avoid a 30-percent shortage once every thirty years (Barakat & Chamberlin, Inc. 1994).

Timing and duration. NID would complete construction of the Mt. Vernon Intertie by October of 2016, and PCWA would complete construction of the Locksley Lane Intertie by October of 2016. We therefore assume the project would begin conferring these benefits in 2017. They would persist for the lifetime of the project, at least 25 years.

Beneficiaries. The beneficiaries of this benefit would include the customers of PCWA and NID in Nevada and Placer counties. Both NID and PWCA serve north Auburn, a disadvantaged community in Placer County.

Sources of uncertainty. The value of this benefit would depend on the likelihood of supply disruptions without the project and the degree to which improvements mitigate the problem.

15. Other: **Reduced costs for providing conservation education**

Underlying change. As described in non-monetized benefit #1 (Provide education or technology benefits), PCWA and NID would pool their resources to provide a common conservation education program to all customers in the service area.

Evidence for demand and value. Managers with NID and PCWA expect that developing and implementing a joint program would reduce the total costs of providing conservation education. This would increase the overall efficiency of generating benefits to water supply through conservation. The value of this benefit would depend on the actual cost savings the districts realize by coordinating efforts. Managers expect this would materialize, but are unable to estimate the savings.

Timing and duration. NID and PCWA would develop the new conservation education program during the period of the project, by 2016. We therefore assume the project would begin conferring these benefits in 2017. They would persist for the lifetime of the project, at least 25 years.

Beneficiaries. The beneficiaries of this benefit would include the customers and ratepayers of PCWA and NID in Nevada and Placer counties. Both NID and PWCA serve north Auburn, a disadvantaged community in Placer County.

Sources of uncertainty. If managers are unable to effectively coordinate efforts, the value of this benefit would not materialize. It is also possible that the action would increase costs in the short-run, but decrease costs in the long-run as decisions are made and materials developed.

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $723,535. The calculations for each monetized benefit are shown in Tables 15-1 and 15-2 at the end of this section.

1. Increased water supply for agricultural purposes

Underlying change. With the project, NID and PCWA would reduce seepage and system losses from four miles of earthen canals, which would allow them to conserve 200 acre-feet of water per year. This water would be used to meet demands largely from rural customers who would use the water to irrigate pastures, improve fire breaks through vegetation, and produce crops. To the extent that other conservation and efficiency improvements built into this project increase water savings, this value is likely an underestimate of the true impact of the project on water supply.

Evidence for demand and value. An economic analysis of water transactions between 1990 and 2003 found that the median price paid in California to acquire water for agricultural purposes $58 per acre-foot (Brown 2007). Using this value to measure the value of additional water for increase irrigation and other agricultural users, we estimate the annual, undiscounted value of this benefit is $11,600.

Timing and duration. NID would complete installation of the canal lining by May of 2016. To reduce the risk of overestimating this benefit, we assume the project would begin conferring benefits related to increased water supply for agricultural users in 2017. These benefits would persist for the lifetime of the project, at least 25 years.

Beneficiaries. The beneficiaries of this benefit are the agricultural water users who would put additional water to beneficial use. The benefits may extend beyond these users, to the extent that the water applied to reduce the risk of wildfire translates into an overall reduction in the risk that wildfires and associated damage occur in the region.

Sources of uncertainty. The value we derive from the findings of Brown (2007) embodies the uncertainty inherent in the individual study as well as from applying results from past research to future conditions. There is, however, no obvious reason to conclude that the estimate systematically overestimates the true marginal value of water for agricultural purposes in the CABY region.

2. Reduced operation and maintenance costs

Underlying change. With the installation of new gaging stations and staff gages, the project will reduce the amount of travel that the distribution operators drive to measure water and determine canal flows to make adjustments. Project proponents estimate these operators drive about 360 miles per day. Assuming the operators drive 30 miles per hour, they spend about 12 hours per day traveling for adjustments. This is likely a conservative assumption, since we do not account for the time operators would have to spend exiting their vehicles to take measurements and make adjustments.
The project would result in a 20 percent savings in these costs—about 72 miles and 2.4 hours per day.

Evidence for demand and value. As of January 1st, 2013 the federal standard mileage rates for the use of a car for business miles driven was $0.565 per mile (IRS. 2012).[9] We use this value to estimate the cost savings from reducing travel time for the operators. NID and PCWA pay these operators an average of $50 per hour. The annual undiscounted value of this benefit is therefore $58,648.

Timing and duration. NID and PCWA will complete construction of the gaging stations by March of 2016. To be conservative, we assume these benefits will begin to accrue in 2017. These benefits would persist for the lifetime of the project, 25 years.

Beneficiaries. The beneficiaries of this benefit would include the customers and ratepayers of PCWA and NID in Nevada and Placer counties. Both NID and PWCA serve north Auburn, a disadvantaged community in Placer County.

Sources of uncertainty. The main source of uncertainty associated with this value is the extent to which the project would reduce the operators' costs described above. NID and PCWA estimate they spend close to $0.80 per mile for vehicle and vehicle-related expenses related to these activities. The federal standard mileage rate therefore likely underestimates the value of reducing operators' travel times.

Table 15-1 – Increased instream flows for agriculture
(All benefits should be in 2012 dollars)
Project: Water Efficiency, Water Quality, and Supply Reliability in the CABY Region

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Increased flows for agricultural use	Acre-feet	0	0	0	$ 58.00	$ -	1.000	$ -
2013	Increased flows for agricultural use	Acre-feet	0	0	0	$ 58.00	$ -	0.943	$ -
2014	Increased flows for agricultural use	Acre-feet	0	0	0	$ 58.00	$ -	0.890	$ -
2015	Increased flows for agricultural use	Acre-feet	0	0	0	$ 58.00	$ -	0.840	$ -
2016	Increased flows for agricultural use	Acre-feet	0	0	0	$ 58.00	$ -	0.792	$ -
2017	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.747	$ 8,668
2018	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.705	$ 8,178
2019	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.665	$ 7,715
2020	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.627	$ 7,278
2021	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.592	$ 6,866
2022	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.558	$ 6,477
2023	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.527	$ 6,111
2024	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.497	$ 5,765
2025	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.469	$ 5,439
2026	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.442	$ 5,131
2027	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.417	$ 4,840
2028	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.394	$ 4,566
2029	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.371	$ 4,308
2030	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.350	$ 4,064
2031	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.331	$ 3,834
2032	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.312	$ 3,617
2033	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.294	$ 3,412
2034	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.278	$ 3,219
2035	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.262	$ 3,037
2036	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.247	$ 2,865
2037	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.233	$ 2,703
2038	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.220	$ 2,550
2039	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.207	$ 2,405
2040	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.196	$ 2,269
2041	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.185	$ 2,141
2042	Increased flows for agricultural use	Acre-feet	0	200	200	$ 58.00	$ 11,600.00	0.174	$ 2,020
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 119,477**

Comments: The project would produce an additional 200 acre-feet through water conservation and reduced seepage and leakage. Valued at the median market rate for agricultural flows in California.

[9] IRS. 2012. *Standard Mileage Rates for 2013.* Accessed 26 March 2013, from: http://www.irs.gov/uac/2013-Standard-Mileage-Rates-Up-1-Cent-per-Mile-for-Business,-Medical-and-Moving.

Table 15-1 – Reduced operations and maintenance costs
(All benefits should be in 2012 dollars)
Project: Water Efficiency, Water Quality, and Supply Reliability in the CABY Region

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced O&M Costs	Dollars	0	0	0	$ 58,648.00	$ -	1.000	**$ -**
2013	Reduced O&M Costs	Dollars	0	0	0	$ 58,648.00	$ -	0.943	**$ -**
2014	Reduced O&M Costs	Dollars	0	0	0	$ 58,648.00	$ -	0.890	**$ -**
2015	Reduced O&M Costs	Dollars	0	0	0	$ 58,648.00	$ -	0.840	**$ -**
2016	Reduced O&M Costs	Dollars	0	0	0	$ 58,648.00	$ -	0.792	**$ -**
2017	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.747	**$ 43,825**
2018	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.705	**$ 41,345**
2019	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.665	**$ 39,004**
2020	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.627	**$ 36,796**
2021	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.592	**$ 34,714**
2022	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.558	**$ 32,749**
2023	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.527	**$ 30,895**
2024	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.497	**$ 29,146**
2025	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.469	**$ 27,496**
2026	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.442	**$ 25,940**
2027	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.417	**$ 24,472**
2028	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.394	**$ 23,087**
2029	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.371	**$ 21,780**
2030	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.350	**$ 20,547**
2031	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.331	**$ 19,384**
2032	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.312	**$ 18,287**
2033	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.294	**$ 17,252**
2034	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.278	**$ 16,275**
2035	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.262	**$ 15,354**
2036	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.247	**$ 14,485**
2037	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.233	**$ 13,665**
2038	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.220	**$ 12,891**
2039	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.207	**$ 12,162**
2040	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.196	**$ 11,473**
2041	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.185	**$ 10,824**
2042	Reduced O&M Costs	Dollars	0	1	1	$ 58,648.00	$ 58,648.0	0.174	**$ 10,211**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 604,058**

Comments: The project would reduce the amount of time driving between gaguing stations. Assumes a federal milage rate of 0.565 per mile and a labor rate of $50 per hour. See text for additional details.

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2014, is $1,812,891 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[10]

The project may involve some operation and maintenance activities, but these do not differ substantially from activities under the baseline conditions. For example, NID has more than a hundred gauging stations and NID will operate the new gauging stations regularly as part of its normal activity. This will not create a significant increase in the cost of operation or maintenance. Similarly, PCWA will conduct routine maintenance of the valves, flow meter, pipe and appurtenances over the life of the project in order to maintain the benefits of the project. We do not have sufficient information to estimate the value of these costs, but they are likely small.

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: Water Efficiency, Water Quality, and Supply Reliability in the CABY Region

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 357,947.20							$ 357,947	0.943	$ 337,686
2014	$ 1,657,540.00							$ 1,657,540	0.890	$ 1,475,205
									Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries	$ 1,812,891

Comments:

[10] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

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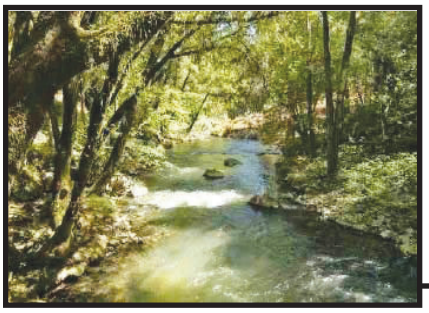


5 Wolf Creek Watershed: Restoration, Storm Water Source Control and Flood Management

5. Wolf Creek Watershed: restoration, Stormwater Source Control and Flood Management

Project Description

Conditions Without the Project

Peabody Creek flows from the hills surrounding downtown Grass Valley, through residential neighborhoods, and along the edge of a local park before joining Wolf Creek, a major tributary to the Bear River. Wolf Creek provides drinking water for Grass Valley. The Bear River provides drinking water for residents of southern Nevada County and Placer County. Development in and around Grass Valley over the last 20 years has altered the natural hydrology and has impacted the function of the creek. Most creeks in the area have been lost to development or are buried in an underground network of culverts.

This disturbance of the natural hydrologic regime has increased the frequency of flooding in the neighborhoods surrounding Peabody Creek. Runoff from impervious surfaces and direct connections between storm drains and the creek result in regular flooding of the neighborhoods and downstream reaches of the watershed.

These hydrologic changes also negatively affect the water quality in Peabody Creek and downstream receiving bodies of water. Twenty-three miles of Wolf Creek and its associated tributaries, including Peabody Creek, are impaired and have a TMDL schedule for fecal coliform.

Although parts of the neighborhood experience regular flooding, some areas are no longer within the flood area because urbanization has altered the natural hydrology of the watershed. FEMA has not updated its flood maps to address these changes, so residents must continue to pay for flood insurance though their homes are not at risk for flooding.

Conditions With the Project

The project has three main components. Under the first component, the project would restore the floodplain and riparian areas along Peabody Creek. Under the second component, the project would initiate efforts to install several green stormwater infrastructure projects relying on a broad range of techniques, including downspout disconnection, pervious pavement, raingardens, and vegetated bioswales. Under the third component, the project would complete planning and designs for two floodplain sites, which will help the project sponsors secure funding for implementation from future grant applications.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-5 identifies the non-monetized benefits the project would likely generate.

Table 12-5. Non-monetized Benefits Checklist 5. Wolf Creek Watershed: restoration, Stormwater Source Control and Flood Management		
No.	Will the proposal…	Response
Community/Social Benefits		
1	Provide education or technology benefits? Enhanced human and social capital	Yes
2	Provide social recreation or access benefits?	No
3	Help avoid, reduce or resolve various public water resources conflicts?	No
4	Promote social health and safety? Reduced frequency and severity of floods	Yes
5	Have other social benefits? Amenity value and avoided property damages	Yes
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive use value of special status species	Yes
7	Improve water quality in ways that were not quantified in Attachment 7? Reduced costs associated with controlling urban pollutants	Yes
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	Yes
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	No
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7?	No
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

1. Provide education or technology benefits Enhanced human and social capital

Underlying change. The project would offer educational opportunities related to the installation of green stormwater infrastructure facilities through outreach efforts to homeowners and training efforts geared at licensed concrete specialists. The project would also offer volunteer opportunities to Native American youth from the Sierra Nevada Alliance. These youth would learn about ecosystem function and restoration techniques as they help plant native vegetation in the Peabody Creek floodplain.

Evidence for demand and value. For reasons identified below in monetized benefit #3 (Avoided costs of compliance with MS4 permit), the project would provide benefits by supporting outreach and volunteer efforts related to the installation of green stormwater infrastructure, education of stormwater-related issues, and restoration techniques. The value quantified in monetized benefit #3 (Avoided costs of

compliance with MS4 permit) does not fully incorporate the values derived by the volunteers and the individuals receiving educational outreach themselves.

Drawing a cause-and-effect relationship between volunteer, training, and education efforts and specific water-supply or water-quality outcomes is difficult, but there are several ways the project would produce tangible economic benefits through these components. For example, volunteer and training opportunities may increase the public's understanding of and support or demand for future restoration and stormwater projects. Furthermore, volunteering opportunities improve the well-being of people who choose to participate. These improvements may not result in water-supply or water-quality benefits directly, but they may better people's lives in other ways that have economic importance. Spending time outdoors may improve an individual's emotional and physical health, which constitutes an investment in human capital. Working with others in restoration efforts has the potential to strengthen the relationships among community members, which constitutes an investment in social capital. Both of these effects may contribute to an overall improvement in quality of life.

These effects may be small, but subtle changes arising from volunteer efforts should not be dismissed. For example, interactions among community members in the context of this project may be brief, compared to all of the other interactions that go on day-to-day, but the effect combined with all of the other small effects may accumulate into measurable improvements in quality of life in the long run. The efforts of this project, in combination with other sustained efforts in the long run, likely will translate to economic benefits for the community that reach beyond this project.

Timing and duration. These benefits would begin as the education and outreach components of the project are implemented from 2013 to 2015. Some outreach techniques (e.g., signs) would continue to provide education benefits for many years. Changes in behavior brought about by education may produce benefits for the lifespan of the people who are reached.

Beneficiaries. Direct beneficiaries would be the residents of Grass Valley and visitors who encounter the signs and other educational components of the project. Indirect benefits arising from changes in behavior may improve the well being of a broader set of people, potentially all residents of California.

Sources of uncertainty: Without detailed program evaluations of educational efforts, it is difficult to predict when particular benefits to education, outreach, and public engagement activities might emerge and what their impact might be. The peer-reviewed literature on this topic is scant, and results from one study may not be broadly transferrable to other programs because specifics of program design, delivery, and audience may affect the level of benefits achieved.

4. Promote social health and safety **Reduced frequency and severity of floods**

Underlying change. Reconnecting Peabody Creek with the floodplain, restoring riparian function, and installing green stormwater infrastructure would help reduce peak flows within the creek basin. By reducing peak flows, the project would decrease the frequency and severity of flood events that currently occur on nearby properties.

Evidence for demand and value. The economic benefits arising from the potential change in flood frequency and severity is composed of two components. The first, which we discuss in this section, is its effect on health and safety associated with flood events. The second, which we discuss under non-monetized benefit #5, is its effect on property damages associated with flood events.

When flood events occur, individuals exposed to damages suffer several health and safety related consequences. Some of these health and safety consequences stem from flood impacts on: structural stability, electrical and gas hazards, carbon monoxide, chemicals and contaminants, molds and mildew, asbestos, lead, and poisonous wildlife (National Park Service 2002). Exposure to each of these consequences comes at a cost. Data are not sufficient to quantify the project's impact on flood frequency or magnitude, or on the actual health and safety costs associated with past flood events. Nonetheless, to the extent that the project does reduce the frequency or severity of future flood events, it would provide avoided costs to all individuals that would have, but for the project, incurred flood-related costs in terms of their health and safety.

Timing and duration. The relevant components of the project that would potential reduce flood-related costs associated with health and safety would occur throughout the project implementation period (late 2013 through 2015). The benefits derived from these efforts would begin accruing when the relevant components of the project are completed. To the extent that the project would support long-term decreases in the frequency and severity of flooding, the benefits would persist through the life of the project, 50 years.

Beneficiaries. The individuals deriving these benefits include those that would have incurred flood-related health and safety damages from future floods, but for the project. Insofar as public agencies provide relief to individuals suffering from flood-related impacts, the project would also provide benefits to those agencies in the form of avoided expenditures.

Sources of uncertainty. The value of this benefit depends on the effectiveness of the project in reducing peak flows and the effect of those biophysical changes on human health and safety. As climate change increases the extent and impacts of flooding in the future, the value of this benefit may increase over time.

5. Have other social benefits: **Amenity value and avoided property damages**

Underlying change. The project would restore riparian and stream habitat near Scotia Pines, a neighborhood in Grass Valley with views of the creek. The project would also install several green stormwater infrastructure facilities within the neighborhood. These aspects of the project could make homes in Scotia Pines more desirable, which could increase property values within the neighborhood as well as the well-being derived by residents and visitors to the area. Furthermore, the project would reduce streamflows, which has the potential to reduce the frequency and severity of future flood events in the area and the property damages associated with those avoided flood events.

Evidence for demand and value. Research suggests that riparian habitat and the installation of green stormwater infrastructure facilities have the capacity to improve amenity values in nearby communities. More specifically, these efforts could improve the economic well-being of individuals living in the area by increasing home values through a number of pathways.

Several studies have shown that trees and other vegetation increase property values in urban areas. While there are insufficient data to estimate this value for efforts associated with this project, research suggests that green stormwater infrastructure (such as trees planted on private property) could increase property values by $5-$28 per tree (USDA Forest Service 2006). A study based on data in Philadelphia

found that homes within 1,000 feet of street trees planted through the Fairmont Park Commission's tree planting program sold for about 2.4 percent more than homes more than 1,000 feet from a street tree (controlling for other variables) (Wachter and Wong 2006).

Several studies have found that green infrastructure such as porous pavement and vegetated surfaces decrease noise pollution, by absorbing more noise than gray infrastructure (Olek 2003; Connelly and Hodgson 2008; Navrud 2003). While there are insufficient data to estimate the value of these benefits for this project, the value likely is positive insofar as noise reduction decreases stress, improves well-being, and could potentially increase property values.

In addition to the increase in amenity values associated with riparian restoration and the installation of green stormwater infrastructure facilities, the project has the capacity to reduce flood-related property damages. Data are not sufficient to quantify property damages from past floods, or to quantify the extent to which the project would reduce the costs of potential future property damages related to flooding. Nonetheless, insofar as the project supports future reductions in flood-related property damage in the area, it decreases the costs individuals and public agencies would incur, but for the project.

Timing and duration. The project would begin its efforts related to these benefits soon after being awarded funding (in late 2013). The project's efforts would conclude by the end of 2015. These benefits likely would not materialize until the project is completed, at the end of 2015. These benefits would persist through the life of the project, 50 years.

Beneficiaries. The primary beneficiaries of this benefit include homeowners within the vicinity of the project's riparian restoration efforts and green stormwater infrastructure installations. Individuals benefiting from avoided property damages from flood events include some home and business owners that have experienced flooding in the past as well as government agencies and other groups that support victims of flood damages.

Sources of uncertainty. The value of this benefit depends on the effectiveness of the project in reducing peak flows and the effect, or lack thereof, of those biophysical changes on property damage. As climate change increases the extent and impacts of flooding in the future, the value of this benefit may increase over time.

6. Benefit wildlife or habitat in ways that were not quantified in Attachment 7: **Passive use value of special status species**

Underlying change. For reasons identified below in monetized benefit #2 (Increase in riparian habitat), the project would provide benefits to wildlife and habitat by restoring 0.5 acres of riparian habitat. According to project proponents, this restoration effort would include the restoration of 325 linear feet of stream bank along Peabody Creek, and would support valuable habitat used by special-status species such as the California red-legged frog, the mountain yellow-legged frog, and the western pond turtle.

Evidence for demand and value. The value quantified in monetized benefit #2 (Increase in riparian habitat) does not fully incorporate the potential value associated with improving habitat conditions for the California red-legged frog, the mountain yellow-legged frog, and the western pond turtle. Here, we

describe some of the values associated with supporting special status species, specifically, the California red-legged frog.

In 1996, the California red-legged frog was listed as threatened under the Endangered Species Act (ESA). Each year, the US Fish and Wildlife Service publishes a report summing all ESA-related expenditures by species/population, to the extent that those expenditures can be tied to a particular species/population. From 2009, 2010, and 2011 ESA-related spending tied to the red-legged frog in California totaled $7.1 million, $2.7 million, and $4.5 million (respectively) (U.S. Fish and Wildlife Service. 2009-2011).

These totals do not include land acquisition costs. These expenditures, however, represent only part of the story. Government efforts to support species at risk also impose costs on society, primarily by restricting land use in protected areas (opportunity costs). For example, in 2010, the 1.6 million acres of habitat were designated as critical habitat for the California red-legged frog. The economic impacts associated with this designation were estimated at $14.4-$45.2 million per year (Federal Register 2010). Furthermore, other entities (e.g., non-profit organizations and private individuals) bear costs in implementing their own efforts to help support the species.

Timing and duration. The project would begin its efforts related to these benefits soon after being awarded funding (in late 2013). The project's efforts would conclude by the end of 2015. These benefits likely would not materialize until the project is completed, at the end of 2015. These benefits would persist through the life of the project, 50 years.

Beneficiaries. The beneficiaries of this benefit would be the people of California who care about the status of these special species and adverse environmental effects on them.

Sources of uncertainty. The value of this benefit depends on the effectiveness of the project in providing habitat for these species. The habitat that would be created is located in an urban area. Activities upstream and downstream of the project site, as well as activities adjacent to the riparian area may limit the benefits the new habitat is able to provide.

7. Improve water quality in ways that were not quantified in Attachment 7: Reduced costs associated with controlling urban pollutants

Underlying change. By installing green stormwater infrastructure facilities and restoring streambank and riparian habitat, the project would improve downstream water quality. These efforts would improve downstream water quality by removing harmful pollutants (including oils, metals, and sediment) from stormwater as it filters through the green infrastructure facilities and through restored habitats. Furthermore, by better regulating stormwater, the project has the capacity to decrease the frequency and magnitude of overflow events associated with the City's sewer system.

Evidence for demand and value. Stormwater sewer systems collect, convey, and treat stormwater before it is released into nearby waterways in order to reduce the stormwater's potential impact on water quality. In most cases, individuals pay for this service through a stormwater utility. The value of these stormwater utility payments sheds light on the low-end value of maintaining water quality. In other words, municipalities have decided that maintaining water quality is worth at least as much as it costs to manage stormwater.

In addition to the general water quality benefits discussed above, the project has the potential to reduce the City of Grass Valley's costs attributable to sewer system overflows (SSOs). In 2012, the City of Grass Valley was charged a fine of $110,850 for the four SSOs between October 19, 2011 and March 19, 2012. Since then, the City has had five more SSO events. In response to these SSO fines, the City has increased its sewer rates from a flat rate of $23.50 and a use rate of $3.39 per 1,000 gallons used to a flat rate of $26.00 and a use rate of $3.75 per 1,000 gallons used. Data are not sufficient to quantify the potential change in frequency or magnitude of SSO events with the project, but to the extent that they decrease future SSO fines, they could help reduce sewer rates for relevant ratepayers.

Timing and duration. The project would begin its efforts related to these benefits soon after being awarded funding (in late 2013). The project's efforts would conclude by the end of 2015. These benefits likely would not materialize until the project is completed, at the end of 2015. These benefits would persist through the life of the project, 50 years.

Beneficiaries. The primary beneficiaries of this benefit include individuals throughout the basin that value water quality issues. It has the potential to benefit individuals that pay stormwater fees in the form of decreased future rates.

Sources of uncertainty. The value of this benefit depends on the project's ability to avoid fines related to SSOs and improve water quality for downstream users.

10. Improve the overall, long-term management of California groundwater resources

For reasons identified above, in non-monetized benefit #7 (Improve water quality in ways not quantified in Attachment 7) the project would support the infiltration of stormwater into receiving permeable surfaces, rather than collecting and conveying the stormwater through the area's stormwater system. According to project sponsors, the project would reduce stormwater runoff into Peabody Creek and increase stormwater infiltration by 8 acre-feet in 2014 and 10 acre-feet per year by 2015. The benefits associated with this marginal change in infiltration are small, and likely do not contribute significantly to the regional benefits associated with groundwater resources.

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $85,558. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3 at the end of this section.

1. Avoided flood insurance costs

Underlying change. Using the Hydrologic Engineering Centers River Analysis System (HEC-RAS) modeling, the project would submit a revision of FEMA's floodplain maps. Project proponents expect the FEMA inundation zone to shrink by 6 acres. This would reduce the number of houses in the official floodplain, which, in turn, would reduce the costs to those homes of purchasing flood insurance. Project proponents expect that a total of six residential properties.

Evidence for demand and value. According to FEMA's flood insurance data, a total of 203 flood insurance policies were in force in 2013 in Nevada County (US Federal Emergency Management Agency. 2013). These insurance policies covered a total of $50 million, with annual premiums totaling $162,851. The average premium for properties within Nevada County receiving FEMA's flood insurance in 2013 was $802 per property. Average premiums for properties in Grass Valley were $930, average premiums in Nevada City were $1,081, average premiums in Truckee were $676, and average premiums in unincorporated areas in the county were $811. Applying this full range of annual premiums ($676-$1,081 per property) to the six properties the project would remove from the inundation zone suggests a total avoided cost of $4,056 to $6,484 per year. We use the low end of this range in our calculations to avoid the risk of overestimating the benefit.

Timing and duration. Project proponents hope to complete efforts required to update the FEMA inundation maps by early 2014. The benefits associated with the new maps would begin accruing when the relevant property owners no longer have to pay FEMA's flood insurance premiums, assumed to start in 2015. Barring additional changes to FEMA's inundation maps, these benefits would persist through the duration of the project, 50 years.

Beneficiaries. The individuals benefiting from this component of the project are those six property owners that would no longer pay annual premiums for FEMA's flood insurance.

Sources of uncertainty. We are underestimating this benefit if the actual value of flood insurance paid by the property owners who would be removed from the floodplain is larger than the value we use; the converse would mean we have overestimated the benefit.

2. Increase in riparian habitat

Underlying change. The project would restore 0.5 acres of riparian habitat along Peabody Creek by removing invasive species and revegetating the floodplain and riparian areas with native plants.

Evidence for demand and value. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results identify per-acre estimates for passive use values by geographic region and forest biome. For our

analysis, we use the passive use value associated with North American forestland in the cool coniferous biome, $125 per acre per year. Once habitat reaches maturity, after 15 years, the undiscounted value of this benefit is $63 per year.

Timing and duration. Project proponents expect to complete riparian habitat restoration by 2014. To reduce the risk that we overestimate this benefit, we assume the project would begin accruing benefits related to improvements in riparian habitat in 2015. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

Beneficiaries. The beneficiaries of this benefit are the people of California who value enhanced riparian habitat along Peabody Creek.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of the riparian habitat created would also affect the economic benefit estimate described here. The value described above estimates society's total willingness to pay for fully-restored forest land in cool coniferous forests in North America. Insofar as this estimate considers only passive use values, it likely underestimates the total economic value of riparian and other forest-based restoration because direct users of the restored habitat likely are willing to pay more for its restoration. It also likely underestimates the value because, as human populations and incomes grow in California, the marginal value of forest land probably will increase, as will the value of restoration efforts. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates derived in the past underestimate, perhaps substantially, the true value of future increases in fully-restored riparian and other forest habitat.

3. Avoided costs of compliance with MS4 permit

Underlying change. The project would support many opportunities for education, volunteerism, and other forms of community outreach. These outreach efforts would support several efforts required by the City of Grass Valley's NPDES MS4 permit, including: (1) writing and publishing articles to local media, (2) developing and placing sings to increase awareness of stormwater quality concerns, (3) supporting community volunteerism and participations, and (4) conducting training workshops.

Evidence for demand and value. The City of Grass Valley is required to conduct several outreach-related efforts in order to comply with its NPDES MS4 permit. To the extent that the project would contribute to those requirements, it would provide avoided costs to the City. We assume that these outreach efforts would cost the same whether conducted as part of the project or as part of the City's efforts, so the value of the benefit (the avoided cost to the City) is equal to the cost of the relevant components of the project. Project sponsors estimate that the education and outreach components of this project that would satisfy some of the City's education and outreach requirements under its new MS4 permit would cost $29,000 between September 2013 and January 2015.

Timing and duration. The benefit associated with these avoided costs would accrue as the funds are spent by the project (2013-2015). We assume the value described above is distributed evenly, by month, through those years.

Beneficiaries. The beneficiaries of this benefit would be the City of Grass Valley and its taxpayers.

Sources of uncertainty. The value of this benefit would only materialize if the City of Grass Valley would have done similar education and outreach activities as this project would provide, and City staff decide that this project satisfies the City's requirement under the MS4 permit. If either of these assumptions doesn't play out, this value may be smaller than we quantify or it would disappear entirely.

Table 15-1 – Avoided flood insurance costs

(All benefits should be in 2012 dollars)

Project: Wolf Creek Watershed: restoration, Stromwater Source Control and Flood Management

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced insurance	Properties	0	0	0	$ 676.00	$ -	1.000	**$ -**
2013	Reduced insurance	Properties	0	0	0	$ 676.00	$ -	0.943	**$ -**
2014	Reduced insurance	Properties	0	0	0	$ 676.00	$ -	0.890	**$ -**
2015	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.840	**$ 3,405**
2016	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.792	**$ 3,213**
2017	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.747	**$ 3,031**
2018	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.705	**$ 2,859**
2019	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.665	**$ 2,697**
2020	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.627	**$ 2,545**
2021	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.592	**$ 2,401**
2022	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.558	**$ 2,265**
2023	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.527	**$ 2,137**
2024	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.497	**$ 2,016**
2025	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.469	**$ 1,902**
2026	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.442	**$ 1,794**
2027	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.417	**$ 1,692**
2028	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.394	**$ 1,597**
2029	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.371	**$ 1,506**
2030	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.350	**$ 1,421**
2031	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.331	**$ 1,341**
2032	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.312	**$ 1,265**
2033	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.294	**$ 1,193**
2034	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.278	**$ 1,126**
2035	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.262	**$ 1,062**
2036	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.247	**$ 1,002**
2037	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.233	**$ 945**
2038	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.220	**$ 892**
2039	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.207	**$ 841**
2040	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.196	**$ 793**
2041	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.185	**$ 749**
2042	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.174	**$ 706**
2043	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.164	**$ 666**
2044	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.155	**$ 629**
2045	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.146	**$ 593**
2046	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.138	**$ 559**
2047	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.130	**$ 528**
2048	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.123	**$ 498**
2049	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.116	**$ 470**
2050	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.109	**$ 443**
2051	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.103	**$ 418**
2052	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.097	**$ 394**
2053	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.092	**$ 372**
2054	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.087	**$ 351**
2055	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.082	**$ 331**
2056	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.077	**$ 312**
2057	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.073	**$ 295**
2058	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.069	**$ 278**
2059	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.065	**$ 262**
2060	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.061	**$ 247**
2061	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.058	**$ 233**
2062	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.054	**$ 220**
2063	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.051	**$ 208**
2064	Reduced insurance	Properties	0	6	6	$ 676.00	$ 4,056.00	0.048	**$ 196**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 56,897.57**

Comments: The full range of annual premiums is $676-1081, making these estimates a lower bound.

Table 15-2 – Increase in riparian habitat
(All benefits should be in 2012 dollars)

Project: Wolf Creek Watershed: restoration, Stromwater Source Control and Flood Management

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Riparian Habitat	functional acres	0	0	0	$ 125.00	$ -	1.000	**$ -**
2013	Riparian Habitat	functional acres	0	0	0	$ 125.00	$ -	0.943	**$ -**
2014	Riparian Habitat	functional acres	0	0	0	$ 125.00	$ -	0.890	**$ -**
2015	Riparian Habitat	functional acres	0	0.03	0.03	$ 125.00	$ 4.17	0.840	**$ 3**
2016	Riparian Habitat	functional acres	0	0.07	0.07	$ 125.00	$ 8.33	0.792	**$ 7**
2017	Riparian Habitat	functional acres	0	0.10	0.10	$ 125.00	$ 12.50	0.747	**$ 9**
2018	Riparian Habitat	functional acres	0	0.13	0.13	$ 125.00	$ 16.67	0.705	**$ 12**
2019	Riparian Habitat	functional acres	0	0.17	0.17	$ 125.00	$ 20.83	0.665	**$ 14**
2020	Riparian Habitat	functional acres	0	0.20	0.20	$ 125.00	$ 25.00	0.627	**$ 16**
2021	Riparian Habitat	functional acres	0	0.23	0.23	$ 125.00	$ 29.17	0.592	**$ 17**
2022	Riparian Habitat	functional acres	0	0.27	0.27	$ 125.00	$ 33.33	0.558	**$ 19**
2023	Riparian Habitat	functional acres	0	0.30	0.30	$ 125.00	$ 37.50	0.527	**$ 20**
2024	Riparian Habitat	functional acres	0	0.33	0.33	$ 125.00	$ 41.67	0.497	**$ 21**
2025	Riparian Habitat	functional acres	0	0.37	0.37	$ 125.00	$ 45.83	0.469	**$ 21**
2026	Riparian Habitat	functional acres	0	0.40	0.40	$ 125.00	$ 50.00	0.442	**$ 22**
2027	Riparian Habitat	functional acres	0	0.43	0.43	$ 125.00	$ 54.17	0.417	**$ 23**
2028	Riparian Habitat	functional acres	0	0.47	0.47	$ 125.00	$ 58.33	0.394	**$ 23**
2029	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.371	**$ 23**
2030	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.350	**$ 22**
2031	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.331	**$ 21**
2032	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.312	**$ 19**
2033	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.294	**$ 18**
2034	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.278	**$ 17**
2035	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.262	**$ 16**
2036	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.247	**$ 15**
2037	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.233	**$ 15**
2038	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.220	**$ 14**
2039	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.207	**$ 13**
2040	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.196	**$ 12**
2041	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.185	**$ 12**
2042	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.174	**$ 11**
2043	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.164	**$ 10**
2044	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.155	**$ 10**
2045	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.146	**$ 9**
2046	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.138	**$ 9**
2047	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.130	**$ 8**
2048	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.123	**$ 8**
2049	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.116	**$ 7**
2050	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.109	**$ 7**
2051	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.103	**$ 6**
2052	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.097	**$ 6**
2053	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.092	**$ 6**
2054	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.087	**$ 5**
2055	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.082	**$ 5**
2056	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.077	**$ 5**
2057	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.073	**$ 5**
2058	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.069	**$ 4**
2059	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.065	**$ 4**
2060	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.061	**$ 4**
2061	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.058	**$ 4**
2062	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.054	**$ 3**
2063	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.051	**$ 3**
2064	Riparian Habitat	functional acres	0	0.50	0.5	$ 125.00	$ 62.50	0.048	**$ 3**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 585.96**

Comments: Restored riparian habitat increases linearly over the first fifteen years starting in 2015.

Table 15-3 – Avoided costs of compliance with MS4 permit
(All benefits should be in 2012 dollars)

Project: Wolf Creek Watershed: restoration, Stromwater Source Control and Flood Management

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Avoided permit costs	monthly costs	0	0	0	$ 1,705.00	$ -	1.000	**$ -**
2013	Avoided permit costs	monthly costs	0	4	4	$ 1,705.00	$ 6,820.00	0.943	**$ 6,434**
2014	Avoided permit costs	monthly costs	0	12	12	$ 1,705.00	$ 20,460.00	0.890	**$ 18,209**
2015	Avoided permit costs	monthly costs	0	1	1	$ 1,705.00	$ 1,705.00	0.840	**$ 1,432**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 26,074.84**

Comments:

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2014, is $317,108 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[11]

The project would involve operations and maintenance, but these costs do not differ significantly from baseline activities and so we do not include them in the cost tables. The City of Grass Valley currently maintains the site where the project will be implemented, and this maintenance will continue in the future. For example, under current conditions, the City mucks out the creek channel and clears the riparian zone of invasive plants using a backhoe, which exacerbates erosion, invasive plants spread, and decreases aesthetic value of the creek. With the project, the City will adopt a management plan to make their techniques more watershed friendly.

The project would also involve 100 hours of volunteer labor for planning natives, installing rock bank protection and grade controls. This labor is not specialized, so we value it using California's current minimum wage, $8.00 per hour.

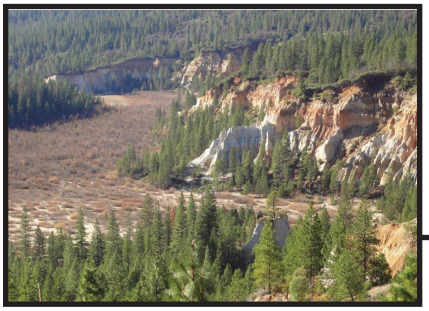
Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: Wolf Creek Watershed: restoration, Stromwater Source Control and Flood Management

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 216,732.00							$ 216,732	0.943	$ 204,464
2014	$ 125,767.00						$ 800.00	$ 126,567	0.890	$ 112,644
								Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries		$ 317,108

Comments:

[11] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.



6 CABY Mercury and Sediment Abatement Initiative

6. CABY Mercury and Sediment Abatement Initiative

Project Description

Conditions Without the Project

Mercury and sediment are two related pollutants of concern for waterways in the CABY region and downstream receiving waters of the California Bay-Delta. In the 19th century the CABY region hosted the most intensive mining and extensive mercury pollution in California. This has created a legacy of mercury contamination in the Bear, American, and Yuba River watersheds.

Today, continuous and ongoing erosion of mine sites in the headwaters, along with each storm event that occurs, washes this toxic element into downstream impoundments via spillways and controlled releases, where it methylates and permeates the aquatic ecosystem. This poses a serious health hazard to humans and wildlife that rely on this water body and downstream environments.

The transport of mercury and methylmercury through Sierra Nevada reservoirs is a significant contributor to Bay-Delta methylmercury levels. Over a 20-year period (1984-2003) it is estimated that 98% of total mercury loads to the Delta came from upstream tributaries. The tributaries of the Sacramento River are the source of 80 percent or more of total mercury flowing into the Bay-Delta, and "the Cache Creek, Feather River, American River, Putah Creek watersheds in the Sacramento Basin have both relatively large mercury loadings and high mercury concentrations in suspended sediment, which makes these watersheds effective candidates for total mercury load reduction programs." (Wood et al. 2010a)

Mercury loads entering the Delta are highest in winter and spring, (Foe 2003) which is when the majority of sediment and mercury is transported from the Yuba and Bear River Watersheds, into the Feather River, and finally downstream to the Sacramento River and Bay-Delta. Furthermore, mercury from gold mining in the Sierra Nevada is more biologically available than material from mercury mines in the Coast Range (Wood et al. 2010b). Fish tested in Combie Reservoir (largemouth bass and Sacramento sucker) and in tributaries of the Yuba River were among the highest in mercury in a state-wide survey recently completed by the State Water Resources Control Board's Surface Water Ambient Monitoring Program (Davis et al. 2010).

Mercury is a water quality constituent of national concern. Consumption of mercury-laden fish leads to developmental delays in fetuses, infants, and children, and can lead to neurological symptoms and other health problems in adult humans as well as ecological problems in wildlife (Weiner et al. 2003a,b). Native peoples practicing a traditional diet consume more mercury-contaminated fish than average Sierra residents.

Total Maximum Daily Load (TMDL) limits have been established for sediment and mercury in the Delta and efforts are ongoing to develop a Statewide Mercury Policy and establish other mercury TMDLs in the upper watershed tributaries. Point sources and reservoir deposits have been identified as the two most feasible locations to clean up legacy mercury contamination.

It has been estimated that California statewide reservoirs have filled with 2.1 billion m3 of sediment to date, or 1.7 MAF, and that many reservoirs have likely lost more than half their initial capacity to sedimentation (Minear and Kondolf, 2009).

Conditions With the Project

The purpose of the project is to conduct an integrated approach to the cleanup of the legacy of abandoned mines in the CABY region with point source remediation activities and information collection to inform regional planning. With the project, the Sierra Fund would conduct a cleanup and assessment of legacy mine pollution in the CABY region. This would involve five projects at potential remediation sites in CABY's upper watersheds:

1. **Remediation of Relief Hill Mine**. This project would implement measures to address abandoned mine runoff from the site from carrying mercury and sediment into downstream water ways and riparian systems. It will accomplish this by minimizing site runon and runoff of suspended and mercury from the mine pit; minimize the potential for exposure and release of mercury that may be present at the base of ground sluices; and improve public awareness of on-site objective dangers. It will also limit unauthorized off-road vehicle use at the site and revegetate certain areas to further prevent mercury-contaminated sediments from being washed into waterways.

2. **Feasibility Study for remediation of Malakoff Diggins and downstream Humbug Creek.** This project would work with a range of stakeholders and expert advisors to evaluate feasibility and implement pilot measures to stop mercury contamination from the mine entering Humbug Creek and Diggins Creek. This process will involve identifying, quantifying, and tracing sediment sources in the pit, with the aim of developing effective sediment and mercury abatement techniques to use at the sensitive site. Due to the historical significance of the site, large-scale terracing and revegetation is not feasible. It will, however, implement and monitor targeted revegetation and re-sloping in specific areas of the pit that act as major sources of mercury and sediment.

3. **Assessment of Omega Diggins and downstream Scotchman Creek.** This project would work with landowners and agencies toward management of forest in the Scotchman Creek watershed to reduce mercury contamination and will use the Forest Service's previous reclamation work at Alpha Diggins (also in the watershed) as a model.

4. **Forest Plan Update for the mining-impacted Inimim Forest.** The project would involve the YWI, which would compile additional information, create a listing of existing mining claims in the forest, and update the Management and Implementation Plan. It is a direct result of local citizen' desire to be included in the land use decisions for Federal lands.

5. **Sediment and mercury removal at Combie Reservoir.** DWR funds would allow XX to lease and demonstrate effectiveness of mercury removal components of the facility that the project would use. During 2013-2016, demonstration of the mercury removal engineering and design, and generate support and funding for implementing the overall project at Combie Reservoir. The District expects to process at least 6,000 pounds of mercury-contaminated sediment as part of facility demonstration. Based on previous operation and testing, these operations would remove at least 36 mg of mercury. Demonstration of the project would include large public and private demonstrations to build support. The District expects to conduct at least six outreach demonstrations in the first year of the project, and three per year thereafter, reaching a minimum of 100 individuals. These demonstrations are

critical for NID to make the case for the project's importance as a model, and secure funding to implement the overall dredging and treatment project.

These projects would also inform mercury and sediment abatement planning and prioritization by coordinating through the regional CABY Mercury Forum. The Forum would provide technical advice to on-the-ground pilot projects and leverage the results of these projects to provide an example for other mercury-impacted watersheds in the Sierra Nevada and for the current planning process for a Statewide Mercury Policy.

The project would also involve filling data gaps on fish mercury contamination, increasing awareness about mercury and fish consumption, posting of fish consumption advisories, abandoned mine land awareness, and community relation plans. This will include the 2013-2016 Angler Survey, which will involve the Sierra Nevada Alliance and their program the Native Conservation Corps. The Sierra Fund will collect fish samples from at least eight critical locations, which the OEHHA 2003 report identified as in need of a specific number of additional samples before it could establish advisories.

This component of the project would collect a total of 500 fish samples, with 175 in 2014, 175 in 2015 and 150 in 2016. The project would also post signs with fish consumption guidelines at 303(d) listed bodies. This will include 9 signs posted in 2014, and 2 signs posted in 2015. These signs will include information about eating fish from mercury-contaminated water bodies at fishing access locations.
This project may form a more effective solution to Bay-Delta methylmercury problems than a similar projects in the Coast Range.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-6 identifies the non-monetized benefits the project would likely generate.

Table 12-6 – Non-monetized Benefits Checklist 6. CABY Mercury and Sediment Abatement Initiative		
No.	*Will the proposal…*	*Response*
	Community/Social Benefits	
1	Provide education or technology benefits?	No
2	Provide social recreation or access benefits? Enhanced value of recreational angling	Yes
3	Help avoid, reduce or resolve various public water resources conflicts?	No
4	Promote social health and safety? Reduce health impacts and costs associated with mercury	Yes
5	Have other social benefits? Protect cultural value associated with fish consumption	Yes
	Environmental Stewardship Benefits	
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7?	No
7	Improve water quality in ways that were not quantified in Attachment 7?	No
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
	Sustainability Benefits	
10	Improve the overall, long-term management of California groundwater resources?	No
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	No
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7?	No
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

2. Provide social recreation or access benefits: Enhanced value of recreational angling

Underlying change. See non-monetary benefit # 4 below for a description of the mechanism by which environmental mercury contaminates fish. To the extent that fishermen are aware of it, contamination of fishery resources from methylmercury pollution diminishes recreational benefits. Awareness of contamination (and therefore diminished recreational enjoyment) is inversely related to the public health concerns associated with consuming mercury-contaminated fish, described below. To the extent that anglers are aware of the public health risks associated with consuming fish from the Sierra and Bay Delta regions, they may avoid that consumption. By abating 1,003 pounds of discharged mercury and removing 36 mg of liquid elemental mercury from the watershed, this project may contribute to a reduction in fish contamination, particularly in fish near the project site.

Evidence for demand and value. There is an economic cost associated with contaminated fish, from an angler's perspective. To the extent that anglers would like to eat the fish they catch but don't because they know of contamination issues, their economic benefit of angling is diminished. While this problem is a well-documented and significant and this project would only have a small affect on total contamination levels, the incremental reduction in risk has some value. The benefits are likely to be most visible in the Sierra region in the short-run. As the project provides momentum for future efforts to reduce mercury from sources in the Sierras, the benefits could grow in amount and scope. Ultimately the majority of economic value that could be achieved from reducing fish contamination levels would be realized in the Delta region.

To the extent that recreational anglers in the region are aware of the mercury contamination, it would impose an economic cost on them in terms of their lost enjoyment, or consumer surplus, related to the fishing activities. A review of the recreational fishing literature in the United States analyzed the losses in consumer surplus recreational anglers experience as a result of fish consumption advisories. They found that the per trip loss ranges from $2.55 - $5.24 with an aggregate annual loss of approximately $8.83 million (Jakus et al 2002).

This benefit interacts closely with non-monetized benefit #4, below. To the extent that anglers eat the fish and receive the full benefit of their angling experience, they may incur health consequences described below.

Timing and duration. Project proponents expect the Relief Hill project, which would confer the bulk of the benefits related to mercury discharge abated, to begin conferring benefits in 2014. The Relief Hill project will mercury abatement related benefits for the project lifetime, 20 years.

Beneficiaries. The beneficiaries of this benefit would include recreational users, particularly anglers, in the Sierra Nevada. Many of these anglers, especially those who are low-income, may also be fishing for subsistence purposes. Fish contamination is tightly linked to environmental justice issues, as often those who bear the largest share of the costs are most dependent on the resource for meeting their basic needs. The prevalence of disadvantaged communities in the CABY region suggests anglers from these areas could be a large share of the beneficiaries.

Sources of uncertainty. Drawing the link between removing elemental mercury in the environment and improving the economic well-being of anglers through fish consumption is relatively straight-forward: the scientific literature confirms the link exists between mercury in the environment and fish contamination (Klasing and Brodberg 2003). Surveys conducted in the Sierra confirm that anglers are affected by contaminated fish (Monohan 2011). Much more difficult and where the bulk of the uncertainty lies is in estimating the magnitude and economic value of the effects of the project on recreational anglers' consumer surplus losses. Another source of uncertainty associated with this project is in the extent to which it would reduce fish contamination rates in areas where people catch the fish.

4. Promote social health and safety: **Reduce health impacts and costs associated with mercury**

Underlying change. Mercury is a water quality constituent of statewide concern that poses a serious health risk to individuals across the state. The watersheds in the Sierra Nevada and the Central Valley contain thousands of legacy mercury and gold mining features. From these sources, and natural geothermal activity, soil, atmospheric deposition, industrial and domestic waste-water and other

sources—inorganic mercury enters the food chain primarily through bacteria-mediated mercury methylation.

Mercury then bio accumulates in organisms, particularly fish, of higher trophic levels. As a result, predatory fish (e.g. striped bass) have the highest tissue concentrations of mercury. There is substantial evidence that fish in the Sierra and Bay Delta regions have tissue levels meet and exceed the EPA Office of Environmental Health Hazard Assessment and Food and Drug Administration threshold for safe consumption. For example, the Central Valley Regional Water Quality Control Board database and San Francisco Estuary Institute have shown mercury concentration in commonly eaten fish in the Northern Delta region exceed this threshold for the following species: carp, catfish, crappie, largemouth bass, Sacramento pike minnow, split-tail, and striped bass.

There is also evidence that fish in the waterbodies within the project area have tissue levels exceeding EPA standards. The most recent comprehensive fish survey in the Yuba and Bear watersheds found that fish tissue levels meet and exceed the EPA threshold in each of the following relevant waterbodies, with species and levels:

1. Engleright Reservoir: Smallmouth and spotted bass, >0.3 ppm
2. Scotts Flat Reservoir: Most largemouth bass, >0.3 ppm
3. Rollins Reservoir: Most channel catfish and largemouth bass, >0.3 ppm
4. Lake Combie: All largemouth bass, >0.7 ppm
5. Camp Far West: All spotted and largemouth bass and channel catfish >0.5 ppm, half of the spotted bass, >1.0 ppm
6. Bear River at Dog Bar Road and Little Deer Creek at Pioneer Park: Half of brown trout sampled, >0.3 ppm

More than 95 percent of mercury found in fish occurs as methylmercury, which is a highly toxic form of the element (Klasing and Brodberg 2003). Humans interact with this substance directly, through consumption. The U.S. Department of the Interior estimates that 10 percent of Californians engage in sport and subsistence fishing, many of whom fish in the watersheds of the Sacramento-San Joaquin Rivers Delta and San Francisco Bay. A survey of residents in the Sierra Nevada who live near major reservoirs found over 90 percent of respondents had eaten fish that they had themselves caught or eaten fish caught by someone they knew (Monohan 2011). Another health evaluation of fishers in the Sierra Nevada foothills found that fishers consuming predatory fish from this area are potentially exposed to methylmercury concentrations above the USEPA reference dose.

The fish from the Sierra Nevada also interact with, and travel to, the Delta region in California, contributing to mercury-contaminated fish in that region as well. A study of the Central Valley found that anglers, who tend to favor predatory fish for recreation and consumption, are particularly at risk for consuming mercury-contaminated fish (Shilling et al 2010). California's Delta region also has very high ethnic and language diversity and many of its communities rely on fishing as a cultural and economic practice. Finally, there are many California-born fish consumers in the Delta who subsistence fish.
In a survey of anglers in California, Shilling et al. (2010) find the mean consumption rates of locally caught fish were 27.4 grams / day, higher than the USEPA standard fish consumption rate of 17.5 grams / day. Predictably, they found higher rates of mercury intake corresponded to higher rates of fish consumption. The entire sample had a mean total mercury intake rate greater than the USEPA reference

dose, with 5 percent of those with a mercury intake rate at least 10 times higher than the reference dose.

The health risks associated with consuming mercury-contaminated fish are profound. These can include brain, nervous system, kidney, and immune system damage. Children and infants are especially vulnerable to low-levels of mercury exposure and consumption of mercury-laden fish leads to developmental delays and neurological symptoms in fetuses and infants, and slow development, impair language and memory, delay walking, and contribute to attention disorders in children. High doses can cause birth defects and mental retardation.

By abating 1,003 pounds of discharged mercury and removing 36 mg of liquid elemental mercury from the watershed, this project would contribute to a small improvement in health-related outcomes for these communities. While this problem is a well-documented and significant and this project will only have a small affect on the total contamination levels, the increment has some value. Moreover, while having only a small impact on the problem in the Delta, the project could have a significant local impact for recreational and subsistence fishermen the project area. These impacts are likely to be most visible in the Sierra region.

The project may also contribute to future improvements in public health to the extent that it also contributes to identifying implementation measures for mercury and sediment in the upper watersheds for the Methylmercury Total Maximum Load in the Delta and upcoming Statewide Mercury Policy and other mercury TMDLs in the upper watershed tributaries.

Evidence for demand and value. Shilling et al. (2010) note there has "never been an economic evaluation of the cost of reducing fish contamination in California, though it is popularly thought to be high." (Shilling 2010). To our knowledge, this remains true today. There is substantial evidence, however, that human health has substantial economic value. For example, the U.S. Environmental Protection Agency estimates the value of a statistical life is $8.14 million, based on willingness to pay for small reductions in mortality risk (Shilling 2010).

Consumption of fish by wildlife and humans is legally protected in these waters as a beneficial use under the Clean Water Act. To the extent that methylmercury concentrations in fish detract from the public's right to consume these fish it imposes a heavy economic cost on society.

Timing and duration. Project proponents expect the Relief Hill project, which would confer the bulk of the benefits related to mercury discharge abated, to begin conferring benefits in 2014. The Relief Hill project will mercury abatement related benefits for the project lifetime, 20 years.

Beneficiaries. The beneficiaries of this benefit are the anglers and subsistence fishers in the Bay Delta and Sierra regions, particularly to residents and native groups local to the project area. There are significant environmental justice implications associated with this benefit. According to Shilling et al. (2010), mean mercury intake rates for Southeast Asian, Vietnamese, Lao, and Asian/Pacific Islander were all significantly higher than the USEPA reference dose. They also found awareness about fish contamination was generally very low, but was highest among white and middle-aged respondents. Southeast Asians tended to have the lowest levels of awareness.

Native Americans who traditionally eat sport fish may also be disproportionately impacted by mercury contamination of fish. Some indigenous subpopulations eat about 4 to 5 times the amount of fish

assumed in EPA models to determine fish consumption advisories (Roe 2003). Native Americans there therefore often exposed to higher levels of mercury than other populations. See non-monetized benefit # 5 below for a more detailed discussion of the economic effects related to this population.

Sources of uncertainty. Drawing the link between removing elemental mercury in the environment and improving the economic well-being of people through fish consumption is relatively straight-forward: the scientific literature confirms the link exists between mercury in the environment and fish contamination (see discussion above). Much more difficult and where the bulk of the uncertainty lies is in estimating the magnitude and economic value of the health effects related to mercury ingestion. Another source of uncertainty associated with this project is in the extent to which it would reduce fish contamination rates in areas where people use the fish.

5. Have other social benefits: **Protect cultural value associated with fish consumption**

Underlying change. In addition to suffering from a higher prevalence of mercury-related health problems, as we describe in non-monetized benefit #4 (Promote social health and safety), above, methylmercury pollution inflicts sociocultural damage to indigenous peoples who fish for substance. Native Americans have a special cultural relationship to the land and an ethos of sustainability; cultural values that may experience damage from mercury pollution. Subsistence dominates the cultural underpinnings of many groups, while others fish as part of annual cultural rituals. These events are often of critical importance to maintaining ethnic identity. Native Americans in the Sierra Nevada exemplify this generalization rather than exempt from it; many native peoples of the region practice gathering, hunting, fishing, firewood use and toolstone quarrying to meet their basic needs (Anderson and Moratto 1996). To the extent that the project contributes reduced localized impacts on a significant scale (or small impacts on a large scale) it may ease the sociocultural damage inflicted by mercury pollution.

Evidence for demand and value. When mercury contamination threatens the fish populations, Native Americans must face a trade-off between cultural identity and their health. As Roe (2003) puts it: “giving up fish could mean giving up culture.” For Native Americans, the choice between the health and fish consumption is not as straightforward for other Western cultures. In economic terms, this choice imposes high opportunity costs that may seriously endanger the individuals’ well-being. However, many Native Americans recognize the importance of salmon outside the cultural framework and economic terms western society often imposes (Malloy 1992). Accordingly, they reject the validity of applying a dollar value to protecting a core element of their cultural and spiritual well-being.

Timing and duration. Project proponents expect the Relief Hill project, which would confer the bulk of the benefits related to mercury discharge abated, to begin conferring benefits in 2014. The Relief Hill project will mercury abatement related benefits for the project lifetime, 20 years.

Beneficiaries. The beneficiaries of this benefit are the Native American populations in the Sierra Nevada and in California, generally.

Sources of uncertainty. Drawing the link between removing elemental mercury in the environment and improving the economic well-being of people through fish consumption is relatively straight-forward: the scientific literature confirms the link exists between mercury in the environment and fish contamination (see discussion above). The cultural benefits of fish consumption are also well documented in the anthropological literature. The primary source of uncertainty associated with this

project is in the extent to which it would reduce fish contamination rates in areas where people use the fish for cultural purposes.

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $1,730,559. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3 at the end of this section.

1. Avoided costs associated with reduced sediment deposition

Underlying change. The project would avoid a total of 10,003 tons of sediment per year from entering the nearby water bodies. The Relief Hill Hydraulic Mine Remediation Project would abate 10,000 tons of sediment deposition per year by constructing check dams and rock armoring of spillways to retain sediment on site. The Malakoff Diggins Hydraulic Mine Feasibility Study would abate 3 tons of sediment deposition per year by implementing erosion control and streambank restoration. The Combie Reservoir Mercury Treatment Facility will abate an additional 3 tons of sediment deposition with six demonstration projects over three years of project implementation.

Evidence for demand and value. Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. For our analysis, we apply the average value for the counties in the Lower Yuba watershed, $9.86 per ton, to estimate the benefits derived from the prevention of sediment deposition. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing
- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Navigation – shipping industry avoidance of damages from groundings

The annual undiscounted value of this benefit is $98,622.

Timing and duration. Project proponents expect the Relief Hill project to begin conferring benefits in 2014, the Malakoff Diggins Feasibility Study in 2016, and the Combie Reservoir in 2014. The Relief Hill project will confer sediment related benefits for the project lifetime, 20 years. The Malakoff Diggins Feasibility Study will confer benefits for the lifetime of its restored riparian area, 50 years. The Combie Reservoir will reduce 500 pounds of sediment during each trial, for a total of 3 tons of sediment over three years, between 2014 and 2016.

Beneficiaries. The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of reduced sedimentation would also affect the economic benefit estimate described here. See Attachment 7 for a description of these biophysical sources of uncertainty.

At least three major factors suggest that the value of sediment we use underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the proposed projects. If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations.

2. Passive-use value associated with increased forest biodiversity

Underlying change. The project would restore 88 acres of forest habitat and 26 acres of riparian habitat, by planting trees and plants, for a total increase of 114 acres of forest biodiversity. Much of this benefit is related to the Relief Hill project, which would restore 86 acres of forest habitat and 12 acres of forested riparian habitat. The Malakoff Diggins project would restore an additional 2 acres of forest habitat and 14 acres of forested riparian habitat. The increased diversity of plants likely would increase the amount of habitat for other native wildlife. Overall, the project likely would directly increase the biodiversity of the restored acres, and potentially also indirectly increase the biodiversity of the adjacent habitat. We assume the existing habitat provides no functionality, and restoration would fully increase its function as it matures over a 30-year period. Once the restoration reaches year 30, the function persists for the long-run, at least 50 years.

Evidence for demand and value. Data are insufficient to delineate specific impacts of the project's restoration efforts on the ecosystem services provided by this area of riparian habitat. Thus, instead we employ a value that accounts for people's willingness to pay for the flow of goods and services from an acre of forested riparian habitat. In 2009, researchers conducted several meta-analyses estimating various use and nonuse values associated with forestland. In estimating the passive use value of forestland, the researchers compiled data from 23 relevant studies (Chiabai et al. 2009). Their results

identify per-acre estimates for passive use values by geographic region and forest biome. For our analysis, we use the passive use value associated with North American forestland in coniferous biome, $125 per acre per year.

Timing and duration. Project proponents expect the Relief Hill project to begin conferring benefits in 2014, while the Malakoff Diggins Feasibility Study will begin conferring benefits in 2016. These benefits would persist for the lifetime of the restored habitat, at least 50 years.

Beneficiaries. The beneficiaries of this benefit would include Californians who value the existence of forest biodiversity in northern California.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of increased forest biodiversity would also affect the economic benefit estimate described here. See Attachment 7 for a full description of these biophysical sources of uncertainty. By only considering passive use, we likely underestimate the total value of the benefits derived from riparian restoration. This value also may underestimate the total value to the extent that it does not account for potential increases in the biodiversity of habitat adjacent to the restored area.

3. Avoided costs of climate change from carbon sequestration

Underlying change. The project would plant 88 acres of forest habitat, including native trees, shrubs, and grasses. This change in vegetation likely would increase the amount of carbon sequestered in the area. For our analysis, we assume the project would sequester 59.9 to 338.2 metric tons of carbon dioxide per year, depending on the year and the age of the stand. The actual amount of sequestered carbon dioxide is dependent on many variables, including, but not limited to, the precise mix of species planted, the density of the saplings, the age of the saplings, climate patterns, and the surrounding vegetation and land uses.

Evidence for demand and value. The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents “the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere.” (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[12] Thus, while this range of costs for carbon is well within the broader range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change.

We calculate the carbon sequestration benefits of the project over a 50 year period using a 6 percent discount rate. Reforestation results in 19,562 tons of sequestered carbon over a 50 year span with a net present value of $30,240.

Timing and duration. Project proponents expect the Relief Hill project to begin conferring benefits in 2014, while the Malakoff Diggins Feasibility Study will begin conferring benefits in 2016. These benefits would persist for the lifetime of the restored habitat, at least 50 years.

Beneficiaries. The beneficiaries of this benefit would include all residents of California.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. In particular, the estimate of carbon sequestration does not account for the expected mortality rates of the planted trees, the age of the trees at planting, or other environmental factors that could effect the total amount of sequestered carbon. To the extent that these factors reduce the amount of carbon sequestered by the project, we are overestimating the value of the project. However, because we are using a low estimate of the value of the social cost of carbon, it is likely that we are underestimating the real value of carbon sequestration from the project in the long run.

[12] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

Table 15-1 Avoided Cost of Sediment Deposition
(All benefits should be in 2012 dollars)

Project: CABY Mercury and Sediment Abatement Initiative

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Reduced Sediment Deposition	tons	0	0	0	$ 9.86	$ -	1.000	**$ -**
2013	Reduced Sediment Deposition	tons	0	0	0	$ 9.86	$ -	0.943	**$ -**
2014	Reduced Sediment Deposition	tons	0	10004	10004	$ 9.86	$ 98,639.44	0.890	**$ 87,789**
2015	Reduced Sediment Deposition	tons	0	10004	10004	$ 9.86	$ 98,639.44	0.840	**$ 82,820**
2016	Reduced Sediment Deposition	tons	0	10004	10004	$ 9.86	$ 98,639.44	0.792	**$ 78,132**
2017	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.747	**$ 73,702**
2018	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.705	**$ 69,530**
2019	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.665	**$ 65,594**
2020	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.627	**$ 61,881**
2021	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.592	**$ 58,379**
2022	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.558	**$ 55,074**
2023	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.527	**$ 51,957**
2024	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.497	**$ 49,016**
2025	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.469	**$ 46,241**
2026	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.442	**$ 43,624**
2027	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.417	**$ 41,155**
2028	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.394	**$ 38,825**
2029	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.371	**$ 36,628**
2030	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.350	**$ 34,554**
2031	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.331	**$ 32,598**
2032	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.312	**$ 30,753**
2033	Reduced Sediment Deposition	tons	0	10003	10003	$ 9.86	$ 98,629.58	0.294	**$ 29,012**
2034	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.278	**$ 8**
2035	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.262	**$ 8**
2036	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.247	**$ 7**
2037	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.233	**$ 7**
2038	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.220	**$ 7**
2039	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.207	**$ 6**
2040	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.196	**$ 6**
2041	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.185	**$ 5**
2042	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.174	**$ 5**
2043	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.164	**$ 5**
2044	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.155	**$ 5**
2045	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.146	**$ 4**
2046	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.138	**$ 4**
2047	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.130	**$ 4**
2048	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.123	**$ 4**
2049	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.116	**$ 3**
2050	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.109	**$ 3**
2051	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.103	**$ 3**
2052	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.097	**$ 3**
2053	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.092	**$ 3**
2054	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.087	**$ 3**
2055	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.082	**$ 2**
2056	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.077	**$ 2**
2057	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.073	**$ 2**
2058	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.069	**$ 2**
2059	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.065	**$ 2**
2060	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.061	**$ 2**
2061	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.058	**$ 2**
2062	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.054	**$ 2**
2063	Reduced Sediment Deposition	tons	0	3	3	$ 9.86	$ 29.58	0.051	**$ 2**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 1,067,383.80**

Comments: The Relief Hill Hydraulic Mine Remediation Project would save 10,000 tons for the first 20 years, the Malakoff Diggins Hydraulic Mine Feasability Study would abate 3 tons each year for the 50 years, and the Combie Reservoir Mercury Treatment Facility would abate 1 ton for each of the first three years.

Table 15-2 – Passive-use value associated with increased forest biodiversity

(All benefits should be in 2012 dollars)

Project: CABY Mercury and Sediment Abatement Initiative

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Increased Forest Habitat	Acres	0	0	0	$ 120.00	$ -	1.000	**$ -**
2013	Increased Forest Habitat	Acres	0	0	0	$ 120.00	$ -	0.943	**$ -**
2014	Increased Forest Habitat	Acres	0	3.8	3.8	$ 120.00	$ 456.00	0.890	**$ 406**
2015	Increased Forest Habitat	Acres	0	7.6	7.6	$ 120.00	$ 912.00	0.840	**$ 766**
2016	Increased Forest Habitat	Acres	0	11.4	11.4	$ 120.00	$ 1,368.00	0.792	**$ 1,084**
2017	Increased Forest Habitat	Acres	0	15.2	15.2	$ 120.00	$ 1,824.00	0.747	**$ 1,363**
2018	Increased Forest Habitat	Acres	0	19	19	$ 120.00	$ 2,280.00	0.705	**$ 1,607**
2019	Increased Forest Habitat	Acres	0	22.8	22.8	$ 120.00	$ 2,736.00	0.665	**$ 1,820**
2020	Increased Forest Habitat	Acres	0	26.6	26.6	$ 120.00	$ 3,192.00	0.627	**$ 2,003**
2021	Increased Forest Habitat	Acres	0	30.4	30.4	$ 120.00	$ 3,648.00	0.592	**$ 2,159**
2022	Increased Forest Habitat	Acres	0	34.2	34.2	$ 120.00	$ 4,104.00	0.558	**$ 2,292**
2023	Increased Forest Habitat	Acres	0	38	38	$ 120.00	$ 4,560.00	0.527	**$ 2,402**
2024	Increased Forest Habitat	Acres	0	41.8	41.8	$ 120.00	$ 5,016.00	0.497	**$ 2,493**
2025	Increased Forest Habitat	Acres	0	45.6	45.6	$ 120.00	$ 5,472.00	0.469	**$ 2,565**
2026	Increased Forest Habitat	Acres	0	49.4	49.4	$ 120.00	$ 5,928.00	0.442	**$ 2,622**
2027	Increased Forest Habitat	Acres	0	53.2	53.2	$ 120.00	$ 6,384.00	0.417	**$ 2,664**
2028	Increased Forest Habitat	Acres	0	57	57	$ 120.00	$ 6,840.00	0.394	**$ 2,693**
2029	Increased Forest Habitat	Acres	0	60.8	60.8	$ 120.00	$ 7,296.00	0.371	**$ 2,709**
2030	Increased Forest Habitat	Acres	0	64.6	64.6	$ 120.00	$ 7,752.00	0.350	**$ 2,716**
2031	Increased Forest Habitat	Acres	0	68.4	68.4	$ 120.00	$ 8,208.00	0.331	**$ 2,713**
2032	Increased Forest Habitat	Acres	0	72.2	72.2	$ 120.00	$ 8,664.00	0.312	**$ 2,701**
2033	Increased Forest Habitat	Acres	0	76	76	$ 120.00	$ 9,120.00	0.294	**$ 2,683**
2034	Increased Forest Habitat	Acres	0	79.8	79.8	$ 120.00	$ 9,576.00	0.278	**$ 2,657**
2035	Increased Forest Habitat	Acres	0	83.6	83.6	$ 120.00	$ 10,032.00	0.262	**$ 2,626**
2036	Increased Forest Habitat	Acres	0	87.4	87.4	$ 120.00	$ 10,488.00	0.247	**$ 2,590**
2037	Increased Forest Habitat	Acres	0	91.2	91.2	$ 120.00	$ 10,944.00	0.233	**$ 2,550**
2038	Increased Forest Habitat	Acres	0	95	95	$ 120.00	$ 11,400.00	0.220	**$ 2,506**
2039	Increased Forest Habitat	Acres	0	98.8	98.8	$ 120.00	$ 11,856.00	0.207	**$ 2,459**
2040	Increased Forest Habitat	Acres	0	102.6	102.6	$ 120.00	$ 12,312.00	0.196	**$ 2,409**
2041	Increased Forest Habitat	Acres	0	106.4	106.4	$ 120.00	$ 12,768.00	0.185	**$ 2,356**
2042	Increased Forest Habitat	Acres	0	110.2	110.2	$ 120.00	$ 13,224.00	0.174	**$ 2,302**
2043	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.164	**$ 2,247**
2044	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.155	**$ 2,120**
2045	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.146	**$ 2,000**
2046	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.138	**$ 1,887**
2047	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.130	**$ 1,780**
2048	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.123	**$ 1,679**
2049	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.116	**$ 1,584**
2050	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.109	**$ 1,494**
2051	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.103	**$ 1,410**
2052	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.097	**$ 1,330**
2053	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.092	**$ 1,255**
2054	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.087	**$ 1,184**
2055	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.082	**$ 1,117**
2056	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.077	**$ 1,053**
2057	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.073	**$ 994**
2058	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.069	**$ 938**
2059	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.065	**$ 885**
2060	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.061	**$ 834**
2061	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.058	**$ 787**
2062	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.054	**$ 743**
2063	Increased Forest Habitat	Acres	0	114	114	$ 120.00	$ 13,680.00	0.051	**$ 701**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 92,935.60**

Comments: These calculations assume that it will take 50 years for 114 acres of forest habitat to be restored. The acres of benefit increase linearly over this period and then remain constant at 114 acres from 2063-2113.

Table 15-3 – Avoided costs of climate change from carbon sequestration

(All benefits should be in 2012 dollars)

Project: CABY Mercury and Sediment Abatement Initiative

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Year	**Type of Benefit**	**Measure of Benefit (Units)**	**Without Project**	**With Project**	**Change Resulting from Project (e) – (d)**	**Unit $ Value (1)**	**Annual $ Value (1) (f) x (g)**	**Discount Factor (1)**	**Discounted Benefits (1) (h) x (i)**
2012	Increased carbon sequestration	Metric tons	0		0	$ 13.00	$ -	1.000	**$ -**
2013	Increased carbon sequestration	Metric tons	0		0	$ 13.33	$ -	0.943	**$ -**
2014	Increased carbon sequestration	Metric tons	0	121	121	$ 13.66	$ 1,652.63	0.890	**$ 1,471**
2015	Increased carbon sequestration	Metric tons	0	121	121	$ 14.00	$ 1,693.95	0.840	**$ 1,422**
2016	Increased carbon sequestration	Metric tons	0	121	121	$ 14.35	$ 1,736.30	0.792	**$ 1,375**
2017	Increased carbon sequestration	Metric tons	0	121	121	$ 14.71	$ 1,779.71	0.747	**$ 1,330**
2018	Increased carbon sequestration	Metric tons	0	121	121	$ 15.08	$ 1,824.20	0.705	**$ 1,286**
2019	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 15.45	$ 879.83	0.665	**$ 585**
2020	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 15.84	$ 901.82	0.627	**$ 566**
2021	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 16.24	$ 924.37	0.592	**$ 547**
2022	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 16.64	$ 947.48	0.558	**$ 529**
2023	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 17.06	$ 971.16	0.527	**$ 512**
2024	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 17.48	$ 995.44	0.497	**$ 495**
2025	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 17.92	$ 1,020.33	0.469	**$ 478**
2026	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 18.37	$ 1,045.84	0.442	**$ 463**
2027	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 18.83	$ 1,071.98	0.417	**$ 447**
2028	Increased carbon sequestration	Metric tons	0	56.936	56.936	$ 19.30	$ 1,098.78	0.394	**$ 433**
2029	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 19.78	$ 1,831.25	0.371	**$ 680**
2030	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 20.28	$ 1,877.03	0.350	**$ 658**
2031	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 20.78	$ 1,923.96	0.331	**$ 636**
2032	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 21.30	$ 1,972.06	0.312	**$ 615**
2033	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 21.83	$ 2,021.36	0.294	**$ 595**
2034	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 22.38	$ 2,071.89	0.278	**$ 575**
2035	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 22.94	$ 2,123.69	0.262	**$ 556**
2036	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 23.51	$ 2,176.78	0.247	**$ 538**
2037	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 24.10	$ 2,231.20	0.233	**$ 520**
2038	Increased carbon sequestration	Metric tons	0	92.576	92.576	$ 24.70	$ 2,286.98	0.220	**$ 503**
2039	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 25.32	$ 2,794.27	0.207	**$ 579**
2040	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 25.95	$ 2,864.12	0.196	**$ 560**
2041	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 26.60	$ 2,935.73	0.185	**$ 542**
2042	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 27.27	$ 3,009.12	0.174	**$ 524**
2043	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 27.95	$ 3,084.35	0.164	**$ 507**
2044	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 28.65	$ 3,161.46	0.155	**$ 490**
2045	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 29.37	$ 3,240.49	0.146	**$ 474**
2046	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 30.10	$ 3,321.51	0.138	**$ 458**
2047	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 30.85	$ 3,404.54	0.130	**$ 443**
2048	Increased carbon sequestration	Metric tons	0	110.352	110.352	$ 31.62	$ 3,489.66	0.123	**$ 428**
2049	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 32.41	$ 4,963.16	0.116	**$ 575**
2050	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 33.22	$ 5,087.24	0.109	**$ 556**
2051	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 34.05	$ 5,214.42	0.103	**$ 537**
2052	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 34.91	$ 5,344.78	0.097	**$ 520**
2053	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 35.78	$ 5,478.40	0.092	**$ 502**
2054	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 36.67	$ 5,615.36	0.087	**$ 486**
2055	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 37.59	$ 5,755.74	0.082	**$ 470**
2056	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 38.53	$ 5,899.64	0.077	**$ 454**
2057	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 39.49	$ 6,047.13	0.073	**$ 439**
2058	Increased carbon sequestration	Metric tons	0	153.12	153.12	$ 40.48	$ 6,198.31	0.069	**$ 425**
2059	Increased carbon sequestration	Metric tons	0	195.8	195.8	$ 41.49	$ 8,124.15	0.065	**$ 525**
2060	Increased carbon sequestration	Metric tons	0	195.8	195.8	$ 42.53	$ 8,327.25	0.061	**$ 508**
2061	Increased carbon sequestration	Metric tons	0	195.8	195.8	$ 43.59	$ 8,535.43	0.058	**$ 491**
2062	Increased carbon sequestration	Metric tons	0	195.8	195.8	$ 44.68	$ 8,748.82	0.054	**$ 475**
2063	Increased carbon sequestration	Metric tons	0	195.8	195.8	$ 45.80	$ 8,967.54	0.051	**$ 459**
							Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)		**$ 30,240.50**

Comments:

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2014, is $2,305,135 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[13]

The project would involve 1,576 hours of in-kind volunteer labor for water quality monitoring and volunteer labor from SYRCL volunteers and additional volunteer labor for water, air, and wildlife monitoring and analysis. These costa are included in the budget and demonstrated as in-kind matching funds.

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: CABY Mercury and Sediment Abatement Initiative

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs (2)						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +...+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 1,072,430.00							$ 1,072,430	0.943	$ 1,011,726
2014	$ 1,453,274.00							$ 1,453,274	0.890	$ 1,293,409
Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries										$ 2,305,135

Comments:

[13] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

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CABY Integrated Regional Water Management Plan
Proposition 84, Round 2 Implementation Grant

7 Meadow Restoration, Assessment and Restoration in the American, Bear and Yuba Watersheds

7. Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds

Project Description

Conditions Without the Project

Meadows in the CABY region serve important ecological functions for water storage and regulation, habitat provision, and climate regulation. These functions support the provision of goods and services that all Californians enjoy. Grazing and forest fire control practices over the last century have degraded and reduced the acreage of functional meadows in the CABY region. Many of the meadow ecosystems that still exist are invaded with non-native plants, eroded by drainage ditches, and crossed by roads and culverts. As forest managers and property owners have suppressed wildfires, stands of conifers have expanded into meadows, shading and crowding out aspen groves. All of these changes limit the meadows' capacity to produce ecological goods and services. Without restoration, these influences will continue to erode the amount of functional meadow acreage in the CABY region.

The project is focused on seven meadows in the American and Yuba watersheds that are currently degraded, and without the project would continue to worsen:

- Elliot Meadow is located in Shirttail Creek watershed, a tributary to the North Fork American River in the Tahoe National Forest (TNF). A man-made ditch and developing head cuts in Shirttail Creek have lowered the water table in the meadow, and conifers and invasive plants have established in the meadow.

- Gold Hill Ranch is a 272-acre property that contains a small lake, six undeveloped springs and unique low elevation wetland complexes that feed two major tributary springs (Granite Creek and Shingle Creek) to the South Fork American River. The site is of historical significance as it represents the first Japanese settlement in North America.

- Upper Bear Valley / Discovery Trail is located in the Yuba watershed and has a long history of use, including recreation and seasonal livestock grazing. Invasive plants have established in the area.

- Deer Meadow is located on the headwaters of Texas Creek in the TNF and is hydrologically connected to Loney Meadow, one of the largest wetland complexes in the South Yuba River watershed. Portions of the meadow have been hydrologically altered and are currently in poor condition.

- Butcher Ranch and Rucker Meadows are located in the Yuba watershed, and are suffering from conifer encroachment into aspen strands, which reduces the area of functional meadow vegetation, both through exclusion and competition for shallow water.

- Bear Meadow is a five-acre meadow in the Yuba Watershed near Bullards Bar Reservoir. The meadow is currently infested with non-native plants, including yellow star thistle and Scotch broom.

- Blackjack Ravine Fen/Peatland is located in the TNF and contains wet meadow/peatland complexes. Cattle have disturbed the area, which has reduced the health of local plant communities. Currently, a closed road is interrupting the hydrology of the Blackjack wet meadow/peatland complex.

Apart from these seven sites, data about the location, land ownership, and ecological conditions of meadow sites are limited in the American River watershed. Without this information, managers are unable to identify and prioritize meadow restoration activities that would yield the most benefits. Experience in the Yuba and Mokelumne watersheds has shown that once data are available to show where investments would yield the greatest benefits, financial support becomes available to implement meadow restoration projects.

Conditions With the Project

The project would restore the ecological function at each of the meadows through various strategies. The project would also implement the prioritization and assessment method from American Rivers to fill geographical data gaps in the American River watershed that would help identify future restoration needs and support funding opportunities for those restoration efforts.

Section D2. Non-Monetized Benefits Analysis

In this section, we describe the economic importance of the project's effects for which sufficient information to quantify in monetary terms does not exist. Table 12-7 identifies the non-monetized benefits the project would likely generate.

Table 12-7. Non-monetized Benefits Checklist 7. Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds		
No.	Will the proposal…	Response
Community/Social Benefits		
1	Provide education or technology benefits? Enhanced human capital	Yes
2	Provide social recreation or access benefits? Enhance recreational experience	Yes
3	Help avoid, reduce or resolve various public water resources conflicts?	No
4	Promote social health and safety?	No
5	Have other social benefits?	No
Environmental Stewardship Benefits		
6	Benefit wildlife or habitat in ways that were not quantified in Attachment 7? Passive use value of special-status species	Yes
7	Improve water quality in ways that were not quantified in Attachment 7? Reduce costs associated with sedimentation	Yes
8	Reduce net emissions in ways that were not quantified in Attachment 7?	No
9	Provide other environmental stewardship benefits, other than those claimed in Sections D1, D3, or D4?	No
Sustainability Benefits		
10	Improve the overall, long-term management of California groundwater resources?	Yes
11	Reduce demand for net diversions for the regions from the Delta?	No
12	Provide a long-term solution in place of a short-term one?	No
13	Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources?	No
14	Improve water supply reliability in ways not quantified in Attachment 7?	No
15	Other (If the above listed categories do not apply, provide non-monetized benefit description)?	No

Notes: [1] A "no" response may mean the project does not produce this benefit, or it may mean the benefit is already quantified in Attachment 7, or monetized directly under Section D3 below.

1. Provide education or technology benefits: Enhanced human capital

Underlying change. Youth from the Sierra Native Alliance, other students, and other volunteers would provide on-the-ground project work. These individuals (about 530 in total) would be responsible for planting, monitoring, and other efforts conducted under the project, during which they will receive training related to the restoration and monitoring efforts. The project will also install a kiosk and interpretive signs at Gold Hill Ranch, which will provide visitors with information describing the historical significance of the site as the first Japanese settlement in North America.

Evidence for demand and value. Drawing a cause-and-effect relationship between educational efforts and specific water-supply or water-quality outcomes is difficult, but there are several ways the project could produce tangible economic benefits through its education components:

- Education made possible by this project over the long term, may increase the public's understand of and support or demand for future watershed-enhancement projects. Increased community support for and participation in future public projects may make future meadow restoration projects easier to implement and less costly to complete, resulting in additional water quality and quantity benefits at lower cost to the community.
- Opportunities to participate in educational programs and restoration opportunities improve the well-being of the youth, students, and volunteers who choose to participate. These improvements may not result in water-supply or water-quality benefits directly, but they may better people's lives in other ways that have economic importance. Spending time outdoors may improve an individual's emotional and physical health, which constitutes an investment in human capital. Working with others in restoration efforts has the potential to strengthen the relationships among community members, which constitutes an investment in social capital. Both of these effects may contribute to an overall improvement in quality of life.

These effects may be small, but subtle changes arising from education should not be dismissed. For example, interactions among community members in the context of this project may be brief, compared to all of the other interactions that go on day-to-day, but the effect combined with all of the other small effects may accumulate into measurable improvements in quality of life in the long run. Similarly, staff who work with community members on watershed education attest that a public better educated about watershed issues generates dividends in future projects. The efforts of this project, in combination with other sustained efforts in the long run, likely will translate to economic benefits for the community that reach beyond this project.

Timing and duration. Volunteer-related benefits would materialize when the District begins its restoration, monitoring, and data collection efforts. Project proponents anticipate beginning these efforts soon after awarded funding (fall of 2013). In total, these efforts would last through 2015, for a total of two years of education experiences. The individuals participating in these efforts, however, would retain the knowledge they gained beyond the two-year project period. Other education benefits (those associated with the interpretive signs at Gold Hill Ranch) would begin accruing when the project is completed, and would persist for the life of the project (50 years), assuming the signs are maintained over the life of the project.

Beneficiaries. Volunteer-related efforts would provide education benefits to youth from the Sierra Native Alliance, students from local school groups, and other volunteers participating in restoration, monitoring, and data collection efforts. The education benefits associated with signs and access to Gold Hill Ranch will accrue to local and non-local visitors to the site.

Sources of uncertainty. Without detailed program evaluations of educational efforts, it is difficult to predict when particular benefits to education and public engagement activities might emerge and what their impact might be. The peer-reviewed literature on this topic is scant, and results from one study may not be broadly transferrable to other programs because specifics of program design, delivery, and audience may affect the level of benefits achieved.

2. Provide social recreation or access benefits: **Enhance recreational experience**

Underlying change. Restoration efforts at Gold Hill Ranch would increase public access to recreation benefits at the site.

Evidence for demand and value. The increased public access would provide economic benefits if they:

- improved the experience for visitors who already visit the area, by providing new amenities they care about.
- attracted new visitors who wouldn't have gone elsewhere.
- attracted visitors who would have gone elsewhere, but are able to enjoy an equivalent experience closer to home.

Another source of value comes from people who haven't actually visited Gold Hill Ranch, but are willing to pay to have the option of using it at some point in the future, if they choose. Data are not available to determine if this "option value" is an important component of the value of the project's access improvements, but given that the National Park Service recently placed the Wakamatsu Colony site on the National Register of Historic Places at a level of "National Significance" these values may be sizeable.

Timing and duration. Benefits associated with the improved access at Gold Hill Ranch would begin accruing after the project is completed, and would persist for the life of the project (50 years), assuming the access is maintained over the life of the project.

Beneficiaries. Anyone who visits Gold Hill Ranch, or who would value the opportunity to visit the site at some point in the future would benefit from the public access aspects of the project.

Sources of uncertainty. Quantifying the extent to which economic benefits would arise from this project is difficult, as data aren't available to describe current visitation levels, levels of satisfaction with the experience, or determine how the project would improve recreational experiences.

6. Benefit wildlife or habitat**: Passive use value of special-status species**

Underlying change. The project would enhance 8 acres of aquatic habitat. Restoration and enhancement efforts in Elliot Meadow and Gold Hill Ranch would reduce summer water temperatures in downstream areas by two degrees and improve aquatic habitat. Efforts in Elliot Meadow would restore the natural sediment regime on five miles of stream, and efforts in Gold Hill Ranch would restore and enhance five acres of aquatic resources and would restore the natural sediment regime on 0.25 miles of stream. The project would involve invasive species removal that would enhance suitable habitat for the threatened California red-legged frog.

Evidence for demand and value. In 1996, the California red-legged frog was listed as threatened under the Endangered Species Act (ESA). Each year, the US Fish and Wildlife Service publishes a report summing all ESA-related expenditures by species/population, to the extent that those expenditures can be tied to a particular species/population. From 2009, 2010, and 2011 ESA-related spending tied to the red-legged frog in California totaled $7.1 million, $2.7 million, and $4.5 million (respectively) (US Fish

and Wildlife Service. 2009-2011.). These totals do not include land acquisition costs. These expenditures, however, represent only part of the story. Government efforts to support species at risk also impose costs on society, primarily by restricting land use in protected areas (opportunity costs). For example, in 2010, the 1.6 million acres of habitat were designated as critical habitat for the California red-legged frog. The economic impacts associated with this designation were estimated at $14.4-$45.2 million per year. Furthermore, other entities (e.g., non-profit organizations and private individuals) bear costs in implementing their own efforts to help support the species. In addition to this spending,

Timing and duration. Project proponents expect to complete instream and aquatic habitat enhancement in Elliot Meadow by 2015, and in Gold Hill Ranch by 2014. We assume that the project would fully complete both these efforts by the end of 2015. These benefits would persist for the lifetime of the project, 50 years.

Beneficiaries. The beneficiaries of this benefit are the people of California who value enhanced instream and aquatic habitat in the lower CABY region.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of the instream and aquatic habitat created would also affect the economic benefit estimate described here. See Attachment 7 for a description of these biophysical sources of uncertainty.

7. Improve water quality: **Reduce costs associated with sedimentation**

Underlying change. By reducing erosion and stabilizing stream bank, the project would reduce sediment delivery to several water bodies in the North Fork American and South Fork American watersheds. There are insufficient data available to estimate the quantity of avoided sedimentation associated with the project.

Evidence for demand and economic value. Economic studies have examined and monetized some of the benefits that materialize when excessive sediment does not impair streams, rivers, estuaries, and the marine environment. A study conducted by the U.S. Department of Agriculture identified 13 types of benefits associated with decreasing sediment (Hansen and Ribaudo 2008). For each benefit, the researchers modeled the potential value associated with reducing sediment, per ton, for each county across the country. The average value of avoided sedimentation costs for the counties in the North Fork American and South Fork American watersheds is an average of $7.60 per ton. Included in this value are the regional benefits associated with the impacts of sediment on:

- Water-based recreation – cleaner fresh water recreation
- Irrigation ditches and channels – reduced cost of removing sediment and aquatic plants from irrigation channels
- Road drainage ditches – less damage to and flooding of roads
- Municipal water treatment – lower sediment-removal costs for water treatment plants
- Flood damage – reduced flooding and damage from flooding
- Marine fisheries – improved catch rates for marine commercial fisheries
- Marine recreational fishing – improved catch rates for marine recreational fishing

- Municipal and industrial water use – reduced damages from salts and minerals dissolved from sediment
- Steam power plants – reduced plant growth on heat exchangers
- Soil productivity – reduced losses in soil productivity
- Dust cleaning – decrease in cleaning due to reduced wind-borne particulates.
- Reservoir services – less sediment in reservoirs
- Navigation – shipping industry avoidance of damages from groundings

Timing and duration. Project proponents expect to have finished all efforts supporting this reduction in sedimentation by the end of 2015. Assuming the project is effective, we anticipate the benefits would persist for the lifetime of the project, 50 years.

Beneficiaries. The beneficiaries of this benefit are the wide array of downstream users associated with each of the benefits listed above. To some extent, these beneficiaries include the general public, municipal water treatment operators and their ratepayers, irrigators, recreationalists, downstream property owners, and fishermen.

Sources of uncertainty. At least three major factors suggest that the value of sediment we identify underestimates the true value of the sediment-reduction benefits. First, the value does not reflect many potential benefits, such as the goods and services derived from potential impacts on wetlands and endangered species. Second, the estimates of sediment erosion that the projects would reduce are based on current sediment erosion rates. Climate change is expected to increase the frequency and intensity of storm events, which would likely increase the rate of sediment erosion absent the proposed projects.[14] If future sediment erosion rates exceed current rates, the without-project sediment erosion is likely to increase, and thus, the expected benefit of each project's sediment control activities is likely to be an underestimate. Third, this estimate does not anticipate increases in value that occur over time. We anticipate that the value of sediment-reduction benefits will increase, relative to the general price index, but have not accounted for this increase in our calculations.

10. Improve the overall, long-term management of California groundwater resources?

For the reasons described below in monetized benefit #3 (Increased groundwater recharge), this project would confer this benefit.

[14] Masden, T. and E. Figdor. 2007. *When it Rains, it Pours.* Environment America Research and Policy Center and Frontier Group.

Section D3. Monetized Benefits Analysis

The present value of the monetized benefits in 2012 dollars, discounted annually at 6 percent over the relevant lifespan of each component of the project (described for each benefit below), is $115,606. The calculations for each monetized benefit are shown in Tables 15-1, 15-2, 15-3 at the end of this section.

1. Enhanced and improved meadow/wetland habitat

Underlying change. The project would increase the amount of meadow and wetland habitat in two distinct instance: (1) as part of restoration efforts in Elliot Meadow, the project would restore 10 acres of meadows, and (2) as part of restoration efforts in Gold Hill Ranch, the project would restore 5 acres of meadow and 12 acres of wetlands. Restoring these area would help promote aquifer storage and recharge through re-connection of the floodplain to the stream corridor and provide long-term solutions to habitat loss, erosion, and sedimentation.

The project would increase the amount of riparian habitat in two distinct instances: (1) as part of restoration efforts in Elliot Meadow, the project would increase the length of stream bank by 1,300 feet, and (2) as part of restoration efforts in Gold Hill Ranch, the project would increase the length of stream bank by 2,600 feet. Restoring these area would help promote aquifer storage and recharge through re-connection of the floodplain to the stream corridor and provide long-term solutions to habitat loss, erosion, and sedimentation.

Evidence for demand and economic value. The value of the improved and expanded wetland habitat is based on estimates of the existence value of wetland habitat as reported in Woodward and Wui (2001). In this case, existence value represents the value of protecting the wetland habitat for current and future generations. Woodward and Wui (2001) estimate the annual nonuse value of habitat of a single-service wetland is $167 to $1,723 per acre. To reflect the uncertainty over the quality of the wetland habitat created by this project, we use the lower end of this range, $167.

This value is multiplied by the number of acres of improved wetland and meadows based on the net increase in the number of acres of wetland that the project is expected to create, to estimate the annual value of this benefit at $4,509 per year. We do not explicitly add the riparian area created by the project to the meadow habitat, but do recognize that because the meadows would provide additional riparian habitat, we may underestimate the value of this benefit.

The restored riparian areas increase in ecological function over time as vegetation matures. Our annual value reflects this steady improvement, using a simple assumption that the quantity of ecological services—and thus people's willingness to pay for them—increases linearly over a 50-year period.

Timing and duration. Project proponents expect to complete meadow and wetland restoration and enhancement efforts in Elliot Meadow by 2015, and in Gold Hill Ranch by 2014. We assume that the project would fully complete both these efforts by the end of 2015. These benefits likely would increase over time, as restoration matures, and would persist over the long run (at least 50 years).

Beneficiaries. The beneficiaries of this benefit are the people of California who value enhanced meadow and wetland habitat in the lower CABY region.

Sources of uncertainty. All sources of uncertainty surrounding the estimate of the meadow and wetland habitat created would also affect the economic benefit estimate described here. See Attachment 7 for a description of these biophysical sources of uncertainty. Applying a value derived from studies conducted elsewhere in the United States may over or underestimate the total economic value of increases in certain types of habitat. The value described above estimates society's willingness to pay for one fully-restored acre of wetland habitat in North America. This value is generally applicable to seasonal wetland habitat in California. By only considering passive use, we likely underestimate the total value of the benefits derived from wetland restoration because this value ignores direct users of restored habitat that are likely willing to pay more for its restoration. This value also may underestimate the total value to the extent that it does not account for potential increases in the biodiversity of habitat adjacent to the restored area. Moreover, as human populations and incomes in California grow, the marginal value of natural landscapes will increase, as will the value of restoration.

2. Avoided social costs associated with increased carbon sequestration

Underlying change. By enhancing habitat and promoting soil carbon sequestration on 27 acres of restoration, the project would increase the number of metric tons of carbon sequestered by 30 in 2015 and 200 in 2016 and thereafter.

Evidence for demand and value. The International Panel on Climate Change has identified anthropogenic greenhouse gas emissions as the main contributor of global warming and climate change. Carbon dioxide emissions have received the most attention as they account for the majority of these emissions – 77 percent in 2004 (IPCC 2007). Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment (IPCC 2007).

Economists use the social cost of carbon to estimate the value of changes in greenhouse gas emissions. The social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere." (Shaw 2009) There are currently over 200 different estimates of the social cost of carbon. One review of the literature found values ranging from about $7 to $111 per ton of carbon dioxide equivalent ($2007) (Shaw 2009). Another analysis suggests increasing the social cost of carbon, in real terms, by 2–3 percent per year to reflect the rising damages from climate change (Nordhaus 2008).

California's cap-and-trade system for carbon provides one such estimate of the social cost of carbon. The cap-and-trade system, which took effect January 1, 2012, allots credits through auctions. The second such auction on February 19, 2013 elicited bids that ranged from $10.71-$50.01, with a mean and median price of $14.71 and $12.56, respectively (California Air Resources Board 2012). The cap-and-trade market, however, only applies to large producers of carbon and producers are allowed to offset up to 8 percent of carbon emissions.[15] Thus, while this range of costs for carbon is well within the broader

[15] These projects may currently include, and may only include forestry, urban forestry, dairy manure digesters, and the destruction of ozone depleting substances. California Environmental Protection Agency - Air Resources Board. Air Resources Board sets stage for carbon offset projects. December 14, 2012.

range of costs, this market is not the appropriate mechanism for determining the cost of carbon beyond the cost for large producers.

For this analysis, we use a value of $13 per ton of carbon dioxide equivalent sequestered to represent the social cost of carbon. We inflate this value by 2.5 percent per year, in real terms, to reflect the rising damages from climate change. With full implementation of the project, the annual, undiscounted value of this benefit is $2,600, increasing at a real rate of 2.5 percent per year.

Timing and duration. Project proponents expect to complete meadow and wetland restoration and enhancement efforts in Elliot Meadow by 2015, and in Gold Hill Ranch by 2014. We assume that the project would fully complete both these efforts by the end of 2015. These benefits would increase over time, as the vegetation matures, and would persist over the long run (at least 50 years).

Beneficiaries. The beneficiaries of this benefit are all residents of California.
Sources of uncertainty. All sources of uncertainty surrounding the estimate of increased carbon dioxide sequestered would also affect the economic benefit estimate described here. In particular, the estimate of carbon sequestration may not account for some net effects of converting a forested area to meadow-wetland habitat. To the extent that these factors reduce the amount of carbon sequestered by the project, we are overestimating the value of the project. However, because we are using a low estimate of the value of the social cost of carbon, it is likely that we are underestimating the real value of carbon sequestration from the project in the long run.

3. Increase groundwater recharge

Underlying change. The projects would increase groundwater recharge by 5 acre-feet over the baseline in 2015 and by 10 acre-feet over the baseline in 2016 and thereafter, for the project lifetime.

Evidence for demand and value. Economists who study the economic importance of groundwater describe this importance using two major categories of value: extractive values and *in situ* values (CVG 1997). The major extractive values include the economic importance of groundwater consumption by municipalities, business and industry, and agricultural producers. Groundwater aquifers offer significant advantages over surface storage for consumptive uses including: no costs for storage facility, no loss through evaporation, and groundwater also protect water quality at no or little cost relative to surface storage. Another advantage of groundwater aquifers is their capacity to distribute water over long distances at little to no cost. Constructing pipe systems on the surface is much more expensive than relying on an existing aquifer for water movement.

In situ values derive from the services that groundwater provides in place, rather than through consumptive use. *In situ* values include:

- Buffer values—given that supplies of surface water can fluctuate, groundwater supplies can help smooth out, or buffer, variability in water supplies in cases where water districts manage groundwater conjunctively with surface water. One study found that the buffer capacity of groundwater can represent over 80 percent of the total value of surface and groundwater (CVG 1997, page 60.).

- Environmental values—groundwater can help assimilate harmful pollutants. These assimilative properties helps avoid filtration and related costs that water users would otherwise face. Groundwater also often supports surface water flows and riparian and wetland ecosystems during parts of the year.
- Subsidence-avoidance values—the structural services that groundwater provides *in situ* help avoid ground subsidence and related damages to roads, pipeline, foundations and other structures and infrastructure. One way of describing the associated economic values is the avoided costs of subsidence damage.

While data are not available to quantify the value of increased groundwater directly, we assume the groundwater has sufficient interaction with instream flows to use that value for these purposes.

Additional instream flows would help support ecosystem goods and services that people value, including improved habitat for species and clean water for recreation and other uses. A recent study that included information on the lease rates paid for water rights in the Central Valley found that the average leases rate for instream flows environmental purposes between 2000 and 2009 was $128 per acre foot (*WestWater Research in* Aylward and Merrill 2012). We use this value to measure the value of additional water for in-stream flows to enhance ecosystems, water-quality and fish and other affected species. Using this value, the annual, undiscounted value of offsetting 70 acre-feet per year of diverted surface flows would be $8,960 per year.

Beneficiaries. The beneficiaries of this benefit are groundwater users in the area, potentially other surface water users in the region, and people who value the ecological services provided by enhancing groundwater recharge and building the resiliency of groundwater-surface water interactions.

Timing and duration. The projects would increase groundwater recharge by 5 acre-feet over the baseline in 2015 and by 10 acre-feet over the baseline in 2016 and thereafter, for the project lifetime, 50 years.

Sources of uncertainty. The value we derive from the data provided by WestWater Research, as presented in the findings of Aylward and Merrill (2012) embodies the uncertainty inherent in the individual study as well as from applying results from past research to future conditions. There is, however, no obvious reason to conclude that the estimate systematically overestimates the true marginal value of water for environmental purposes from the CABY region. As human populations and incomes grow in California, the marginal value of wild salmonid populations and other benefits derived from instream flows for environmental purposes is likely to increase, as will the value of stream flows that support their continued existence. Because we found no reliable estimate of the rate of increase, we did not fold this increase into our estimates. For these reasons, it seems reasonable to conclude that the value estimates we apply in this analysis underestimate—perhaps substantially—the true value of future increases in water supplies that would result from the projects.

Table 15-1 – Enhanced and improved meadow/wetland habitat
(All benefits should be in 2012 dollars)
Project: Meadow Restoration, Assessment andPrioritization in the American, Bear and Yuba Watersheds

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Improved Wetland	functional acres	0	0	0	$ 167.00	$ -	1.000	**$ -**
2013	Improved Wetland	functional acres	0	0	0	$ 167.00	$ -	0.943	**$ -**
2014	Improved Wetland	functional acres	0	0	0	$ 167.00	$ -	0.890	**$ -**
2015	Improved Wetland	functional acres	0	1.8	1.8	$ 167.00	$ 300.60	0.840	**$ 252**
2016	Improved Wetland	functional acres	0	3.6	3.6	$ 167.00	$ 601.20	0.792	**$ 476**
2017	Improved Wetland	functional acres	0	5.4	5.4	$ 167.00	$ 901.80	0.747	**$ 674**
2018	Improved Wetland	functional acres	0	7.2	7.2	$ 167.00	$ 1,202.40	0.705	**$ 848**
2019	Improved Wetland	functional acres	0	9	9	$ 167.00	$ 1,503.00	0.665	**$ 1,000**
2020	Improved Wetland	functional acres	0	10.8	10.8	$ 167.00	$ 1,803.60	0.627	**$ 1,132**
2021	Improved Wetland	functional acres	0	12.6	12.6	$ 167.00	$ 2,104.20	0.592	**$ 1,245**
2022	Improved Wetland	functional acres	0	14.4	14.4	$ 167.00	$ 2,404.80	0.558	**$ 1,343**
2023	Improved Wetland	functional acres	0	16.2	16.2	$ 167.00	$ 2,705.40	0.527	**$ 1,425**
2024	Improved Wetland	functional acres	0	18	18	$ 167.00	$ 3,006.00	0.497	**$ 1,494**
2025	Improved Wetland	functional acres	0	19.8	19.8	$ 167.00	$ 3,306.60	0.469	**$ 1,550**
2026	Improved Wetland	functional acres	0	21.6	21.6	$ 167.00	$ 3,607.20	0.442	**$ 1,595**
2027	Improved Wetland	functional acres	0	23.4	23.4	$ 167.00	$ 3,907.80	0.417	**$ 1,631**
2028	Improved Wetland	functional acres	0	25.2	25.2	$ 167.00	$ 4,208.40	0.394	**$ 1,657**
2029	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.371	**$ 1,674**
2030	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.350	**$ 1,580**
2031	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.331	**$ 1,490**
2032	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.312	**$ 1,406**
2033	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.294	**$ 1,326**
2034	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.278	**$ 1,251**
2035	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.262	**$ 1,180**
2036	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.247	**$ 1,114**
2037	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.233	**$ 1,051**
2038	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.220	**$ 991**
2039	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.207	**$ 935**
2040	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.196	**$ 882**
2041	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.185	**$ 832**
2042	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.174	**$ 785**
2043	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.164	**$ 741**
2044	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.155	**$ 699**
2045	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.146	**$ 659**
2046	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.138	**$ 622**
2047	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.130	**$ 587**
2048	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.123	**$ 553**
2049	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.116	**$ 522**
2050	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.109	**$ 493**
2051	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.103	**$ 465**
2052	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.097	**$ 438**
2053	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.092	**$ 414**
2054	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.087	**$ 390**
2055	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.082	**$ 368**
2056	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.077	**$ 347**
2057	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.073	**$ 328**
2058	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.069	**$ 309**
2059	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.065	**$ 292**
2060	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.061	**$ 275**
2061	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.058	**$ 259**
2062	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.054	**$ 245**
2063	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.051	**$ 231**
2064	Improved Wetland	functional acres	0	27	27	$ 167.00	$ 4,509.00	0.048	**$ 218**
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 42,273.14**

Comments: Wetland restoration is expected to mature over time. These benefits are assumed to increase linearly over 15 years to a max benefit of 27 acres.

Table 15-2 – Net increase in carbon sequestration
(All benefits should be in 2012 dollars)

Project: Meadow Restoration, Assessment andPrioritization in the American, Bear and Yuba Watersheds

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Sequestered carbon	tons	0	0	0	$ 13.00	$ -	1.000	$ -
2013	Sequestered carbon	tons	0	0	0	$ 13.33	$ -	0.943	$ -
2014	Sequestered carbon	tons	0	0	0	$ 13.66	$ -	0.890	$ -
2015	Sequestered carbon	tons	0	30	30	$ 14.00	$ 419.99	0.840	$ 353
2016	Sequestered carbon	tons	0	200	200	$ 14.35	$ 2,869.91	0.792	$ 2,273
2017	Sequestered carbon	tons	0	200	200	$ 14.71	$ 2,941.66	0.747	$ 2,198
2018	Sequestered carbon	tons	0	200	200	$ 15.08	$ 3,015.20	0.705	$ 2,126
2019	Sequestered carbon	tons	0	200	200	$ 15.45	$ 3,090.58	0.665	$ 2,055
2020	Sequestered carbon	tons	0	200	200	$ 15.84	$ 3,167.85	0.627	$ 1,988
2021	Sequestered carbon	tons	0	200	200	$ 16.24	$ 3,247.04	0.592	$ 1,922
2022	Sequestered carbon	tons	0	200	200	$ 16.64	$ 3,328.22	0.558	$ 1,858
2023	Sequestered carbon	tons	0	200	200	$ 17.06	$ 3,411.43	0.527	$ 1,797
2024	Sequestered carbon	tons	0	200	200	$ 17.48	$ 3,496.71	0.497	$ 1,738
2025	Sequestered carbon	tons	0	200	200	$ 17.92	$ 3,584.13	0.469	$ 1,680
2026	Sequestered carbon	tons	0	200	200	$ 18.37	$ 3,673.73	0.442	$ 1,625
2027	Sequestered carbon	tons	0	200	200	$ 18.83	$ 3,765.58	0.417	$ 1,571
2028	Sequestered carbon	tons	0	200	200	$ 19.30	$ 3,859.71	0.394	$ 1,519
2029	Sequestered carbon	tons	0	200	200	$ 19.78	$ 3,956.21	0.371	$ 1,469
2030	Sequestered carbon	tons	0	200	200	$ 20.28	$ 4,055.11	0.350	$ 1,421
2031	Sequestered carbon	tons	0	200	200	$ 20.78	$ 4,156.49	0.331	$ 1,374
2032	Sequestered carbon	tons	0	200	200	$ 21.30	$ 4,260.40	0.312	$ 1,328
2033	Sequestered carbon	tons	0	200	200	$ 21.83	$ 4,366.91	0.294	$ 1,285
2034	Sequestered carbon	tons	0	200	200	$ 22.38	$ 4,476.09	0.278	$ 1,242
2035	Sequestered carbon	tons	0	200	200	$ 22.94	$ 4,587.99	0.262	$ 1,201
2036	Sequestered carbon	tons	0	200	200	$ 23.51	$ 4,702.69	0.247	$ 1,161
2037	Sequestered carbon	tons	0	200	200	$ 24.10	$ 4,820.25	0.233	$ 1,123
2038	Sequestered carbon	tons	0	200	200	$ 24.70	$ 4,940.76	0.220	$ 1,086
2039	Sequestered carbon	tons	0	200	200	$ 25.32	$ 5,064.28	0.207	$ 1,050
2040	Sequestered carbon	tons	0	200	200	$ 25.95	$ 5,190.89	0.196	$ 1,015
2041	Sequestered carbon	tons	0	200	200	$ 26.60	$ 5,320.66	0.185	$ 982
2042	Sequestered carbon	tons	0	200	200	$ 27.27	$ 5,453.68	0.174	$ 950
2043	Sequestered carbon	tons	0	200	200	$ 27.95	$ 5,590.02	0.164	$ 918
2044	Sequestered carbon	tons	0	200	200	$ 28.65	$ 5,729.77	0.155	$ 888
2045	Sequestered carbon	tons	0	200	200	$ 29.37	$ 5,873.01	0.146	$ 859
2046	Sequestered carbon	tons	0	200	200	$ 30.10	$ 6,019.84	0.138	$ 830
2047	Sequestered carbon	tons	0	200	200	$ 30.85	$ 6,170.33	0.130	$ 803
2048	Sequestered carbon	tons	0	200	200	$ 31.62	$ 6,324.59	0.123	$ 776
2049	Sequestered carbon	tons	0	200	200	$ 32.41	$ 6,482.71	0.116	$ 751
2050	Sequestered carbon	tons	0	200	200	$ 33.22	$ 6,644.77	0.109	$ 726
2051	Sequestered carbon	tons	0	200	200	$ 34.05	$ 6,810.89	0.103	$ 702
2052	Sequestered carbon	tons	0	200	200	$ 34.91	$ 6,981.17	0.097	$ 679
2053	Sequestered carbon	tons	0	200	200	$ 35.78	$ 7,155.70	0.092	$ 656
2054	Sequestered carbon	tons	0	200	200	$ 36.67	$ 7,334.59	0.087	$ 635
2055	Sequestered carbon	tons	0	200	200	$ 37.59	$ 7,517.95	0.082	$ 614
2056	Sequestered carbon	tons	0	200	200	$ 38.53	$ 7,705.90	0.077	$ 593
2057	Sequestered carbon	tons	0	200	200	$ 39.49	$ 7,898.55	0.073	$ 574
2058	Sequestered carbon	tons	0	200	200	$ 40.48	$ 8,096.01	0.069	$ 555
2059	Sequestered carbon	tons	0	200	200	$ 41.49	$ 8,298.41	0.065	$ 537
2060	Sequestered carbon	tons	0	200	200	$ 42.53	$ 8,505.87	0.061	$ 519
2061	Sequestered carbon	tons	0	200	200	$ 43.59	$ 8,718.52	0.058	$ 502
2062	Sequestered carbon	tons	0	200	200	$ 44.68	$ 8,936.48	0.054	$ 485
2063	Sequestered carbon	tons	0	200	200	$ 45.80	$ 9,159.89	0.051	$ 469
2064	Sequestered carbon	tons	0	200	200	$ 46.94	$ 9,388.89	0.048	$ 454
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 55,914.23**

Comments: The social cost of a ton of carbon dioxide is assumed to start from a base of $13/ton and increases annually at 2.5%.

Table 15-3 – Increase groundwater recharge
(All benefits should be in 2012 dollars)

Project: Meadow Restoration, Assessment andPrioritization in the American, Bear and Yuba Watersheds

(a) Year	(b) Type of Benefit	(c) Measure of Benefit (Units)	(d) Without Project	(e) With Project	(f) Change Resulting from Project (e) – (d)	(g) Unit $ Value (1)	(h) Annual $ Value (1) (f) x (g)	(i) Discount Factor (1)	(j) Discounted Benefits (1) (h) x (i)
2012	Increased groundwater recharge	acre-feet	0	0	0	$ 128.00	$ -	1.000	$ -
2013	Increased groundwater recharge	acre-feet	0	0	0	$ 128.00	$ -	0.943	$ -
2014	Increased groundwater recharge	acre-feet	0	0	0	$ 128.00	$ -	0.890	$ -
2015	Increased groundwater recharge	acre-feet	0	5	5	$ 128.00	$ 640.00	0.840	$ 537
2016	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.792	$ 1,014
2017	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.747	$ 956
2018	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.705	$ 902
2019	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.665	$ 851
2020	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.627	$ 803
2021	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.592	$ 758
2022	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.558	$ 715
2023	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.527	$ 674
2024	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.497	$ 636
2025	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.469	$ 600
2026	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.442	$ 566
2027	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.417	$ 534
2028	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.394	$ 504
2029	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.371	$ 475
2030	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.350	$ 448
2031	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.331	$ 423
2032	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.312	$ 399
2033	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.294	$ 377
2034	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.278	$ 355
2035	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.262	$ 335
2036	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.247	$ 316
2037	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.233	$ 298
2038	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.220	$ 281
2039	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.207	$ 265
2040	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.196	$ 250
2041	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.185	$ 236
2042	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.174	$ 223
2043	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.164	$ 210
2044	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.155	$ 198
2045	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.146	$ 187
2046	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.138	$ 177
2047	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.130	$ 167
2048	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.123	$ 157
2049	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.116	$ 148
2050	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.109	$ 140
2051	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.103	$ 132
2052	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.097	$ 124
2053	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.092	$ 117
2054	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.087	$ 111
2055	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.082	$ 104
2056	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.077	$ 99
2057	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.073	$ 93
2058	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.069	$ 88
2059	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.065	$ 83
2060	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.061	$ 78
2061	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.058	$ 74
2062	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.054	$ 69
2063	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.051	$ 66
2064	Increased groundwater recharge	acre-feet	0	10	10	$ 128.00	$ 1,280.00	0.048	$ 62
								Total Present Value of Discounted Benefits Based on Unit Value (Sum of the values in Column (j) for all Benefits shown in table)	**$ 17,418.48**

Comments:

Section D3. Cost Analysis

The present value of the project's costs, which would occur between 2013 and 2019, is $558,729 in 2012 dollars, discounted at a 6-percent annual rate. These costs would fund labor, planning, equipment, and materials necessary to implement the project.[16]

The Gold Run project will require some regular operation and maintenance activities. For example, the hedgerow installation will require periodic maintenance for about 5 years to ensure success. Monitoring and management of invasive plant and animal species will be necessary for at least 5 years post project completion. These activities will be conducted by volunteers; we include 500 hours of volunteer labor for monitoring and maintenance over five years. Projects in the Yuba watershed would also use about 1,100 hours of volunteer labor for construction activities. This labor is not specialized, so we value it using California's current minimum wage, $8.00 per hour.

Table 19 – Annual Costs of Project
(All costs should be in 2012 Dollars)

Project: Meadow Restoration, Assessment andPrioritization in the American, Bear and Yuba Watersheds

	Initial Costs Grand Total Cost from Table 7 (row (i), column (d))	Adjusted Grant Total Cost(1)	Annual Costs [2]						Discounting Calculations	
			Admin	Operation	Maintenance	Replacement	Other	Total Costs (a) +…+ (g)	Discount Factor	Discounted Project Costs (h) x (i)
Year	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
2012								$ -	1.000	$ -
2013	$ 135,031.00							$ 135,031	0.943	$ 127,388
2014	$ 472,485.00						$ 8,800.00	$ 481,285	0.890	$ 428,342
2015							$ 800.00	$ 800	0.840	$ 672
2016							$ 800.00	$ 800	0.792	$ 634
2017							$ 800.00	$ 800	0.747	$ 598
2018							$ 800.00	$ 800	0.705	$ 564
2019							$ 800.00	$ 800	0.665	$ 532
								Total Present Value of Discounted Costs (Sum of column (j)) Transfer to Table 20, column (c), Proposal Benefits and Costs Summaries		$ 558,729

[16] We have distributed the costs outlined Table 7 across the project's implementation period based on the expected timing and phasing described in the Work Plan. Actual distribution of costs during this period may differ somewhat.

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SUMMARY

Table 20, on the following page, summarizes the benefits and costs of the seven projects included in the proposal package. Each row shows, for each project, the total present value of the monetizable project costs, total present value of the monetizable project benefits, and summarizes the non-monetizable benefits.

The monetary and non-monetizable benefits of these projects should be considered together to understand the full set of benefits each project would generate. This is particularly important for this set of projects, many of which produced low levels of benefits that we were able to monetize relative to costs. This arises for several reasons:

- Many of the projects are designed to test new techniques or demonstrate proof-of-concept for larger efforts. These projects may have lower monetizable benefits (especially compared to their costs) because they are small in scale. These projects likely have non-monetary benefits that would reach well beyond their direct effects, because they would lay the necessary groundwork and generate momentum for future efforts that would yield high levels of benefits.
- A few projects involve actions that focus primarily on increasing the skills and knowledge—building human and social capital resources, in economic terms—of the region's citizens. These investments in human and social capital are difficult to quantify in monetary terms, but research indicates that, in many cases, providing people with knowledge can yield dividends well beyond the limited lifespan of a particular project.
- Many of the projects involve restoring the region's natural capital, which would provide ecosystem goods and services that people care about and value, especially over the long-term. The monetized benefits that accrue well into the future are heavily discounted in this analysis, at a discount rate that is higher than is often recommended as appropriate for adjusting ecological benefits for social time-preference (U.S. EPA 2010).

Moreover, our monetary estimates of environmental benefits likely underestimate the true value insofar as the studies on which we base the estimates have examined the value of specific ecosystem goods and services in isolation, overlooking the cumulative value provided to human society by the ecosystem as a whole. Both ecologists and economists have recognized the importance of the integrated, composite workings of ecosystems, but both disciplines have yet to develop reliable techniques for describing, let alone measuring their value (Millennium Ecosystem Assessment 2005). In effect, then, our estimates give only a partial view of the total value of improvements in environmental quality.

To further buttress our belief that our non-market estimates of value probably underestimate the true value of the potential benefits from protecting and enhancing the environment, we turn to the National Research Council's review of methods for valuing the goods and services produced by water-related ecosystems. Based on its assessment, the report concluded,

> "**There is a much greater danger of underestimating the value of ecosystem goods and services than over-estimating their value.** Under-estimation stems primarily from the failure to include in the value estimates all of the affected goods and services and/or all

> of the sources of value, or from use of a valuation method that provides only a lower bound estimate of value. In many cases, this reflects the limitations of the available valuation methods. Over-estimation, on the other hand, can stem from double-counting or from possible biases in valuation methods. However, it is likely that in most applications the errors from omission of relevant components of value will exceed the errors from over-estimation of the components that are included" (National Research Council 2004, p. 242).

We believe this conclusion applies across each of the projects: the likelihood that we have underestimated the benefits of the projects is far greater than the likelihood that we have overestimated them.

Table 20 – Proposal Benefits and Costs Summary[1] Proposal: CABY Headwaters Resilience and Adaptability Program			
Project and Project Proponent	**Total Present Value Monetized Costs**	**Total Present Value Monetized Benefits**	**Non-Monetized Benefits Summary**
Camptonville Water System Improvement Project	$888,544	$167,123	1. Education or technology benefits: Enhance knowledge about conservation 3. Help avoid, reduce, or resolve various public water resources conflicts 4. Promote social health and safety: Improved drinking water quality and Reduced risk of injury and death from improved fire protection 5. Other social benefits: Reduce costs of fire insurance protection and/or increased property values 7. Improve water quality: Reduce discharges of chlorinated water 14. Improve water supply reliability: Enhance supply capacity and support studies to identify alternate sources of groundwater 15. Other: Avoided costs and improved water-supply reliability associated with reduced probability of water system damage from wildfire
City of Placerville Waterline Replacement	$1,291,794	$760,385	4. Promote social health and safety: Reduced risk of injury and death from improved fire protection 5. Other social benefits: Reduce costs of fire insurance protection and/or increased property values from better fire protection 7. Improve water quality: Avoided costs associated with reduced probability of sediment delivery 14. Improve water supply reliability: Reduced risk of outage from pipe failure, improve overall supply reliability by increasing system efficiency
El Dorado County Small Hydroelectric Development Program	$1,642,446	$245,873	1. Education or technology benefits: Demonstrate an innovative way to produce renewable electricity with existing resources and build momentum for future projects 4. Social health and safety: Improved air quality and reduced health impacts 12. Provide a long-term solution in place of a short-term one 13. Promote energy savings or replace fossil fuel based energy sources with renewable energy and resources 14. Improve water supply reliability: Enhance reliability and resiliency of local electricity grid
Water Efficiency, Water Quality and Supply Reliability in the CABY Region	$1,812,891	$723,535	1. Education or technology benefit: Enhanced water conservation education 4. Social health and safety: Reduce the risk of injury and death by improving fire flow reliability and protect public health by reducing the risk of outages 5. Other social benefits: Reduce costs of fire insurance protection and/or increased property values 14. Improve water supply reliability: Enhance supply capacity and system redundancy 15. Other: Reduced costs for providing conservation education
Wolf Creek Watershed: restoration, Stormwater Source Control and Flood Management	$317,108	$85,558	1. Education or technology benefits: Enhanced human and social capital 4. Social health and safety: Reduced frequency and severity of floods 5. Other social benefits: Amenity value and avoided property damage 6. Benefit wildlife or habitat: Passive-use value of special-status species 7. Improve water quality: Reduced costs associated with controlling urban pollutants 10. Improve the overall, long-term management of California's groundwater resources

Table 20 – Proposal Benefits and Costs Summary[1] Proposal: CABY Headwaters Resilience and Adaptability Program			
Project and Project Proponent	**Total Present Value Monetized Costs**	**Total Present Value Monetized Benefits**	**Non-Monetized Benefits Summary**
CABY Mercury and Sediment Abatement Initiative	$2,305,135	$1,730,559	2. Social recreation or access benefits: Enhanced value of recreational angling 4. Social health and safety: Reduce health impacts and costs associated with mercury 5. Other social benefits: Protect cultural value associated with fish consumption
Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds	$558,729	$115,606	1. Education or technology benefits: Enhanced human capital 2. Social recreation or access benefits: Enhance recreational experiences 6. Benefit wildlife or habitat: Passive use value of special-status species 7. Improve water quality: Reduce costs associated with sedimentation 10. Improve the overall, long-term management of California groundwater resources
Program Administration[2]	$277,151	The benefits of program administration are accounted for in the benefits of each project above.	

Notes:[1]All projects were analyzed using the benefit-cost framework outlined Sections D2 and D3 of the Proposal Solicitation Package (DWR 2012). We did not use the cost-effectiveness framework outlined in Section D1, so we do not include that column in these summary results. We also did not conduct a flood benefits reduction analysis, as described in Section D4, so we omit that column as well.
[2] At the suggestion of DWR, proposal organizers separated out administration costs from project-specific costs to better-account for grant-related administration costs. We include them separately here as well.

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