Attachment 7

Technical Justification of Projects

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

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

Attachment 7. Technical Justification of Projects

This attachment contains technical justifications for the physical benefits claimed by the seven implementation projects contained in this Proposal. Benefits are based on estimated measures of project accomplishments over the period of analysis. All measurable restoration, protection and enhancement of beneficial uses are included.

The implementation projects included in this proposal are:

1. Camptonville Water System Improvement Project
2. City of Placerville Waterline Replacement
3. El Dorado County Small Hydroelectric Development Program
4. Water Efficiency, Water Quality and Supply Reliability in the CABY Region
5. Wolf Creek Watershed: Restoration, Stormwater Source Control and Flood Management
6. CABY Mercury and Sediment Abatement Initiative
7. Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds

For each project there is included:

- A summary of the types of physical benefits being claimed
- A narrative description of all the project's expected physical benefits
- Annual Physical Benefits Tables
- List of studies, documents and other reference materials being submitted to demonstrate the technical adequacy of the projects

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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 Technical Justification Introduction

This project will solve critical water quality and supply needs for the Camptonville DAC. The project includes the retrofit of an existing water treatment plant, the construction of a new water storage tank and the development and institution of significantly improved operational procedures. The project will enable treatment plant to meet water quality standards, improve storage capacity, evaluate and modify water infrastructure to improve system efficiency, increase knowledge of the ground water system, manage creek flows to benefit the ecosystem, and optimize efficient use, conservation and recycling of water resources through customer outreach and education.

Project Physical Benefits

Types of Project Benefits Summary

- 3,000,000 gallons per year increased flow in Campbell Gulch
- 3,000,000 gallons reduced volume of treated water annually
- Up to 1,500,000 gallons reduced water demand per year
- 100 percent reduction of chlorinated water discharged into Campbell Gulch, resulting in improved water quality
- 100 percent reduction in violations in water discharge annually, resulting in improved water quality to water customers
- 120,000 gallons of water per year available to enhance fire protection capabilities

Expected Project Physical Benefits Narrative

Increased flows in Campbell Gulch

Currently, water is diverted from Campbell Gulch and treated based on the operator's forecast of near-term future customer demand. In order not to run short, the operator tends to forecast on the high side. (Running short of water causes not only a water supply but a water quality issue.) This operational scenario results in periods when demand is less than forecasted and excess water is treated, spilled out of the tank, and discharged to waste. The water discharged to waste does eventually re-enter Campbell Gulch, however a portion is lost to evaporation and seepage. This results in unnecessarily reduced flows in a portion of Campbell Gulch and permanent loss of flows to the creek system.

Preliminary estimates of the existing conditions indicate that in 2012 the plant diverted at least 2,000,000 gallons of excess water. This project has the potential to eliminate the diversion of any excess water.

Following improvements to process controls and modifications to control of water through the plant, flow through the plant will be based upon actual demand. This will be

accomplished through effluent control valves and float valves on the upstream side of the filters.

A comparison of historic plant production records with post project plant production records will allow operators to estimate the total reduction in diversion of excess water.

Plant improvements and improved process controls will allow the operator to assure that there is no diversion of excess water.
No adverse physical effects are anticipated.

Reduced volume of treated water
The existing treatment facility operates on a 24 hour basis even when no demand exists in the distribution system. These results in excess water being diverted treated and discharged to waste.

Preliminary estimates of the existing conditions indicate that in 2012 the plant treated at least 2,000,000 gallons of excess water. This project has the potential to eliminate the treatment of any excess water.

Following improvements to process controls and modifications to control of water through the plant, flow through the plant will be based upon actual demand. This will be accomplished through effluent control valves and float valves on the upstream side of the filters.

A comparison of historic plant production records with post project plant production records will allow operators to estimate the total reduction in treatment of excess water.

Plant improvements and improved process controls will allow the operator to assure that there is no treatment of excess water.

No adverse physical effects are anticipated.

Reduced water demand due to reductions in unaccounted-for water
Unaccounted-for water, also referred to as non-revenue water, is water that has been diverted, treated, and put into the distribution system but is lost before it reaches the customer. These can be direct losses through leakage, theft, or un-metered extractions at fire hydrants, or they can be due to metering inaccuracies. Unaccounted-for water is quantified as the difference between the total water leaving the treatment plant and the total of all customer meter readings over the same period of time, usually expressed in gallons/day. Currently, the system has no way to compare total treated water with total volume purchased by customers and consequently cannot accurately define unaccounted-for water.

Until project improvements are completed, there is no way to estimate unaccounted-for water.

This project will allow the District to develop an unaccounted-for water management program which should result in reductions in unaccounted-for water.

Following completion of the project, plant production records will be compared with customer meter records to quantify the volume of unaccounted-for water. Implementation of the unaccounted-for water management program will include on-going comparison of treatment and customer meter readings to determine the effectiveness of the program.

The District will adopt new policies and procedures associated with the development of a new unaccounted-for water management program.

The level of benefit will not be known until completion of the project and implementation of the unaccounted-for water management program.

Improved water quality in Campbell Gulch

Currently, because of limitations in plant process controls, the plant periodically treats excess water which is discharged to waste from the water storage tank. Chlorine concentration in the discharged water typically ranges from 0.3 mg/l to 1.0 mg/l. Water leaves the tank through a pipeline which discharges to a rock dissipater, then is conveyed through an open drainage channel, and is eventually discharged to Campbell Gulch. Chlorine concentrations at the point of discharge are reduced through dissipation along the open channel, however it is likely that some level of chlorinated water is being periodically discharged to Campbell Gulch.

Because the chlorinated water discharges through an open channel with a natural chlorine demand, it is not possible to accurately estimate the amount of chlorine discharged to Campbell Gulch.

As a result of improved process controls, the treatment plant will no longer discharge chlorinated water.

The physical benefit will be that the discharge of chlorinated water will be eliminated. Results of the physical benefit cannot be quantified due to the unknown existing impact.

Improved process controls will eliminate the discharge of chlorinated water.

Results of the physical benefit cannot be quantified due to the unknown existing impact.

No adverse physical effects are anticipated.

Physical benefits cannot be quantified due to a lack of background information on the impacts of the existing discharge of chlorinated water.

Improved water quality to water customers

The existing treatment facility does not meet Title 22 requirements for chlorine contact time

and maximum day demand (MDD). Additionally, process control does not allow for the verification of proper filtration rates within each filter cell. Failure to meet chlorine contact requirements and failure to comply with required filtration rates can have potential public health impacts.

Based upon plant records, it is estimated that chlorine contact time was not met on at least 30 instances during the last two years of operation. Plant records also show that MDD has periodically exceeded plant capacity.

Increased storage will provide adequate chlorine contact time. Increased filter area will add treatment capacity that will help meet MDD requirements. New control valves and water meters on individual filter cells will allow the operator to verify compliance with required filtration rates.

Continued plant record keeping will verify compliance with Title 22 requirements. Future compliance will be compared to historic records which will demonstrate physical benefits.

All aspects of the proposed project will contribute to compliance with Title 22 and associated health benefits.

It is unknown if the health of any individual has been compromised due to previous plant operations.

No known adverse physical impacts are expected.

Physical benefits in terms of Title 22 compliance can be quantified. However, physical benefits in terms of public health impacts are typically not quantifiable.

Enhanced fire protection capabilities

Camptonville CSD currently has 65,000 gallons of storage capacity for treatment and domestic water supply purposes with minimal volume available for fire suppression. Current standard of care for fire protection would require significantly more storage volume. Title 22 requires a volume equal to the maximum day demand which is estimated to be 100,000 gpd.

Current standards of care for residential communities would recommend a minimum of 120,000 gallons of storage for fire suppression purposes above that required for treatment and domestic storage. The existing 65,000 gallons is considered inadequate to meet current Title 22 requirements with no allowance for fire protection.

It is proposed that a new 220,000 gallon tank be constructed in order to meet Title 22 requirements while providing 120,000 gallons of storage dedicated to fire protection.

The physical benefits of fire storage in the community are valuable but difficult to quantify.

No known adverse physical effects are expected.

Physical benefits associated with fire protection and prevention is difficult to quantify because of the unknown associated with possible fire events.

Annual Physical Benefits Tables

Annual Project Physical Benefits			
Project Name: Camptonville Water System Improvement Project			
Type of Benefit Claimed: Reduced volume of treated water			
Measure of Benefit Claimed (Name of Units): Gallons per Year (GAL/Year)			
Additional Information about this Measure: Treated water discharged to waste			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	3,000,000 GAL/Year	Not complete	N/A
2014	3,000,000 GAL/Year	Not complete	N/A
2015	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Etc.	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Last Year of Project Life	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Comments: N/A			

Annual Project Physical Benefits			
Project Name: Camptonville Water System Improvement Project			
Type of Benefit Claimed: Increased flow in Campbell Gulch			
Measure of Benefit Claimed (Name of Units): Gallons per Year (GAL/Year)			
Additional Information about this Measure: Excess diverted water			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	3,000,000 GAL/Year	Not complete	N/A
2014	3,000,000 GAL/Year	Not complete	N/A
2015	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Etc.	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Last Year of Project Life	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Comments: N/A			

Annual Project Physical Benefits			
Project Name: Camptonville Water System Improvement Project			
Type of Benefit Claimed: Water demand reduction due to unaccounted water			
Measure of Benefit Claimed (Name of Units): Gallons per Year (GAL/Year)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	2,000,000 GAL/Year	Not complete	N/A
2014	2,000,000 GAL/Year	Not complete	N/A
2015	2,000,000 GAL/Year	Program Implementation	N/A
2016	2,000,000 GAL/Year	1,500,000 GAL/Year	500,000 GAL/Year
Etc.	2,000,000 GAL/Year	1,000,000 GAL/Year	1,000,000 GAL/Year
Last Year of Project Life	2,000,000 GAL/Year	1,000,000 GAL/Year	1,000,000 GAL/Year
Comments: Current level unknown, assumed at 2,000,000 gallons/year. Goal of less than 10 percent of total water produced or 1,000,000 gallons/year.			

Annual Project Physical Benefits			
Project Name: Camptonville Water System Improvement Project			
Type of Benefit Claimed: Improved water quality in Campbell Gulch			
Measure of Benefit Claimed (Name of Units): Gallons per Year (GAL/Year)			
Additional Information about this Measure: Chlorinated water discharge			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	3,000,000 GAL/Year	Not complete	N/A
2014	3,000,000 GAL/Year	Not complete	N/A
Etc	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Last Year of Project Life	3,000,000 GAL/Year	0 GAL/Year	3,000,000 GAL/Year
Comments: Actual volume of chlorine dependent upon chlorine concentration and on chlorine demand in discharge channel.			

Annual Project Physical Benefits			
Project Name: Camptonville Water System Improvement Project			
Type of Benefit Claimed: Improved water quality to water customers			
Measure of Benefit Claimed (Name of Units): Violations per Year			
Additional Information about this Measure: Number of instances of non-compliance with Title 22 requirements			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	15 Violations per Year	Not complete	N/A
2014	15 Violations per Year	Not complete	N/A
Etc.	15 Violations per Year	0 Violations per Year	15 Violations per Year
Last Year of Project Life	15 Violations per Year	0 Violations per Year	15 Violations per Year
Comments: Combination of violations based upon CT, not meeting maximum day demand, and exceeding allowable filtration rates			

Annual Project Physical Benefits			
Project Name: Camptonville Water System Improvement Project			
Type of Benefit Claimed: Enhanced fire protection capabilities			
Measure of Benefit Claimed (Name of Units): Gallons (GAL)			
Additional Information about this Measure: Gallons of water available for fire protection purposes			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	Not complete	N/A
2014	0	Not complete	N/A
Etc	0	120,000 GAL	120,000 GAL
Last Year of Project Life	0	120,000 GAL	120,000 GAL
Comments: N/A			

References

The following references are provided in PDF form as supplemental materials to this proposal:

- *In the online package reference documents are grouped into a single PDF uploaded as part of Attachment 7, entitled* ***Att7_IG2_TechJust_1CamptRefs_2of12.pdf****.*
- *In the hard copy package all documents are provided on DVD as separate PDFs in the folder entitled* ***"1 - Camptonville Project."***

A. Camptonville Community Services District, 2012, "Request for Proposals for the Camptonville Water System Improvement Project"

B. CCSD, 2013, "Camptonville: History, Description and Organizations"

C. CCSD, 2013, "Processed Plant Data 2009-2012"

D. GEI Consultants Inc., December 2012, "Camptonville Water System Evaluation and Improvement Study"

E. Plumas Geohydrology, March 2013, "Potential well drilling sites for the Town of Camptonville, Yuba County, California"

F. Sauers Engineering Inc., March 2013, "Public Health Compliance Evaluation Report"

G. Sauers Engineering Inc., March 2013, "Camptonville Water System Improvement Project – 30% Drawings"*

H. Walters Engineering, 1992, "Camptonville Water System 1991 Project – Record Drawings"

I. Yuba County Environmental Health, September 2012, "Small Water System Inspection Report"

**Note: This drawing package shows all needed improvements to the water system, including work scope items that are not included in this proposal. The 30% Design was intended to define all needed improvements, some of which would be eligible for the Prop 84 grant.)*

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 Technical Justification Introduction

The City of Placerville completed a Water Master Plan (WMP) in 2005 that identifies and prioritizes the water infrastructure that needs to be replaced and/or upgraded and/or looped for improved system reliability. The city staff has further refined and prioritized pipeline reaches identified in the WMP and has developed this project to address its highest priority reliability, water loss and fire flow issues. As shown in the attached Unaccounted for Water Exhibit attached to this Proposal, when comparing the amount of water purchased by the City with the amount of water delivered to customers through retail meters, the City's Unaccounted for Water is calculated to be 20 percent for calendar year 2012. As a result, the City has strategically targeted segments of the water system for replacement and this Project is included in the City of Placerville's Capital Improvement Program (CIP). A copy of the City's CIP attached to this Proposal, includes a project description, cost summary, a list of potential funding sources and the impact on annual maintenance and operation costs.

Project Physical Benefits

Types of Project Benefits Summary

- 70 acre feet of water supply conserved annually
- 2,000 feet of water line replaced to upgrade and/or improve aging infrastructure
- 34 tons of emissions avoided
- One adaptive strategies implemented in the CABY Region
- Improved safety and property protection resulting from improved fire flow delivery

Expected Project Physical Benefits Narrative

The deteriorated condition of the City of Placerville's water pipelines has been documented and past and/or current repair and complaint records indicate these pipelines are significantly contributing to the City's unaccounted for water. This loss contributes significantly to the 20 percent of water that is unaccounted for within the City's distribution system. Without this project the City of Placerville will continue to have leaks throughout its water system, which will result in substantial water losses in the future, as water becomes in shorter supply; GHG emissions will increase because less water will be available to use on regional fire suppression; and people and/or property will be less protected as a result of available water supply.

The entire project (Phase I and II) is included in the Cosumnes, American, Bear, Yuba (CABY) Group's Integrated Regional Water Management Plan (IRWMP). Therefore, the project meets the goals and objectives set by CABY and complements the other water supply reliability projects proposed by the Placer County Water Agency, Nevada County Water Agency and the El Dorado Irrigation District being submitted as part of this application. The physical benefits were estimated using the City's WMP, CIP, visual inspections and repair history, which document the existing condition of the water pipelines. Specific numbers were calculated by

City staff including the City Engineer. Gallons of water conserved through project implementation were used to estimate the reduction in GHG emissions. Fire flow tests performed by fire department.

The action of replacing the identified water pipelines is required to obtain these physical benefits. The uncertainty of the benefits listed and the factors that lead to uncertainty include the difficulty assigning a monetary value to fire protection. There are no potential adverse effects from the project.

Annual Physical Benefits Tables

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: Acre feet per year of water supply conserved			
Measure of Benefit Claimed (Name of Units): Acre Feet per Year (AF/Year)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015 - Last Year of Project Life	0	70 AF/Year	-70 AF/Year
Comments: Expert opinion for the City of Placerville Engineer			

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: Number of feet of water line that is replaced to upgrade or improve aging infrastructure			
Measure of Benefit Claimed (Name of Units): Feet (ft)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015 - Last Year of Project Life	0	3,700 ft	-3,700 ft
Comments: Expert Opinion – Estimated using Engineering schematics			

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: Greenhouse gases (GHG) avoided			
Measure of Benefit Claimed (Name of Units): Tons			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015 - Last Year of Project Life	0	34 Tons	-34 Tons
Comments: Calculation using water savings EPA GHG calculator			

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: One thousand cubic feet of natural gas savings			
Measure of Benefit Claimed (Name of Units): Million Cubic Feet (MCF)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015 - Last Year of Project Life	0	600 MCF	-600 MCF
Comments: Calculation using GHG savings and EPA AP42 Compilation of Air Pollution Emission Factors			

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: Pounds per year of pollutants avoided			
Measure of Benefit Claimed (Name of Units): Pounds per Year (lbs/Year)			
Additional Information about this Measure: Pollutant include CO (Carbon Monoxide), PM (Particulate Matter), VOC (Volatile Organic Compounds) and TOC (Total Organic Compounds)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015 - Last Year of Project Life	0	61 lbs/Year	-61 lbs/Year
Comments: Calculation using GHG savings and EPA AP42 Compilation of Air Pollution Emission Factors			

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: Number of adaptive strategies implemented in the CABY Region			
Measure of Benefit Claimed (Name of Units): Number			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	
2014	0	1	-1
2015 - Last Year of Project Life	0	1	-1
Comments: Expert Opinion			

Annual Project Physical Benefits			
Project Name: City of Placerville Waterline Replacement – Pardi/Big Cut/Sacramento Street Area Waterlines Replacement Project			
Type of Benefit Claimed: Improved safety and property protection resulting from improved fire flow delivery			
Measure of Benefit Claimed (Name of Units): Life and property loss			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	
2014	0	?	?
2015 - Last Year of Project Life	0	?	?
Comments: N/A			

References

The following references are provided in PDF form as supplemental materials to this proposal:

- *In the <u>online package</u> reference documents are grouped into two PDFs uploaded as part of Attachment 7, entitled:*
  - ***Att7_IG2_TechJust_2PlacervRefs1_3of12.pdf***
  - ***Att7_IG2_TechJust_2PlacervRefs2_4of12.xls***
- *In the <u>hard copy package</u> all documents are provided on DVD as separate PDFs in the folder entitled **"2 - City of Placerville Project."***

A. City of Placerville Capital Improvement Program (CIP)

B. Kennedy/Jenks Consultants. (December 13, 2005). *City of Placerville Water Master Plan*. (WMP) Cover, Table of Contents, Figure 4.

C. City of Placerville Fire Flow Test Data: Inadequate Pressures for fire flow

D. EPA's Pollution Prevention Program Greenhouse Gas Calculator (excel file)

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 Technical Justification Introduction

There are tremendous demands for new non-carbon, dependable renewable energy generation, and that trend is expected to grow given the state and national policy climates. CABYs water purveyors are in a unique position to contribute to the achievement of state goals to develop renewable energy [small hydro 1.5 megawatt (MW) or less] and increasing energy efficiency and load shifting capability within existing water systems. The 590 kW Tank 7 In-conduit Hydroelectric Project (Project) will be located on El Dorado Irrigation District's (EID) property at an existing water storage tank (Tank 7) and pressure reducing (PRS-5) facility. The Project will tie into the existing 24-inch diameter Pleasant Oak Main (POM) immediately upstream of the existing PRS-5. The PRS-5 currently reduces high pressures in the pipeline before entering two storage tanks (Tank 7A and 7A). The new hydroelectric station will not change water system operations but will act as a pressure reducing station, producing electricity while reducing pipeline pressure with no change in water supply, capacity, or diversions.

There will be no new facilities associated with the development of the Project other than the small footprint of the hydroelectric station itself. The proposed hydroelectric facility will be constructed on the POM entirely within a parcel developed for Tank 7/7A and PRS-5 as shown in Exhibit A. The Hydroelectric station will operate year-round except for repair and maintenance a few days out of the year. Three-phase Pacific Gas & Electric (PG&E) transmission lines are located along Pleasant Valley Road less than 50 feet from the site. Power generated from the project will be transmitted to the grid at this location and sold to PG&E. In addition to this Project strengthening the regional power grid, the Project will increase revenues which can be used to offset water system operation costs, infrastructure replacement in other parts of the water system, and provide a drought resistant energy supply.

Project Physical Benefits

Types of Project Benefits Summary

- 590 Kilowatts of non-carbon renewable energy capacity created
- 716 tons of GHG and air pollutant emissions avoided
- One adaptive management strategy implemented in the CABY Region

Expected Project Physical Benefits Narrative

The Pleasant Oak Main is one of EID's gravity water transmission pipelines that deliver treated water for distribution to EID's customers. Water flows through the pipeline are recorded and provide a basis for determining the amount of renewable energy and emissions offsets to be achieved by the Project.

The Hydroelectric Development Options Study identified hydroelectric opportunities throughout El Dorado County. The report identified the top 10 projects recommended for detailed feasibility and implementation. EID's Tank 7 In-conduit Hydroelectric Project was listed as one of these promising projects. If this project was not implemented it is possible that other projects identified in this study could move forward with implementation. This project represents the most feasible in-conduit project for EID to implement with a relatively quick pay-back period; the other potential projects would provide similar, but not the same magnitude of benefits.

This Project meets the CABY goal *to "Maintain and enhance functioning landscapes that provide sustainable services for humans" and Objective HL-7 to "Work with interested agencies to increase alternative energy generation, including small-scale hydropower projects and existing hydropower plant efficiency improvements by implementing at least two projects by 2015 and an additional two by 2020."* and would demonstrate the potential of similar projects to be implemented throughout the CABY region.

Physical benefits are based on the renewable energy generation estimates in the 2012 Hydroelectric Analysis for El Dorado Irrigation District's Pleasant Oak Main Tank 7 Report. Some of the data used for these analyses was provided by EID including Pleasant Oak Main flow and pressure data from 2009 – 2011.

Project implementation is required to obtain these physical benefits.

There is very little uncertainty because, there is a direct relationship between the known water flows and pressures in the Pleasant Oak Main, and estimating renewable energy generation and GHG/air pollutant emissions reductions from the Project.

The location of the Project within the existing developed POM Reservoir 7 facility and the pre-CEQA Categorical Exemption site evaluations confirm there are no potential adverse physical effects on the environment.

Annual Physical Benefits Tables

Annual Project Physical Benefits			
Project Name: El Dorado County Small Hydroelectric Development Program – Tank 7 In-conduit Hydroelectric Project			
Type of Benefit Claimed: Kilowatts of renewable energy production capacity created			
Measure of Benefit Claimed (Name of Units): Kilowatts (kW)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016 Last Year of Project Life	0	590 kW	-590 kW
Comments: From the Hydroelectric Analysis for El Dorado Irrigation District's Pleasant Oak Main Tank 7 Report			

Annual Project Physical Benefits			
Project Name: El Dorado County Small Hydroelectric Development Program – Tank 7 In-conduit Hydroelectric Project			
Type of Benefit Claimed: Greenhouse gases (GHG) reduced and/or avoided			
Measure of Benefit Claimed (Name of Units): Tons			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016 Last Year of Project Life	0	716 Tons	-716 Tons
Comments: Generated by the EPA GHG calculator and the Hydroelectric Analysis for El Dorado Irrigation District's Pleasant Oak Main Tank 7 Report			

Annual Project Physical Benefits			
Project Name: El Dorado County Small Hydroelectric Development Program – Tank 7 In-conduit Hydroelectric Project			
Type of Benefit Claimed: Thousand Cubic Feet of natural gas savings			
Measure of Benefit Claimed (Name of Units): MCF			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016 Last Year of Project Life	0	12,600	-12,600
Comments: Calculation from the EPA AP42 Compilation of Air Pollution Emission Factors and the Hydroelectric Analysis for El Dorado Irrigation District's Pleasant Oak Main Tank 7 Report			

Annual Project Physical Benefits			
Project Name: El Dorado County Small Hydroelectric Development Program – Tank 7 In-conduit Hydroelectric Project			
Type of Benefit Claimed: Pounds per year of pollutants avoided			
Measure of Benefit Claimed (Name of Units): Pounds per Year (lbs/Year)			
Additional Information about this Measure: Pollutant include CO (Carbon Monoxide), PM (Particulate Matter), VOC (Volatile Organic Compounds) and TOC (Total Organic Compounds)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016 Last Year of Project Life	0	1,300 lbs/Year	-1,300
Comments: Calculation from the EPA AP42 Compilation of Air Pollution Emission Factors and the Hydroelectric Analysis for El Dorado Irrigation District's Pleasant Oak Main Tank 7 Report			

Annual Project Physical Benefits			
Project Name: El Dorado County Small Hydroelectric Development Program – Tank 7 In-conduit Hydroelectric Project			
Type of Benefit Claimed: Number of adaptive strategies implemented in the CABY Region			
Measure of Benefit Claimed (Name of Units): Number			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016 Last Year of Project Life	0	1	-1
Comments: Expert Opinion			

References

The following references are provided in PDF form as supplemental materials to this proposal:

- *In the <u>online package</u> these documents are grouped into two PDF uploaded as part of Attachment 7 entitled*
    - ***Att7_IG2_TechJust_3ElDorRefs1_5of12.pdf*** *and*
    - ***Att7_IG2_TechJust_3ElDorRefs2_6of12.xls***
- *In the <u>hard copy package</u> these documents are provided as separated PDFs in the folder entitled* ***"3 - El Dorado Project."***

A. NLine Energy, Inc., Domenichelli & Associates, EN2 Resources Inc. (November 9, 2012). *Hydrolectric Analysis for El Dorado Irrigation District's Pleasant Oak Main Tank 7*. El Dorado Irrigation District. Entire Report.

B. ECO:LOGIC Engineering Environmental Division. (December 2007). *El Dorado Water Resources Development and Management Plan*. El Dorado County Water Agency. Front Cover, Table of Contents, Chapter 11 pp. 1 and 7.

C. Domenichelli & Associates. *El Dorado Irrigation District Tank 7 In-Conduit Hydroelectric Project 30% Design*. El Dorado Irrigation District. Entire Design.

D. EN2 Resources, Inc. *El Dorado County Hydroelectric Development Options Study*. (July 24, 2009). El Dorado County Water Agency, El Dorado Irrigation District. Front Cover, Table of Contents, Chapter 7 pp. 7-1, 7-47, 7-48, 7-49, 7-50.

E. EPA's Pollution Prevention Program Greenhouse Gas Calculator (excel spreadsheet)

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 Technical Justification Introduction

Interties: The catastrophic Hwy 49 fire, which occurred in 2009, destroyed 63 homes and burned 343 acres near NID's water treatment plant. The fire cutoff power to the treatment plant limiting the plant's ability to meet critical fire flow demands. An emergency connection was opened between NID and PCWA, which provided much needed supplemental water that was used to fight the fire. The installation of the Mt. Vernon and Locksley Interties would be similar to the Highway 49 NID Intertie that was utilized in the Hwy 49 fire and provide treated water flow in these areas in case of an emergency. Systems used in this project will be based on knowledge gained from the Hwy 49 fire emergency intertie project.

Canal Lining: PCWA has over 175 miles of canals delivering raw water to eight PCWA and several private water treatments plants. NID has 425 miles of canals and flumes that deliver water to seven water treatment plants and over 30,000 customers. Raw water is also delivered to over 47,000 accounts that use the water for outdoor irrigation, stock ponds, ponds and commercial agriculture. The canals were constructed during the gold rush era in the late 1800's. Since, several miles of canal have been encased in pipe or lined with gunite to facilitate the construction of towns, railroads, highways, roads, housing developments, reduce erosion, reduce water losses and increase the reliability of the water conveyance system. PCWA actively lines or places into pipe over three miles of canal per year. As of 2012, over 55 miles of canal have been lined with gunite or replaced with pipe. In 2005, with grant funding from DWR (#F63108), PCWA conducted a study of the entire canal system to identify the soil types and permeability rates for the spoils that the canals traverse. From this study, PCWA has been able to estimate water losses due to seepage for defined reaches of canal. These estimates are further quantified, were feasible, with field inflow/outflow measurements.

With 2008 funding from Proposition 50 (#4600007833), PCWA successfully lined with gunite a 1,110 foot section of the Newcastle canal, and piped 1,165 feet of the Upper Banvard Canal. The project realized a reduction of water loss of over 600 acre feet per year.

Gaging Stations: NID has over 425 miles of canals delivering raw-untreated water to seven (7) treatment plants and about 6,000 irrigation customers. Only a small portion (8%) of all the water transported in the canals is delivered to treated water customers; the bulk of NID's water is used for irrigation. NID determined that water losses in the canals range from 10% to 20% of the water conveyed through the canals, and the losses are due to seepage into the ground, operational losses (unaccounted water leaving canals through service boxes), and evaporation; these losses cannot be accurately quantified without adequate measuring devices. Most canals have gaging stations or measuring devices at the beginning (head) and the tail end (end) of the canal; the additional six (6) gaging stations and one hundred staff gages are needed to allow NID a complete set of measuring devices to analyze the actual losses in each canal and assist in

identifying points of leakage and water losses. Once the devices are installed, NID can determine where water losses are severe, and manage operations and make capital improvements to reduce water losses in canals.

Education: The State of California requires all agencies to achieve a 20% reduction in water use by the year 2020. NID and PCWA have determined that water efficiency education information (to consumers) needs to be specific to the CABY region or area. Both PCWA and NID have rural irrigation (raw water) customers and residential treated water customers; both agencies serve water to the same or similar geographic areas (western Placer County and Western Nevada County). In some areas, such as Auburn and western Placer County, the PCWA and NID service areas overlap, and customers of each water district are located in the same neighborhoods. The Placer County Agricultural Commission represents many agricultural customers of both agencies.

Project Physical Benefits

Types of Project Benefits Summary

- .46 miles of pipeline interties
- 4 miles of canal lined
- 1,000 gallons per minute increase in emergency treated water flow
- 200 acre feet reduction in water loss per year
- 6 gaging stations installed
- 100 staff gauges installed
- One Water Efficiency Education Program for PCWA and NID customers
- 3 outreach events (seminars, presentations, etc.) hosted jointly by PCWA and NID
- 3 agricultural water conservation demonstrations/educational classes jointly hosted by PCWA and NID

Expected Project Physical Benefits Narrative

Interties

The project is expected to provide up to .46 miles of pipeline interties (the vast majority at the Mount Vernon Road intertie, the Locksley Lane intertie site only requires minor pipeline installation, less than 100') and 1,000 gpm of emergency treated water flow to either PCWA or NID. The exact flow will need to be verified and may vary dependent upon the hydraulic demands of the existing distribution systems. Upon completion of construction a bi-agency operational test will be performed to better estimate the amount of flow that can be provided in an emergency scenario. The benefit can be realized upon construction of the project and finalization of the Memorandum of Understanding between NID and PCWA.

Canal Lining

The total miles of canal lining is 4 miles (1.7 miles by NID and 2.3 miles by PCWA). This project is expected to reduce water losses by 200 acre feet per year. The actual amounts will be

quantified at the end of each year of construction, with overall reductions determined the year following completion of the project. The gunite lining of the canal will also offer some resistance to the effects of wild fire, large storm events that produce excessive precipitation and other natural disasters, either natural or man-made. A reduction of water loss will also reduce the need to develop new sources of water.

Gaging Stations

Over the past 90 years, NID has relied on gaging stations to regulate the flow of water in canals. In recent decades, gaging stations have been useful in quantifying water losses in canal, where gaging stations are installed at the heads and ends of the canals. The project will complete the District's need for additional gaging stations, provide additional electronic monitoring and reporting capability, and provide for sufficient compliment of staff gauges at isolated locations; therefore, providing accurate and sufficient water measuring capability to locate and reduce water losses. Due to the current lack of certainty relating to canal water losses, the new measuring devices will merely help define and isolate the losses, modify operations, and prioritize future improvements; more importantly, the physical benefits from the project will consist of water savings due to better water management (to reduce operational losses) and strategic capital improvements, such as canal innings and canal encasement (to reduce seepage losses). After operational changes and/or capital improvements are made, adverse benefits could be realized by certain customers who may be used to receiving more water than they currently pay for (unaccounted water through the service box or seepage water).

Education

Currently, the project will combine water efficiency education efforts by both agencies into one common message with similar resource materials for water customers of Placer and Nevada Counties. The physical benefits include an effective array of literature and outreach/educational events that can be easily recognized and utilized by the customers of both agencies. Also, by combining efforts of both water agencies, the physical benefits will include a more efficient use of public resources used for education, helping to keep water rates to a minimum and increasing the customer's awareness of water conservation throughout three watersheds; Yuba, Bear and American.

Annual Physical Benefits Tables

Annual Project Physical Benefits			
Project Name: Mount Vernon Intertie			
Type of Benefit Claimed: Emergency treated water flow up to 1,000 gallons per minute			
Measure of Benefit Claimed (Name of Units): Gallons per Minute (GPM)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2016 (and beyond)	0	1,000 GPM	1,000
Comments: N/A			

Annual Project Physical Benefits			
Project Name: Mount Vernon Intertie			
Type of Benefit Claimed: Interties constructed			
Measure of Benefit Claimed (Name of Units): miles			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2016 (and beyond)	0	.46 miles	.46 miles
Comments: N/A			

Annual Project Physical Benefits			
Project Name: Canal Lining			
Type of Benefit Claimed: Amount of water supply produced, saved, or recycled			
Measure of Benefit Claimed (Name of Units): Acre Feet Per Year (AF/Year)			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2014 (and beyond)	0	200 AF/Year	200
Comments: N/A			

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Annual Project Physical Benefits			
Project Name: Canal Lining			
Type of Benefit Claimed: Canals lined			
Measure of Benefit Claimed (Name of Units): miles			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2014 (and beyond)	Approximately 100 miles of canals lined or encased	Approximately one hundred and four miles of canals lined or encased	21,120 lf new of canal lining (4 new miles of canal lining)
Comments: Increased protection/reliability (robustness) of the canal system in a remote area that is susceptible to natural and man-made disasters that includes wild fires, large storm events, etc.			

Annual Project Physical Benefits			
Project Name: Gaging Stations			
Type of Benefit Claimed: Accurate measurement of canal flows			
Measure of Benefit Claimed (Name of Units): Number of flow measuring devices, and unlimited data collection points			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2015 (and beyond)	150 Gaging Stations 50 Staff Gages	156 Gaging Station 150 Staff Gages	6 Gaging Stations 100 Staff Gages
Comments: N/A			

Annual Project Physical Benefits			
Project Name: Water Efficiency Education			
Type of Benefit Claimed: Common Educational Programs between NID and PCWA			
Measure of Benefit Claimed (Name of Units): No. of Programs, N. of Joint PCWA/NID Outreach events, No. of Joint PCWA/NID Agricultural Demonstrations/Classes			
Additional Information about this Measure: (per year)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2016 (and beyond)	Separate water agency program with different messages for customers. Various brochures and videos used by agencies	Joint NID/PCWA Water Efficiency Program plan and coordinate a unified message in literature, 3 combined outreach events, and 3 co-hosted Irrigation Efficiency workshops	Joint educational program with unified message, pooled resources, 3 combined outreach events and 3 co-hosted. Irrigation Efficiency workshops.

References

The following references are provided in PDF form as supplemental materials to this proposal:

- *In the online package reference documents are grouped into a single PDF uploaded as part of Attachment 7, entitled* ***Att7_IG2_TechJust_4WaterEffRefs_7of12.pdf****.*
- *In the hard copy package all supplemental documents are provided on DVD as separate PDFs in the folder entitled* ***"4 - Water Efficiency Project."***

A. Kleinschmidt 2005 Nevada Irrigation District Raw Water Master Plan Update, Phase I Technical Analysis – Excerpt Section 8 Canal Planning Assessment (pages 8-1 – 8-7)

B. NID 2009 Water Savings from Gunite Canals Chart

C. NID 2012 Agricultural Water Management Plan – Excerpt Section 6 Efficient Water Management Practices (pages 6-1 – 6-11)

D. PCWA 2005 Canal and Reservoir Feasibility Study Report Draft

E. PCWA 2010 Urban Water Management Plan – Excerpt Appendix B-4 Water Shortage Contingency Plan (pages 35-77)

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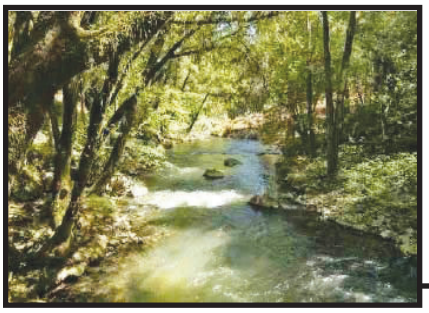
CABY Integrated Regional Water Management Plan
Proposition 84, Round 2 Implementation Grant



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

5. WOLF CREEK WATERSHED: RESTORATION, STORMWATER SOURCE CONTROL, AND FLOOD MANAGEMENT

Project Technical Justification Introduction

In urban and suburban areas of the CABY region, much of the land surface is covered by buildings and pavement, which do not allow rain and snowmelt to soak into the ground. Instead, most developed areas rely on storm drains to carry large amounts of runoff from roofs and paved areas to nearby waterways. This reduces infiltration, increases flooding downstream and negatively impacts water quality (EPA 2007). In addition, as the Sierra snowpack melts earlier and earlier in the season, it is increasingly important to slow runoff and promote lasting solutions that store groundwater in the headwaters (California Water Plan, Update 2009). This project addresses these impacts by 1) instituting a LID source control program that dovetails with nearby demonstration projects and 2) Restoring functioning floodplains in a highly-visible, urban setting. Below we provide references and a technical discussion of the beneficial outcomes this project will deliver:

<u>Restored urban floodplain in disadvantaged community:</u>
The floodplain restoration component of this project is adjacent to a heavily used recreation trail and 80-acre park in Grass Valley. The floodplain restoration will be highly visible, and will provide natural benefits detailed below in the center of this disadvantaged community. In addition, this project will enhance public awareness of green infrastructure, stormwater management, water quality, habitat restoration and other issues it will also provide an avenue for public participation, information sharing, and the enjoyment of beautiful public spaces.

<u>Reduce volume and pollutant load in stormwater runoff</u>
Numerous studies indicate that source control is the most cost effective method of eliminating pollutants in stormwater runoff (Odefey et al 2012). In addition, functioning flood plains capture sediment, the number one pollutant in our nation's rivers (EPA 2007; Opperman et al. 2009). This project combines both BMP's in an urban setting, within a disadvantaged community.

<u>Increase water storage in the upper Bear River watershed</u>
It is well known that LID source control and floodplain restoration are both BMP's that increase infiltration (Opperman et al. 2009; Mitsch 1992; Califonia Water Plan 2009). This project employs both techniques near the center of a disadvantaged community in the upper Bear River watershed.

<u>Reduce FEMA-designated floodplain area in a disadvantaged community</u>
Task 5 will update a section of the FEMA flood inundation rate map in Grass Valley to reduce the area within the special flood hazard area.

<u>Stabilize eroding stream banks and enhance riparian habitat within a disadvantaged community</u>

The floodplain restoration will stabilize eroding stream banks and enhance riparian habitat within Grass Valley, a disadvantaged community.

Engage DAC residents in watershed stewardship and protection

The USEPA (EPA 2012) has listed public education as one of its six LID best management practices, further supporting the need for communities to be educated about water conservation and green infrastructure solutions to stormwater management. This is particularly important given the public's lack of understanding about the primary causes of and solutions to water pollution problems. A 2005 report by the National Environmental Education & Training Foundation (NEEFT) came to the following conclusion: "78 percent of the American public does not understand that runoff from agricultural land, roads, and lawns, is now the most common source of water pollution; and nearly half of Americans (47 percent) believes industry still accounts for most water pollution (Coyle 2005)."

While quantifying and valuing public education is difficult, educating and informing the general public about the efficient use of water resources is a valuable service that can build support for better water management decisions in the future. It is a vital precursor to achieving widespread adoption of green infrastructure solutions and realizing the many benefits they offer to communities.

Provide jobs in a DAC

In addition to providing direct employment during the project period, this project will provide training to concrete contractors during pervious pavement installation. In 2010, American Rivers and PR Design collaborated on a one-day similar training, and more than 20 contractors attended. According to the Nevada Contractors Exchange there is substantial interest in attending demonstration pours and visiting pervious pavement installations. We anticipate this training will lead to greater local capacity to implement this BMP, at a time when demand for pervious pavement is increasing.

Demonstrate innovate BMP's that are resilient to climate change

The California Water Plan (2009) and many others (Foster et al. 2011; EPA 2012) identify floodplain restoration and LID source control as key elements of climate resiliency. These strategies are the central BMPs implemented by this project.

Include residents in project planning and implementation

As described above, the USEPA (2012) has listed public education as one of its six stormwater best management practices. American Rivers and Wolf Creek Community Alliance are both well known for successfully engaging diverse stakeholders in restoration and water management planning and implementation. In this project, residents will be involved in water quality monitoring, planting native species and consultation on educational materials. In addition planning will involve outreach to stakeholders, including residents.

Install innovative demonstration BMPs in a DAC

This project will install climate-resilient and innovative (see above) BMPs for protecting surface

water supplies near the heart of Grass Valley, a disadvantaged community. BMP's include floodplain restoration and LID source control measures.

Increase # of contractors trained in LID installation

During pervious pavement installation, the contractor and project partners will provide training to concrete contractors. In 2010, American Rivers and PR Design collaborated on a similar one-day training, and more than 20 contractors attended. According to the Nevada Contractors Exchange there is substantial interest in attending demonstration pours and visiting pervious pavement installations. We anticipate this training will lead to greater local capacity to implement this BMP, at a time when demand for pervious pavement is increasing.

Habitat Improvements

The Bear River Watershed is home to significant and endangered species, including California red-legged frog, foothill and mountain yellow-legged frog and western pond turtle. The floodplain restoration we propose will provide important habitat for these and other species in an urban setting.

Aesthetic Value

The green infrastructure components of this project will not only be effective at capturing and treating runoff, they will also be quite beautiful. The rain gardens and vegetated swales promoted by the LID source control portion of the project will burst with plant life, including native shrubs, and flowers. These components are indeed "infrastructure" but are not marred by the usual gray infrastructure characteristics of metal and concrete. While this benefit is not currently quantifiable for green infrastructure, the Center for Neighborhood Technology reports a "well observed relationship between urban greening and property values." Several studies have shown that greening of urban neighborhoods increases property values between 2 and 10 percent (CNT 2010).

Types of physical benefits summary

- Acre feet per annum of water supply conserved or enhanced
- Decrease in the number of acres covered by the FEMA inundation zone
- Increase in linear feet of stream bank restored
- Increase acres of restored floodplain
- Reduce the amount of stormwater reaching local waterways
- Increase the time of concentration of contributing impervious service (unquantified due to cost)

Expected Project Physical Benefits

The project will provide numerous physical benefits by restoring Peabody Creek's floodplain and managing stormwater at the source to reduce flooding and pollution within the larger Wolf Creek watershed.

- Reduce the volume and pollutant load in stormwater reaching local waterways. Stormwater is the leading sources of pollution in our urban areas. The volume of

stormwater treated will be calculated from the area of impervious surface treated by source control measures (including pervious concrete, disconnected downspouts, and rain barrels), the annual rainfall, and the capture efficiency of the control measure. Measuring the amount of pollution reduced by the project would be very difficult but we can quantify the amount of stormwater that will be infiltrated through pervious concrete and downspout disconnection. The standard equation is catchment area (ft2) x rainfall (ft) x 7.48 gal/ft x runoff coefficient = net runoff (gal) (Lancaster 2006). This amount can be calculated as more downspouts are disconnected and more pervious concrete is installed.

- Decrease in the number of acres covered by the FEMA inundation zone. Flood Inundation Rate Maps (FIRMs) before and after this project will be compared to quantify the decrease in acreage within the 100-year floodplain.
- Increase in linear feet of stream bank restored. The current stream bank is primarily unvegetated and unarmored, which has led to an eroding the channel that cannot reach its main floodplain. The project will create a series of grade control structures in the channel of the Upper Floodplain that will reduce channel scour and reengage the floodplain. Plantings along the banks and in the floodplain will reduce erosion and further stabilize the bank. The length of bank improved will be measured by GIS delineation of aerial photos and will be tracked as a performance measure.
- Increase acres of restored floodplain. A half-acre of floodplain will be restored through plantings and reengagement. The current floodplain is primarily bare soil and invasive species because it does not follow its natural hydrologic regime. By planting floodplain species and restoring the natural hydrologic regime we can restore the floodplain and reduce flooding in the area. The acreage of restored floodplain will be estimated through GIS analysis and tracked as a performance measure.
- Increase the time of concentration of contributing impervious service to reduce downstream flooding. There is a significant amount of research that shows how green infrastructure and reconnection of floodplains reduces peak flows. The amount that they can reduce peak flows though is highly variable. Measuring and modeling the specifics in Grass Valley would be to variable, technically challenging, and costly as a piece of this project.

Annual Physical Benefits Tables

The tables below provide details for the anticipated annual physical benefits of the project. The numbers for the year 2014 represent benefits that will accrue during the proposed project period. We expect that benefits will continue to accrue after the project period has ended, and those are included in year 2015. Note that these numbers represent benefits that will occur after the proposed project period has ended.

Annual Project Physical Benefits			
Project Name: Wolf Creek Watershed			
Type of Benefit Claimed: Decrease in the number of acres covered by the FEMA inundation zone			
Measure of Benefit Claimed (Name of Units): Acres			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	6	6
2015	0	6	6
Comments:			

Annual Project Physical Benefits			
Project Name: Wolf Creek Watershed			
Type of Benefit Claimed: Acre feet per annum of increased stormwater infiltration			
Measure of Benefit Claimed (Name of Units): Acre feet			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	8	8
2015	0	10	10
Comments: Benefits will increase through time, based on success and adoption of source control program.			

Annual Project Physical Benefits			
Project Name: Wolf Creek Watershed			
Type of Benefit Claimed: Increase in linear feet of stream bank restored			
Measure of Benefit Claimed (Name of Units): Feet			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	325	325
2015	0	325	325
Comments: Will be evaluated using GIS delineation.			

Annual Project Physical Benefits			
Project Name: Wolf Creek Watershed			
Type of Benefit Claimed: Increased acres of restored floodplain			
Measure of Benefit Claimed (Name of Units): Acres			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	.5	.5
2015	0	.5	.5
Comments: Will be evaluated using GIS delineation.			

Annual Project Physical Benefits			
Project Name: Wolf Creek Watershed			
Type of Benefit Claimed: Reduce the amount of stormwater reaching local waterways			
Measure of Benefit Claimed (Name of Units): Acre Feet			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	
2014	0	3 acre feet	3 af
2015	0	6 acre feet	6 af
2016 and on	0	10 acre feet	10 af
Comments: These numbers will increase every year as more downspouts are disconnected and more pervious concrete is installed. These aspects of the project will continue to provide physical benefits after the project is completed.			

Annual Project Physical Benefits			
Project Name: Wolf Creek Watershed			
Type of Benefit Claimed: Increase the time of concentration of contributing impervious service to reduce downstream flooding and erosion			
Measure of Benefit Claimed (Name of Units): Unquantifiable within a reasonable monitoring budget			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013			
2014			
Etc			
Last Year of Project Life			
Comments: Unmeasurable with reasonable cost			

References

The following references are provided in PDF form as supplemental materials to this proposal:

- In the online package these documents are grouped into a single PDF uploaded as part of Attachment 7, entitled **Att7_IG2_TechJust_5WolfCkRefs_8of12.pdf**.
- In the hard copy package these documents are provided on DVD as separate PDFs in the folder entitled **"5 – Wolf Creek Project."**

A. Odefey, J. et al. (2012) Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide.

B. Center for Neighborhood Technology. (2010). The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits.

C. Coyle, Kevin. (2005). Environmental Literacy in American. The National Environmental Education and Training Foundation. Washington D.C.

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M. American Concrete Pavement Association. (2007). Stormwater Management with Pervious Concrete Pavement. Skokie, IL.

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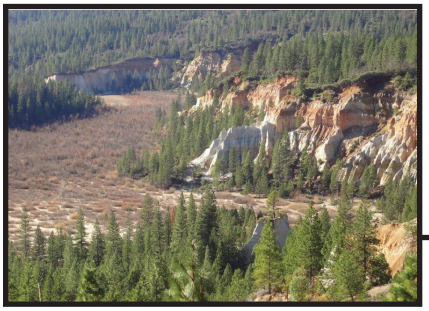

6 CABY Mercury and Sediment Abatement Initiative

6. CABY MERCURY AND SEDIMENT ABATEMENT INITIATIVE

Project Technical Justification Introduction

The transport of mercury and methylmercury through Sierra Nevada reservoirs (via spillways and controlled releases) 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 (Wood et al. 2010). In the Bear River watershed, the study conducted by USGS in Camp Far West Reservoir (downstream of Combie) measured mercury and methylmercury concentrations in water flowing through Camp Far West Resevoir (Alpers, et al. 2008), however additional data on this topic is needed.

The tributaries of the Sacramento River are the source of 80% or more of total mercury flowing into the Bay-Delta, and "the Cache Creek, Feather River, American River, Putah Creek waterhseds 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. 2006). 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 (Alpers et al., 2005). Therefore, this suite of projects is perhaps more effective at solving the Bay-Delta methylmercury problem than a similar project in the Coast Range because it removes mercury that is likely to methylate and become biologically available in the Bay-Delta.

This project will contribute to identifying implementation measures for mecury and sediment in the upper watersheds for the Total Maximum Daily Load (TMDL) in the Delta and upcoming Statewide Mercury Policy and 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 (SWRCB, 2012). It has been estimated that California statewide reservoirs have filled with 2.1 billion m^3 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). By including both upper watershed point source cleanup and downstream cleanup of contamination where sediment has accumulated in reservoirs, the CABY Mercury and Sediment Abatement Initiative demonstrates strategic remediation options for the two types of places that legacy sediment mercury contamination can be addressed in the water system, sources (headwater abandoned mines) and sinks (reservoirs).

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. 2003). As such, removing mercury from the watershed will have the benefit of removing a serious, public health and environmental hazard. 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). Reduction of mercury sources to the Yuba River through mine remediation and removal of mercury from contaminated sediments in Combie Reservoir will reduce the load of total mercury and methylmercury entering the Bay-Delta.

Project Physical Benefits Summary

- 5,166 acres surveyed for abandoned mine lands impacts
- 88 acres of land improved or restored
- 123.75 tons of carbon sequestered per year
- 1,003 pounds of discharged mercury abated
- 36 mg of liquid elemental mercury removed
- 20,003,000 pounds of discharged sediment abated per year
- 10 AF of water storage space preserved per year
- 6,000 pounds of mercury-rich sediment treated
- 26 acres of riparian habitat protected or restored
- 14,400 linear feet of streambank protected or restored
- 3 continuous water quality monitoring gages installed
- 500 fish tissue samples collected
- 11 water bodies posted with fish consumption guidelines

Expected Project Physical Benefits Narrative & Physical Benefits by Project

Relief Hill Hydraulic Mine Remediation Project

- 86 acres surveyed for abandoned mine impacts
- 86 acres improved or restored
- 121 tons of carbon sequestered per year
- 1000 pounds of mercury discharge abated
- 10,000 tons (20,000,000 pounds) of sediment discharge abated per year
- 10 AF of water storage space preserved per year
- 12 acres of riparian habitat protected or restored
- 2,400 linear feet of stream bank protected or restored

The Relief Hill Hydraulic Mine Remediation Project is the implementation of full remediation at an 86-acre historic mine site on Forest Service lands that currently contributes sediment and mercury-laden runoff into the South Yuba River watershed (TetraTech,2007). South Yuba River is used for recreation, freshwater habitat (including spawning and migration), and municipal and domestic water supply.

Hydraulic mining occurred at Relief Hill from the early 1850s to the late 1880s. Liquid mercury was used during hydraulic mining to facilitate gold recovery, an estimated 21,000 to 64,000 pounds of mercury was lost to the environment at Relief Hill (Science Applications International Corporation [SAIC], 2004). Preliminary sampling associated with the EE/CA indicates that there is particulate bound mercury being discharged from the site during turbid conditions, every time it rains (Tetra Tech, 2007).

Preliminary sampling by USGS scientists (Alpers 2003 in SAIC, 2004) quantified the extensive use of mercury and its lasting impacts on the site and to water bodies downstream. The Relief Hill Mine site was scored using the EPA Hazardous Ranking System (HRS) scoring system as a site that would qualify it as an EPA Superfund site, because of the extensive contamination and continued exposure issues. Mercury concentrations in water and sediment at Relief Hill pose a threat to human health and ecological receptors in part because tailings piles on the site are readily accessible, continuously eroding and because there is potential for human exposure to residual surficial mercury contamination via the soil exposure pathway. In addition, there are numerous physical hazards, such as open shafts that are a hazard to ATV riders and hikers (SAIC, 2004).

There are currently no engineering controls at Relief Hill to prevent human exposure or erosion and migration of sediment and mercury during storm events (Tetra Tech, 2007). The engineering controls proposed in this DWR funded project include, the construction of check dams and rock armoring of spillways to retain sediment and mercury on site. The removal action would be implemented during one field season, with operation and maintenance activities consisting of: ensuring success of revegetation efforts, sediment detention basin cleanout, sign and gate replacement/repair, and monitoring.

The project will result in the restoration of the 86-acre mine site, including 12 acres of riparian habitat and/or floodplain protected or restored, and 2,400 linear feet of stream bank protected or restored (Tetra Tech, 2004). Specific actions that will produce these results include:

- Five check dams at the Waukesha Tunnel System
- Three check dams in the Middle Sluice System
- Three check dams in the New Sluice System
- Six check dams in the Cliff Sluice System
- 5 acres revegetated
- 2,300 feet of reclaimed trail
- Site restoration after construction of engineering controls is completed

The project will create 15 environmental contractor jobs and result in 1 abandoned mine lands site restored and 1 project addressing threats to source water areas and increased resiliency of those watersheds, all of which address CABY Plan goals and objectives.

The estimated reduction in suspended sediment from the site after remediation is 10,000 tons of sediment per year. This estimate is based on the sediment and mercury load calculations from Malakoff Diggins where more detailed sediment and mercury load estimates have been completed at Malakoff (TSF, 2013 in review). Malakoff Diggins is a comparable hydraulic mine site since its location, site history, and intensity of mercury use are very similar to Relief Hill (DWR, 1987) (Tetra Tech, 2007). The estimated reduction in mercury from the site after remediation is 1,000 pounds this is based on one year of particulate bound mercury in the discharge from Malakoff Diggins (TSF, 2013 in review). Since the Relief Hill project is going to encapsulate mercury contamination on site, it is expected that the reduction in particulate-bound mercury will occur in the first year (Tetra Tech, 2007). The project team does not foresee any potential adverse physical effects of the project.

Without the project, an estimated 10,000 tons of mercury-contaminated sediment will be discharged from the site every year, in perpetuity. The mercury contaminated sediment will continue to be transported or site during discharge events because there are no erosion control structures on site and natural revegetation does not have a chance to establish because of the nutrient poor soil and unstable slopes (Tetra Tech, 2007). This mercury-contaminated sediment will be deposited in the upstream reaches of Englebright Reservoir, occupying an additional 10 acre feet of water storage space per year. This estimate is based on sediment transported being mainly silt and clay which is estimated to occupy 1.2 cubic meters per ton. In Englebright, 18,750 AF, 25%, of its total 70,000 AF of water storage space are already occupied by sediment from hydraulic mining debris (James, 2005). Deposition of this sediment is a problem not only because water storage is lost, but also because mercury is more readily methylated and incorporated into the foodchain in the warmer, still waters of the reservoir than in the organic carbon limited environment at Relief Hill Hydraulic Mine site (Alpers et al, 2008).

Evaluation of project benefits will take place as part of post-construction reporting by the construction contractor and Tahoe National Forest, as well as monitoring planned through Tahoe National Forest ongoing operations and maintenance. Ongoing maintenance described in the construction project plans (Tetra Tech, 2007), will include:

- Annual site visits to inspect response action measures
- Repairs to signs and gates every 5 years (beginning in year 5)
- Cleanout of the sediment basins each of the first three years and every five years after that.
- Collection and analysis (low-level total mercury and TSS) of four surface water samples (one at each of the known tunnel outlets) to evaluate the effectiveness of the response action. Sampling would be conducted annually in years 1 through 5; semi-annually in years 7 through 15; and in years 20, 25, and 30.

Malakoff Diggins Hydraulic Mine Feasibility Study

- 3,000 acres surveyed for abandoned mine lands impacts
- 2 acres of land improved or restored
- 2.75 tons of carbon sequestered
- 3,000 pounds of discharged sediment reduced per year
- 3 pounds of discharged mercury reduced per year
- 14 acres of riparian habitat protected or restored
- 12,000 linear feet of streambank protected or restored

The Malakoff Diggins Feasibility Study will result evaluation and selection of the most effective actions to improve water quality in Humbug Creek, congruent with the natural habitat and resource management objectives and obligations of State Parks. The project includes assessment of the 3,000 acres of Malakoff Diggins Historic Park for mining impacts (both physical and chemical) and cultural resources. The assessment and feasibility study, including remediation actions, will be developed collaboratively with State Parks and with the guidance of Working Group members.

The abandoned hydraulic mine pit at Malakoff Diggins is 3,000ft long, 1,000ft wide and up to 600ft deep in places (DWR, 1987). It exhibits extreme badland topography and continues to erode massive amounts of sediment contaminated with mercury during storm events (TSF, 2013 in review). The discharge during storm events, a yellow/orange slurry, is typical of hydraulic mine sites. Sediment from the exposed and eroding mine workings is mobilized by heavy rainfall and seasonally impacts the South Yuba River, a State designated and federally nominated Wild and Scenic River. Humbug Creek is under the jurisdiction of the California Dept. of Parks and Recreation (State Parks). It is listed under Section 303(d) of the Clean Water Act as impaired for sediment, mercury, copper and zinc. As a result of sediment and other contaminants in runoff, State Parks must pay a water quality violation fine (discharger's fee) to the State Water Resources Control Board every time it rains. This fine is as much as $7,000 per year (personal communication with Syd Brown Retired State Park Geologist, 2013).

The Malakoff Diggins project is the source of significant sediment and mercury to the South Yuba River every year. The current project assessment activities (begun in 2009) included quantifying the sediment and mercury loads to Humbug Creek and to the South Yuba River. DWR analysis reported that during peak storm events as much as 3,000lbs/min were being discharged from the Hiller Tunnel (DWR, 1987). Since that time, annual sediment loads have been calculated for water year 2011 and 2012 as 8,000 tons of sediment and 10,000 tons of sediment, respectively. These are likely underestimates because the 2012 Water Year is not yet completed and this analysis only includes 141 days, and the 2011 Water Year calculation only included 154 days (TSF, 2013 in review). Annual mercury loads have been calculated to be 800 pounds for WY 2011 (only 141 days) and 1,122 pounds for WY 2012 (through March 8th, 157 days). These load estimates will be published in the Humbug Creek Watershed Assessment in Spring of 2013 (TSF, 2013, in review primary author Dr. Carrie Monohan). These estimates were used to quantify anticipated physical benefits for Relief Hill and Malakoff Diggins. The methodology and equipment that was used to collect data for the sediment and mercury load estimates at Malakoff is what is being requested for Scotchman Creek, Spring Creek and Shady Creek (FTS, 2013).

Without the project, an estimated 10,000 tons of mercury-contaminated sediment will be discharged from the site every year, in perpetuity. The transport of particulate bound mercury from the Malakoff Diggins Pit will continue because the fine silts and clays that make up the majority of the suspended sediment load are not retained in the pit. The natural revegetation of the pit, with volunteer willows, has increased the roughness of the pit floor but has not trapped the silt and clay grain size fraction (Dr. Monohan, personal observation 2012). This mercury-contaminated sediment will be deposited in the upstream reaches of Englebright Reservoir, occupying an additional 10 acre feet per year of water storage space. In Englebright, 18,750 AF of its total 70,000 AF of water storage space are already occupied by sediment (James, 2005). Deposition of this sediment is a problem not only because water storage is lost, but also because mercury is more readily methylated and incorporated into the foodchain in the warmer, still waters of the reservoir than in the organic carbon limited environment at the Malakoff Diggins site (Alpers et al. 2008).

The Malakoff Diggins Feasibility Study project will determine a sediment budget for the pit using state-of-the-art land-based LiDAR so that remediation activities can be designed and engineered and a significant source of sediment and mercury to the South Yuba River watershed can be mitigated (Soulard and Bogle, 2011). The project has been designed in close coordination with USGS sediment and mercury experts (personal communication and field trip on 2/14/2013 with Dr. Charlie Alpers, USGS and Jenny Curtis, USGS). The feasibility study will include erosion control trials on two acres of the pit that are actively eroding but not culturally or historically significant. Eventually (post-2016), the entire abandoned mine site will be restored to meet water quality criteria for sediment and mercury once the effectiveness and feasibility of treatment options are selected and tested. Not only will the project result in restoration of a significant source of sediment and mercury to the downstream watershed, but it will also provide an example for assessing and cleaning up similar sites that are threats to

water quality across the CABY region and other Sierra Nevada IRWM regions.

Prototype treatments that will be implemented on two acres will result in improvement of 14 acres of downstream riparian habitat, and protection of 12,000 feet of streambank. The riparian habitat estimate assumes that 50ft of bank along the length of Humbug Creek from the confluence of Diggins Creek to the confluence with The South Yuba River will be improved if mercury contaminated suspended sediment loads are reduced, in particular the interstitial spaces needed by many benthic macroinvertebrates, and poors of amphibians and gills of salmonid species will be less clogged (Gard, 1994). Monitoring of revegetation trial plot effectiveness will include monitoring suspended sediment and mercury loads before and after treatment at discharge locations near the treatment option and at the outlet of the Pit. The monitoring equipment on Humbug Creek is state of the art pressure transducer (SDI-12 Pressure Transducer) and turbidity meter (DTS-12 Turbidity Meter) that has a range of up to 1600 NTU. Reading from both of these meters take place every 15 minutes and are recorded in the Axiom H2 Data Logger (Forest Technology Systems (FTS), 2013). By developing a linear regression for TSS and turbidity and particulate bound mercury and turbidity, sediment and mercury loads were calculated for Humbug Creek (Stage Discharge R^2 0.92 n=7, TSS and turbidity R^2= 0.71, n=25, and Particulate bound mercury R^2= 0.83, n=25) (TSF, 2013 in review). Conservative estimates of the effect of the pilot treatment activities include a reduction of 3,000 pounds of discharged sediment and 3 pounds of discharged mercury. Other than the revegetation trial plots described, no new facilities or policies are required to obtain these physical benefits. The project team does not foresee any potential adverse physical effects of the project.

<u>Omega Diggins Hydraulic Mine Assessment</u>

- 2,080 acres surveyed for abandoned mine lands impacts
- 2 continuous water quality monitoring gages installed

Scotchman Creek is a tributary to the South Yuba River in Nevada County east of the town of Washington. The Scotchman Creek watershed contains both Alpha Diggins, a hydraulic mine site successfully remediated by the US Forest Service, and the larger Omega Diggins, an untreated former hydraulic mine site, which continues to pollute downstream water bodies at conspicuously high levels, documented through a water quality monitoring station in Scotchman Creek where grab samples have been collected monthly for the past 10 years including dissolved oxygen, pH, conductivity and turbidity (SYRCL, 2011), but until now has not had the resources to specifically assess suspended sediment and mercury loads from Scotchman Creek using continuous monitoring techniques. Scotchman Creek has large volumes of hydraulic mining debris that remain in their upper watershed (James, 2005). Without this project, sediment and mercury drainage from the unremediated Omega Diggins mine site will continue to drain unchecked into the South Yuba River.

The results of this assessment will be documented in the main project deliverable, a collaboratively developed watershed assessment. A continuous monitoring gage station will be used in order to quantify sediment and mercury loads in Scotchman Creek, modeled after the

gage on Humbug Creek at Malakoff Diggins (TSF, 2013 in review) (FTS, 2013). Using this gage annual sediment and mercury loads will be calculated for the site and used to engineer sediment control structures for the site. For example if 10,000 tons of suspended sediment are being discharged from the site per year, then a sediment control system designed to handle this type of load needs to be developed. The final assessment document will detail the importance of the Scotchman Creek watershed as a source water area, monitoring methods used, threats to the resiliency of the watershed including mining issues impacting water quality and habitat, extent of mining impacts including acreage and downstream water reaches, and number and diversity of stakeholders involved in the collaborative process. Monitoring activities on the 2,080 acres of public land in the watershed will be guided by a Monitoring Plan and Site Inspection Plan (two other project deliverables). The project team does not foresee any potential adverse physical effects of the project.

Spring and Shady Creek Mining Impact Assessment

- 1 continuous water quality monitoring gage installed

Spring Creek and Shady Creek are tributaries to the South Yuba River and have their headwaters in the Inimim Forest which consists of ten separate public land parcels, spread over roughly five miles, totaling about 1,813 acres on the central part of San Juan Ridge in Northern Nevada County (YWI, 1997). Spring Creek and Shady Creek have large volumes of hydraulic mining debris in their upper watershed (James, 2005). The San Juan Ridge Mine is proposed to reopen mine scarred lands and would discharge to Spring and Shady Creeks. Spring and Shady Creeks already receive high sediment loads, likely contaminated with mercury during storm events because of the legacy hydraulic mining in this area (James, 2005). Local citizens are concerned about the lack of information about the extensive historic mining impacts in the Forest, and the potential increase in water quality impacts with the newly proposed mine. YWI is seeking funds to monitor Spring and Shady Creeks to collect baseline data of current conditions in order to be able to quantify and respond to the proposed mine's impacts and to inform future remediation and restoration projects in the Inimim Forest.

The project will result in the installation of two continuous monitoring gage stations (on Spring Creek and Shady Creek, respectively), with which annual sediment and mercury loads will be measured for these two watersheds. The use of continuous monitoring equipment, modeled after the gage station in Humbug Creek, will enable better informed sediment and mercury abatement strategies to be developed for the site (FTS, 2013). The installation and results of these gage stations will be documented in the Water Quality Assessment that will be a primary project deliverable. The project team does not foresee any potential adverse physical effects of the project.

Combie Reservoir Mercury Treatment Facility

- 6,000lbs of sediment treated as part of demonstrations
- 36mg of mercury removed during demonstrations

Additional Combie Res. Physical Benefits w/ Full Project Implementation (post-2016)

- *125 acre feet of operational water storage space restored will full project implementation*
- *440 pounds of mercury removed per year with full project implementation*
- *200,000 tons of mercury-contaminated sediment treated for mercury with full project implementation*
- *10 miles of downstream habitat improved*
- *20 acres of reservoir habitat enhanced and restored*

The Nevada Irrigation District (NID) owns and operates two reservoirs on the Bear River which are 303d listed for mercury: Rollins Reservoir and Combie Reservoir. For more than 30 years, NID contracted with private aggregate mining companies to remove sediments that migrate toward the reservoirs. At Combie Reservoir, a dredging operation was used to remove sediments for more than 15 years. These dredging operations in Combie Reservoir were halted in 2003 by the Central Valley Regional Water Quality Control Board as a result of high mercury levels found in dredge effluents (NID, 2009). (Much of the sediment accumulating in Combie and other Sierra Nevada reservoirs originates from upstream legacy hydraulic mines and is therefore contaminated with mercury.)

This decision continues to affect NID efforts to maintain reservoir storage capacity, and NID's ability to supply water to its customers, within the Lake of the Pines and North Auburn Water Treatment Systems (NID, 2009). Combie Reservoir has 5,555 AF of water storage space, and currently has 200,000 tons of mercury contaminated sediment occupying 125 AF of water storage space in the upstream reaches of the reservoir (NID, 2009). Without this project, NID's reservoirs will continue to fill with sediment and the district will not have a way to remove the sediment. This project advances the districts capacity to dredge and treat dredged sediment in a way that has a net environmental benefit. The technology purchased as a part of this project will be used at Combie Reservoir, but it will enable the development of a similar process other reservoirs. With the majority of California's water supply coming from rivers and reservoirs of the Sierra Nevada Mountains, the impact of mercury contaminated sediment threatens water quality and habitat in many reservoirs throughout the Sierra; in addition, the prevention of dredging operations threatens water storage over the long-term for many Californians.

This project includes leasing of mercury treatment facility components of and demonstrating its effectiveness on site. These activities allow for final project design of the sediment treatment facility prior to full project implementation, and also allow the project concept to be demonstrated to state legislators and others to help secure funding for full project implementation. Based on demonstrations of the mercury removal components conducted in 2009, the demonstration trials will remove at least 3mg of mercury from 500lbs of sediment during each trial (NID, 2012 Appendix IV). During the demonstration phase of the project, three

jobs will be created, two to operate the equipment during demonstration trials and one night guard position. At least 100 influential people will be introduced to the project at the demonstration trials.

Full project implementation (post-2016) will remove at least 440lbs of mercury, treat 200,000 tons of sediment and restore 125 acre feet of water storage space (NID, 2009). With full project implementation additional studies will also be conducted to measure project effectiveness:

- Mercury data in the water from sites upstream and downstream of the dredge area at different times of the year will inform how mercury is being transported from the reservoir to downstream environments**;**
- Water quality grab samples will inform regarding mercury transport during storm events, specifically the extent to which mercury is transported downstream with suspended sediment**;**
- Mercury concentrations in zooplankton, and invertebrates will inform how mercury is entering the food web through the pelagic food chain;
- Physical (temperature) and chemical (dissolved oxygen) stratification of the reservoir will be documented so that potential impact on mercury cycling can be evaluated**;**
- Sediment samples from the bottom of the reservoir (specifically from the top 2 centimeters) at different locations will be analyzed for total mercury, methylmercury, reactive mercury(II), grain size, iron and sulfur redox species, and loss on ignition; these data will provide information about mercury methylation conditions in the reservoir pre-and post-dredging; and
- Sediment pore-water samples and bottom water taken from four depths at six sites will be analyzed for total mercury, methylmercury, dissolved organic carbon, and nutrients. These data combined with data from bottom water will be used to calculate the diffusion rates from sediment pore water to the water column in the reservoir, which will provide information regarding the benthic exchange and how mercury and methylmercury may move from the sediment to the aquatic foodchain and document changes in concentrations of mercury (which occurs predominantly as methylmercury) concentration in fish tissue after the project as compared to before.

Not only will both the demonstration and full implementation phases of this project result in cleanup of sediment and mercury in the water system, but it will also provide an example for assessing and cleaning up similar reservoir deposits that are threats to water quality and water supply across the CABY region and other Sierra Nevada IRWM regions. The Combie Sediment and Mercury project was developed with the help of Dr. Charlie Alpers (USGS), Rick Humphreys (SWRCB Abandoned Mine Specialist) and Dr. Carrie Monohan (Science Director at The Sierra Fund and Consulting Scientists to NID). These scientists were especially helpful is designing the monitoring components and in the equipment testing that was done in 2009.

The mercury treatment facility that will be demonstrated using DWR funds (2013-2016) has previously been tested on site at Combie Reservoir. The equipment was tested using replicate closed system tests conducted in partnership with USGS and under the supervision of the

CVRWQCB. The methods and results of these tests are described in the Antidegradation Analysis conducted in 2009 (NID, 2012 Appendix IV). The sediment that was fed into the facility was tested for total mercury and the slurry that came out of the facility was tested for total mercury. The study concluded that 93% of the free elemental mercury was removed by the centrifuge treatment of dredged sediment. Forms of mercury that are bound to sediment are captured either in a dry cake waste product consisting mostly of fines compressed and dried or in settling basins, before clean water is released back into the reservoir (NID, 2012).

Other than the Mercury Treatment Facility components that will be funded through this project, no new facilities or policies are required to obtain the physical benefits. NID does not foresee any adverse physical effects of the project activities (NID, 2012).

Mercury Contaminated Fish: Data Collection and Public Education

- 500 fish tissue samples
- 11 water bodies posted with fish consumption guidelines

The California EPA has issued 303(d) listings for mercury contamination of multiple water ways in the Sierra Foothills, Sacramento-San Joaquin Delta, and San Francisco Bay regions. Table 1 (below) indicates the status of 303(d) listing according to data from the Central Valley Regional Water Quality Control Board (CVRWQCB) and the 2003 and 2009 OEHHA fish advisories (OEHHA, 2003) (OEHHA, 2009).

Table 1: Regulatory Status of Mercury-Impacted Water Ways in the Yuba and Bear Watersheds

Mercury-Impacted Water Way	303(d) Listed as impaired by mercury (CVRWQCB 2010)	Fish Consumption Advisory 2003 (OEHHA 2003)	Fish Consumption Advisory 2009 Update (OEHHA 2009)
Deer Creek	X*	X	**
Upper Scotts Flat Lake	X	X	**
Lower Scotts Flat Lake			
Lake Wildwood	X		
Bear River	X	X	**
Rollins Lake	X	X	X
Lake Combie	X	X	X
Camp Far West Reservoir	X	X	X
South Yuba River	X	X	**
North Yuba River	X		
Lake Englebright	X	X	X
Lower Yuba River (below Englebright)	X		
Lower American River (below Nimbus Dam)	X	X	X

* 303(d) listings have been issued for Little Deer Creek, a tributary to Deer Creek.
** Removed from the fish advisory during the 2009 update due to insufficient number of samples

A previous Angler Survey report was published with data from 2009 and 2010 (TSF, 2011). The Angler questionnaire that will be used was based on one developed by the California Department of Public Health for a survey of anglers in the San Francisco Bay/Delta (Shilling, et al., 2010), in order to facilitate regional comparison of fish consumption. In addition to surveying anglers at local water bodies, this effort quantified fish consumption advisories in the region, and concluded that although 12 of CABY's water bodies are 303 (d) listed for mercury, none have complete fish consumption advisories for all edible fish species, and only two have any advisory information posted where people are fishing (TSF, 2011).

This proposed project will result in an updated and expanded report on fish consumption and new fish tissue data for the completion of Sport Fish Consumption guidelines of mercury contaminated water bodies in the CABY region. The proposed project will update the Angler Survey data with 150 more angler questionnaires collected in 2014, 2015 and 2016 field seasons. Native interns, as part of the Native Youth Conservation Corps, will be trained to conduct the Angler Survey. The proposed project's final report will summarize the survey methods used, number of questionnaires completed by water body, locations questionnaires were completed, demographics and ethnicity of survey respondents, fish species anglers reported eating, known fish tissue concentrations of mercury, and the calculated exposure of survey participants based on their answers.

In addition to completing questionnaires, survey administrators will conduct education and outreach about mercury in fish at each water body and post signs with state-issued fish consumption guidelines at all of the 12 water bodies that are 303 (d) listed for mercury in the CABY region. The survey administrators will track the number of individuals that were provided educational materials, and the number of signs posted. Native interns are expected to reach at least 200 individuals to educate them on fish consumption advisories.

This project will directly address the critical lack of fish consumption advisories by completing the fish tissue data set for each 303 (d) listed water body in the CABY region. These data can then be used by state agencies (OEHHA) to complete fish consumption guidelines for mercury impaired water bodies in the CABY region. At least 500 fish will be caught and sent to an accredited lab for fish tissue analysis for mercury. In order to meet state data standards, rigorous protocols will be followed in fish collection and processing, including ultra clean hands sampling techniques for mercury. Upon collection, fish samples will be field frozen with water surrounded by dry ice, using a low-stress protocol developed by USGS research team members in conjunction with UC Davis School of Veterinary Medicine (Protocol #13464 in Alpers et al, 2008 and Davis 2010). Fish will be thawed, weighed, and measured. Individuals within the human health relevant size ranges (≥ approx. 150 mm for trout and ≥ 305 mm for bass) will be analyzed for fresh weight muscle mercury and smaller fish will be analyzed by whole-body methods using standard cold vapor atomic absorption (CVAA) spectrophotometry at an accredited trace metals lab. Nine to 15 edible-/legal-sized fish of each species will be collected from each targeted location, in order to satisfy the fish advisory requirements. Fish species include: bluegill, sunfish, crappies, brown trout, rainbow trout, catfish, smallmouth bass, largemouth bass, spotted bass, striped bass and carp.

Annual Physical Benefits Tables

The following Physical Benefits Tables are grouped according to project.

RELIEF HILL HYDRAULIC MINE REMEDIATION

Annual Project Physical Benefits			
Project Name: Relief Hill Hydraulic Mine Remediation			
Type of Benefit Claimed: Acres improved or restored			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	86 AC	86 AC
2015	0	0	0
2016	0	0	0
Comments: Project implementation will take place over the 2014 field season. Additional project monitoring and maintenance of revegetation efforts will take place in 2015-2016.			

Annual Project Physical Benefits			
Project Name: Relief Hill Hydraulic Mine Remediation			
Type of Benefit Claimed: Riparian habitat protected or restored			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	12	12
2015	0	0	0
2016	0	0	0
Comments: Project implementation will take place over the 2014 field season. Additional project monitoring and maintenance of revegetation efforts will take place in 2015-2016.			

Annual Project Physical Benefits			
Project Name: Relief Hill Hydraulic Mine Remediation			
Type of Benefit Claimed: Stream bank protected or restored			
Measure of Benefit Claimed (Name of Units): Linear Feet (LF)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	2,400 LF	2,400 LF
2015	0	0	0
2016	0	0	0
Comments: Project implementation will take place over the 2014 field season. Additional project monitoring and maintenance of revegetation efforts will take place in 2015-2016.			

Annual Project Physical Benefits			
Project Name: Relief Hill Hydraulic Mine Remediation			
Type of Benefit Claimed: Acres surveyed for abandoned mine impacts			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	86 AC	86 AC
2015	0	0	0
2016	0	0	0
Comments: N/A			

MALAKOFF DIGGINS HYDRAULIC MINE FEASIBILITY STUDY

Annual Project Physical Benefits			
Project Name: Malakoff Diggins Hydraulic Mine Feasibility Study			
Type of Benefit Claimed: Acres surveyed for abandoned mine impacts			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	1,800	1,800
2014	0	1,200	1,200
2015	0	0	0
2016	0	0	0
TOTAL PHYSICAL BENEFITS			**3,000 acres**
Comments: Acreage of Malakoff Diggins State Historic Park surveyed for cultural resources and abandoned mine land impacts including physical hazards and legacy pollution.			

Annual Project Physical Benefits			
Project Name: Malakoff Diggins Hydraulic Mine Feasibility Study			
Type of Benefit Claimed: Acres improved or restored			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	2 AC	2 AC
Comments: Treatment prototype and erosion control plots covering 2 acres will be constructed over the 2015 field season and benefits will be monitored in the final year of the project period.			

Annual Project Physical Benefits			
Project Name: Malakoff Diggins Hydraulic Mine Feasibility Study			
Type of Benefit Claimed: Discharged sediment reduced			
Measure of Benefit Claimed (Name of Units): Pounds (pds)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	3,000 pds	3,000 pds
Comments: Treatment prototype and erosion control plots covering 2 acres will be constructed over the 2015 field season and benefits will be monitored in the final year of the project period. It is difficult to predict the effectives of erosion treatments that have not been designed or installed yet, but the measurements we do have of sediment discharged during storm conditions of 3000pounds/second (DWR 1987) lead us to believe that at least 3000 pounds can be eliminated from the discharge with treatment over an entire storm season.			

Annual Project Physical Benefits			
Project Name: Malakoff Diggins Hydraulic Mine Feasibility Study			
Type of Benefit Claimed: Mercury discharge reduced			
Measure of Benefit Claimed (Name of Units): Pounds (pds)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	3 pds	3 pds
Comments: Treatment prototype and erosion control plots covering 2 acres will be constructed over the 2015 field season and benefits will be monitored in the final year of the project period. It is difficult to predict the effectives of erosion treatments that have not been designed or installed yet, but the measurements we do have indicate that particulate bound mercury is being discharged during storm events at large quantities (92pounds/min during March 16th, 2012 storm, unpublished data, Monohan Ph.D. in hydrology). It seems that an estimate of 3 pounds of mercury is very conservative.			

Annual Project Physical Benefits			
Project Name: Malakoff Diggins Hydraulic Mine Feasibility Study			
Type of Benefit Claimed: Riparian habitat protected or restored			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	14 AC	14 AC
Comments: Treatment prototype and erosion control plots covering 2 acres will be constructed over the 2015 field season and benefits will be monitored in the final year of the project period.			

Annual Project Physical Benefits			
Project Name: Malakoff Diggins Hydraulic Mine Feasibility Study			
Type of Benefit Claimed: Stream bank protected or restored			
Measure of Benefit Claimed (Name of Units): Linear Feet (LF)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	12,000 LF	12,000 LF
Comments: Treatment prototype and erosion control plots covering 2 acres will be constructed over the 2015 field season and benefits will be monitored in the final year of the project period.			

OMEGA DIGGINS/SCOTCHMAN CREEK ASSESSMENT

Annual Project Physical Benefits			
Project Name: Omega Diggins/Scotchman Creek Assessment			
Type of Benefit Claimed: Acres surveyed for abandoned mine lands impacts			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	76 AC	76 AC	0
2014	76 AC	1,156 AC	1,080 AC
2015	76 AC	826 AC	750 AC
2016	76 AC	326 AC	250 AC
TOTAL PHYSICAL BENEFITS			2,080 AC
Comments: Acreage of public lands in the Scotchman Creek watershed surveyed for cultural resources and abandoned mine land impacts including physical hazards and legacy pollution. Private lands may also be surveyed, but are not included in this accounting. Existing surveyed acres constitute the previously-implemented Forest Service assessment and cleanup project at Alpha Diggins.			

SPRING AND SHADY CREEK MINING IMPACT ASSESSMENT

Annual Project Physical Benefits			
Project Name: Spring and Shady Creek Mining Impact Assessment			
Type of Benefit Claimed: Acres surveyed for abandoned mine lands impacts			
Measure of Benefit Claimed (Name of Units): Acres (AC)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	1,000 AC	1,000 AC
2015	0	800 AC	800 AC
2016	0	0	0
		TOTAL PHYSICAL BENEFITS	1,800 AC
Comments: Acreage of public lands in the Spring and Shady Creek watersheds (10 parcels total) surveyed for cultural resources and abandoned mine land impacts including physical hazards and legacy pollution.			

COMBIE RESERVOIR MERCURY TREATMENT FACILITY

Annual Project Physical Benefits			
Project Name: Combie Reservoir Mercury Treatment Facility			
Type of Benefit Claimed: Sediment Treated			
Measure of Benefit Claimed (Name of Units): Pounds (pds)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	3,000 pds	3,000 pds
2015	0	1,500 pds	1,500 pds
2016	0	1,500 pds	1,500 pds
TOTAL BENEFITS			**9,000 pds**
Comments: Each of a minimum of twelve demonstrations will treat an average of 500 pounds of sediment. Six demonstrations are planned for the first full year of the project. At least three per year will be completed for the second and third years of the project.			

Annual Project Physical Benefits			
Project Name: Combie Reservoir Mercury Treatment Facility			
Type of Benefit Claimed: Mercury Removed			
Measure of Benefit Claimed (Name of Units): Milligrams (mg)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	18 mg	18 mg
2015	0	9 mg	9 mg
2016	0	9 mg	9 mg
TOTAL BENEFITS			**36 mg**
Comments: Each of a minimum of twelve demonstrations will remove an average of 3mg of mercury. Six demonstrations are planned for the first full year of the project. At least three per year will be completed for the second and third years of the project.			

INCREASE DATA AND AWARENESS ABOUT FISH MERCURY CONTAMINATION PROJECT

Annual Project Physical Benefits			
Project Name: Increase Data and Awareness about Fish Mercury Contamination			
Type of Benefit Claimed: Fish tissue samples			
Measure of Benefit Claimed (Name of Units): Number of fish samples			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	157	0	0
2014	157	332	175
2015	157	332	175
2016	157	307	150
TOTAL PHYSICAL BENEFITS			**500 fish samples**
Comments: N/A			

Annual Project Physical Benefits			
Project Name: Increase Data and Awareness about Fish Mercury Contamination			
Type of Benefit Claimed: Signs with Fish Consumption Guidelines Posted at 303(d) listed Water Bodies			
Measure of Benefit Claimed (Name of Units): 303(d) listed water bodies with posted guidelines			
Each water body may be posted in more than one location depending on the number of fishing access locations			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	2	2	0
2014	2	11	9
2015	2	4	2
2016	2	2	0
TOTAL PHYSICAL BENEFITS			**11 water bodies**
Comments: There are 13 targeted water bodies in the CABY region that are 303(d) listed for mercury. Signs about state-issued fish consumption guidelines, and general information about eating fish from mercury-contaminated water bodies will be prominently posted at each fishing access location. There are one or more fishing access locations at each of the 13 water bodies. The majority of signs will be posted in the first field season, and re-posting of destroyed or removed signs will take place in subsequent field seasons.			

References

The following references are provided in PDF form as supplemental materials to this proposal (unless otherwise noted):

- In the online package reference documents are grouped into three PDFs that are uploaded as part of Attachment 7, entitled:
  - **Att7_IG2_TechJust_6MercRefs1_9of12.pdf** (containing references A-M)
  - **Att7_IG2_TechJust_6MercRefs2_10of12.pdf** (containing references N-R)
  - **Att7_IG2_TechJust_6MercRefs3_11of12.pdf** (containing references S-Y)

- In the hard copy package these documents are provided as separated PDFs in the folder entitled **"6 - Mercury Initiative Project."**

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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 Technical Justification Introduction

There are two primary threats to the meadows of the CABY region

1) Invasion by conifers and invasive weeds which change the hydrology and plant communities of the meadows and
2) Direct hydrologic changes, such as draining, ditching and roads.

These threats need to be addressed as they represent ongoing and accelerating damage. Conifers and weeds are choking out meadows at an increased rate each year and drainage ditches deepen over time and dry up the meadows.

There are seven sub-projects focused on one of the two primary threats:

I. Restoring Meadow Communities

A. Rucker Meadow
B. Butcher Ranch Meadow
C. Bear Meadow

II. Restoring Meadow Hydrology

A. Blackjack Meadow
B. Gold Hill Meadow
C. Elliot Meadow
D. Deer Meadow

The project also includes an American River Watershed Meadow Assessment and Prioritization element.

I.A-C: The Rucker, Butcher, and Bear Meadows Projects will work with trained volunteers and the Native Youth Conservation Corps to improve twelve acres of aspens groves and meadows in the Yuba River Watershed. Once removed solar radiation will increase to the aspen clone and increase biodiversity within the aspen stands. Soil moisture will increase and about two acres of yellow star thistle will be removed.

II.A: The Blackjack Meadow Project will remove an old road that currently cuts through the meadow. This road is draining the meadow and drying the soil. As part of this project the road will be removed and the drainage will be stopped.

IIB: The Gold Hill Meadow Project will provide numerous water supply and water quality benefits by restoring and stabilizing a severely eroded stream bank and reconnecting the stream to its associated wetland/floodplain. This project will also provide habitat connectivity and erosion control services through the installation and maintenance of native hedgerows as a

buffer zone between wetland habitat and agricultural lands. The project will restore hydrologic function, encouraging native plant species diversity and abundance (hedgerow installation and riparian plantings) and removal of invasive aquatic species.

II.C: The Elliot Meadow Restoration Project will provide numerous water supply and water quality benefits by filling a deeply incised channel and ditches within the meadow's historic floodplain. This network of incision has altered the natural meadow hydrology by draining groundwater from the meadow earlier in the season, and drying the meadow and downstream reaches that depend on meadow base flow in late season.

II.D: Deer Meadow Restoration Project will provide numerous water supply and water quality benefits reestablishing the correct hydrology through repairing past impacts. These impacts have altered the natural meadow hydrology by draining groundwater from the meadow earlier in the season, and drying the meadow and downstream reaches that depend on meadow base flow in late season. This phase of the project will produce a better understanding of the impacts and provide recommended alternatives. Construction will not occur during this phase of the project.

Total Project Physical Benefits

Types of Project Benefits Summary

Project Physical Measurable Benefits	Amount	Measurement Type
Increase solar radiation to aspen stands	55%	Pre and Post Surveys
Increase in biodiversity in aspen stands	3 species	Pre and Post Surveys
Increase in soil moisture content of aspen stands	28%	Pre and Post Surveys
Increase in soil moisture content of fen habitat	20%	Pre and Post Surveys
Increased groundwater storage	10af	Estimate
Increase in linear feet of stream bank restored	3,900ft	Direct Measure
Increase in acres of meadow restored	27ac	Direct Measure
Increase in miles of stream where the natural sediment regime is restored	5.25mi	Direct Measure
Increase in tons of carbon sequestered	200T	Estimate
Reduced downstream temperature	-2*F	Estimate
Increased late-season streamflow downstream of restored meadow	Unkn	No affordable method
Reduced erosion and turbidity and sedimentation downstream	Unkn	No affordable method
Pollinator and herpetofaunal biodiversity	3 species	Pre and Post Surveys

Expected Project Physical Benefits Narrative & Physical Benefits by Project

I. RESTORING MEADOW COMMUNITIES

- Increase solar radiation to aspen stands by 55%
- Increase in biodiversity in aspen stands by three additional species
- Increase in soil moisture content of aspen stands by 28%

Removal of conifers from aspen stands and meadows will increase the amount of solar radiation to the aspen clone receives (Shepperd, et al, 2006 and Tate et al, 2010). The effect of increased vigor in the aspen clone and therefore aspen stand is an increase in biodiversity of animals, mostly birds (Shepperd, et al, 2006). Increase biodiversity is also related to an increase in understory biomass as a result of conifer removal (Stam et al, 2008; Griffis and Beier, 2003). Another impact of removal of conifers is a reduction in the transpiration, and therefore an increase in soil moisture (Griffiths et al 2005). In total 12 acres of aspen groves and meadows will be improved. At Rucker Meadow and Butcher Ranch Meadow, conifers will be removed with the use of volunteers and the Sierra Native Alliance. Two acres of meadow habitat infested with yellow star thistle will be treated at Bear Meadow by the Sierra Native Alliance.

II. RESTORING MEADOW HYDROLOGY

As a result of this project, appropriate hydrology patterns will be restored in Blackjack Meadow, Gold Hill Meadow, and Elliot Meadow (Deer Meadow is not a construction project and therefore will not result in physical benefits):

A. Blackjack Meadow Project

- Increase in soil moisture content of fen habitat by 20%

Currently a road cuts through a part of Blackjack Meadow. This road is draining the meadow and drying the soil. As part of this project the road will be removed and the drainage will be stopped. Road removal within a fen/meadow increases soil moisture by removing drainage pathways from the road (Hammersmark et al, 2008).

B. Gold Hill Meadow Project

- Increase in linear feet of stream bank restored by 2,600 feet
- Increase in acres of meadow restored by 5 acres
- Increase in miles of stream where the natural sediment regime is restored by 0.25 miles.
- Increased late-season streamflow downstream of restored meadow: unquantifiable.
- Reduced erosion and turbidity and sedimentation downstream: yes but unquantifiable.

The Gold Hill Meadow project will provide numerous physical benefits by restoring the area's natural hydrology, as described and fully referenced within the technical description above. Briefly: The Gold Hill Meadow restoration project will provide numerous water supply and water quality benefits by restoring and stabilizing a severely eroded stream bank and reconnecting the stream to its associated wetland/floodplain. This project will also provide habitat connectivity and erosion control services through the installation and maintenance of native hedgerows as a buffer zone between wetland habitat and agricultural lands. The management and removal of non-native invasive species in the water bodies will also help to restore habitat function and increase native species diversity. Based on the best available science, restoring the aquatic resources at Gold Hill Meadow is expected to have the following benefits:

An unnamed spring feed creek will have 2,600 linear feet of stream bank restored. This physical benefit will also be tracked as a project performance measure. A total of five acres of meadow will be restored as a result of this project.
This project will increase by 0.25 miles the length of stream where the natural sediment regime is restored. Similar to estimates above, the miles of stream bank miles of stream where the natural sediment regime is restored is estimated from GIS analysis and will be ground-truthed during performance measure tracking.

Numerous studies indicate a decrease in erosion, turbidity and sedimentation downstream from meadow restoration sites (Jones and Stokes 2008; National Fish and Wildlife Foundation 2010; Micheli & Kirchner 2002; Lindquist & Wilcox 2000), and the visibly down-cut channels indicate that Goldhill Meadow experienced substantial erosion in the recent past. However, the rate of erosion and sediment transport is widely variable between years, reaching maximum effect during flood events. Monitoring how Elliot meadow restoration attenuates sediment supplied to Shirttail Creek is a long-term, technically challenging and cost prohibitive prospect, and will not be included as a performance measure.

This project will increase late-season streamflow downstream of restored meadow. Numerous empirical and modeling studies indicate an increase in late-season base flow following restoration (Swanson et al. 1987; Heede 1979; Zeedyk and Jansens 2006). However the amount of augmentation varies between water years, and a single metric is difficult to defend. Monitoring streamflow before and after restoration is cost prohibitive. Therefore, this expected benefit will not be included as a performance measure.

C. Elliot Meadow Project

- Increased groundwater storage: 10af
- Increase in linear feet of stream bank restored: 1300ft
- Increase in acres of meadow restored: 10ac
- Increase in miles of stream where the natural sediment regime is restored: 5mi
- Increase in tons of carbon sequestered: 200T

- Reduced downstream temperature: 2 degrees F
- Increased late-season streamflow downstream of restored meadow: Yes, but unquantifiable.
- Reduced erosion and turbidity and sedimentation downstream: Yes, but unquantifiable.
- Increase in biodiversity: 10% increase in pollinators and herpetofaunal.

The Elliot Meadow Restoration Project will provide numerous physical benefits by restoring the meadow's natural hydrology. The project will fill a network of deeply incised channels and ditches that drain groundwater from the meadow. This simple act of stopping drainage benefits almost every aspect of the meadow's ecological function.

The amount of groundwater stored is variable from meadow to meadow; however the specific project effect will be quantified and compared to performance measure targets. The estimate is based on established methods for estimation developed by Limnotech (2012). (Swanson et al. 1987; Heede 1979; Hammersmark et al. 2008; Tague et al. 2008; Loheide II & Gorelick 2006; Cornwell & Brown 2008; Limnotech 2012)

Along Shirttail Creek 1,300 feet of linear stream bank will be restored. The precise length of streambank may vary by 20%, as detailed surveys have not been conducted, and these estimates are from GIS analysis of aerial photos. This physical benefit will also be tracked as a project performance measure.

Ten acres of meadow will be restored. Similar to estimates of stream bank restored, the acreage of meadow affected by restoration is estimated from GIS analysis and will be ground-truthed during performance measure tracking. In addition, ten acres meadow will become part of the active floodplain habitat (Klein et al. 2007; C.T. Hammersmark et al. 2009; Loheide et al. 2009; Allen-Diaz 1991).

This project will increase by 5 miles the length of stream where the natural sediment regime is restored. Similar to estimates above, the miles of stream bank miles of stream where the natural sediment regime is restored is estimated from GIS analysis and will be ground-truthed during performance measure tracking.

This project will increase the amount of carbon sequestered, due to a raised water table and increases in soil carbon storage by 200 tons (Feather River CRM, 2010). We will not field verify the increase in carbon sequestered, but will use the average published value, scaled to project's area of impact.

Downstream water temperatures will decrease by 2 degrees due to increased baseflow (Jones and Stokes 2008; Hammersmark et al. 2008; Zeedyk and Jansens 2006). Both modeling and empirical studies show reduced temperatures downstream of meadow restoration sites due to increased base flow (Swanson et al. 1987; Heede 1979; Hammersmark et al. 2008; Tague et al. 2008; Loheide II & Gorelick 2006). The measures

are highly variable; however, a two degree F decrease in temperature following restoration is conservative. This project will monitor downstream temperatures pre- and post- restoration as part of project monitoring and performance measure tracking, and results will add to the state of the science, when using meadow restoration as a BMP to manage temperature.

Numerous studies indicate a decrease in erosion, turbidity and sedimentation downstream from meadow restoration sites (Jones and Stokes 2008; National Fish and Wildlife Foundation 2010; Micheli & Kirchner 2002; Lindquist & Wilcox 2000), and the visibly down-cut channels indicate that Elliot meadow experienced substantial erosion in the recent past. However, the rate of erosion and sediment transport is widely variable between years, reaching maximum effect during flood events. Monitoring how Elliot meadow restoration attenuates sediment supplied to Shirttail Creek is a long-term, technically challenging and cost prohibitive prospect, and will not be included as a performance measure.

Biodiversity will also be increase due to increased pollinator habitat from the hedgerow installation (Long and Anderson 2010; Morandin et al. 2011). There will also be an Increase in native herpetofaunal (frogs, lizards, snakes etc.) species diversity and abundance (Adams 1999; Adams et al. 2003; Hecnar and M'Closkey 1997; Orchard 2010).

D. Deer Meadow Project

The Deer Meadow Restoration Project will begin with the assembly of a USFS interdisciplinary team to evaluate the historic hydrologic impacts to the meadow. The team will consider all aspects of the community and ecosystem needs and propose alternatives for correct past impacts. This hydrologic focused assessment is necessary because of the confounding and overlapping historic impacts. The next phase of the project will include both the final design and implementation. There are no physical benefits associated with the DWR-funded phase of this project.

American River Meadow Assessment is expected to accelerate the pace of implementing high-quality meadow restoration projects in the CABY region. American Rivers' experience with a similar prioritization in the Mokelumne and Yuba watersheds has led to on-the-ground restoration of top priority meadows within 2 years of the assessment completion. The strength of the collaborative effort involved in the prioritization has attracted corporate and foundation support for restoration, and funders have been asking for similar prioritizations in additional watersheds. SYRCL and American Rivers have both used trained volunteers to assist in the survey fieldwork to make the projects extremely economical. This demonstrated need for prioritized meadows was one impetus for combining the current prioritization with a demonstration and implementation project in Elliot meadow, which is in the American River watershed.

Annual Physical Benefits Tables

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increase solar radiation to Aspen stands			
Measure of Benefit Claimed (Name of Units): Percent canopy cover			
Additional Information about this Measure: Measured by spherical densiometer			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Unkn Develop Baseline		
2014	Unkn		+55%[1]
Etc			+55%[1]
Last Year of Project Life			
Comments 1. Per com Lori Van Laanen, SYRCL employee, 2013 Benefit at Rucker and Butcher Meadows			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increase in biodiversity in Aspen stands			
Measure of Benefit Claimed (Name of Units): Number of individual birds per unit area			
Additional Information about this Measure: Measured by point count bird surveys			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013 -2014	Unkn Develop Baseline		
2015	Unkn	baseline+3	3 species[2]
Etc			
Last Year of Project Life			
Comments 2. From Griffis and Beier, 2003 (see above) Benefit at Rucker and Butcher Meadows			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increase in soil moisture content of aspen stands			
Measure of Benefit Claimed (Name of Units): kilopascals (kPa)			
Additional Information about this Measure: Measured by a tensiometer			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Unkn Develop Baseline		
2014	Unkn		28%[3]
Etc			
Last Year of Project Life			
Comments 3. Griffith, et al 2005 page 353 (see above for citation) Benefit at Rucker and Butcher Meadows			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increase in soil moisture content of fen habitat			
Measure of Benefit Claimed (Name of Units): kilopascals (kPa)			
Additional Information about this Measure: Measured by a tensiometer			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Unkn Develop Baseline		
2014	Unkn		20%[4]
Etc			
Last Year of Project Life			
Comments 4 Estimated based on Griffith, et al 2005 page 353 (see above for citation) Benefit at Blackjack			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increased Groundwater Storage			
Measure of Benefit Claimed (Name of Units): Acre Feet			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Baseline	Baseline	0
2014	Baseline	Baseline	0
2015	Baseline	+ 5 acre feet	5
2016 and thereafter	Baseline	+ 10 acre feet	5
Comments: Estimated using the methods of Limnotech (2012). Benefit at Elliot Meadows			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increase in linear feet of stream bank restored			
Measure of Benefit Claimed (Name of Units): Feet			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	2600	0
2015	0	3900	3900
2016 and thereafter	0	3900	3900
Comments: Gold Hill Meadow: 2600ac Elliot Meadow: 1300			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Acres of Meadow Restored			
Measure of Benefit Claimed (Name of Units): Acres			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Baseline	17	0
2014	Baseline	17	0
2015	Baseline	27	27
2016 and thereafter	Baseline	27	27
Comments: Rucker, Butcher, Bear, Blackjack Meadows: 12ac Gold Hill Meadow: 5ac Elliot Meadow: 10ac			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Miles of Stream where the Natural Sediment Regime is restored			
Measure of Benefit Claimed (Name of Units): Miles			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Baseline	Baseline	0
2014	Baseline	0.25	0.25
2015	Baseline	5.25	5.25
2016 and thereafter	Baseline	5.25	5.25
Comments: Gold Hill Meadow: 0.25mi Elliot Meadow: 5mi			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Tons of Carbon Sequestered			
Measure of Benefit Claimed (Name of Units): Tons			
Additional Information about this Measure: 97% will be sequestered in soils, 3% in above-ground vegetation.			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	Baseline	Baseline	0
2014	Baseline	Baseline	0
2015	Baseline	Baseline	0
2016	Baseline	+30	30
2020 and thereafter	Baseline	+200	200
Comments: Estimation methods follow the empirical results from paired unrestored and restored meadows in the report authored by the Feather River CRM (2010) Benefit at Elliot Meadow			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Reduced downstream temperature			
Measure of Benefit Claimed (Name of Units): degrees F			
Additional Information about this Measure: average daily max temperature for the pre-restoration low-flow period (likely July)			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	0	-2 degrees	-2
2020 and thereafter	0	-2 degrees	-2
Comments: Extrapolated from the results of Loheide and Gorelick (2006) Benefit at Elliot Meadow			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Increased late-season streamflow downstream of restored meadow			
Measure of Benefit Claimed (Name of Units): Unquantifiable within a reasonable monitoring budget			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013			
2014			
2015			
2016			
2020 and thereafter			
Numerous studies demonstrate downstream flow benefits resulting from meadow restoration; however monitoring this impact in Elliot meadow is cost prohibitive (Swanson et al. 1987; Heede 1979; Hammersmark et al. 2008; Hammersmark et al. 2010, Tague et al. 2008; Loheide II & Gorelick 2006) Benefit at Elliot, Goldhill, and Blackjack Meadows			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Reduced erosion and turbidity and sedimentation downstream			
Measure of Benefit Claimed (Name of Units): Unquantifiable within a reasonable monitoring budget			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013			
2014			
2015			
2016			
Numerous studies demonstrate reduced erosion and improved water quality downstream due to stabilized banks (Jones and Stokes 2008; National Fish and Wildlife Foundation 2010; Micheli & Kirchner 2002; Lindquist & Wilcox 2000); however the episodic nature of sediment transport makes monitoring costs prohibitive. Benefit at Elliot, Goldhill, and Blackjack Meadows			

Annual Project Physical Benefits			
Project Name: Meadow Restoration, Assessment and Prioritization in the American, Bear and Yuba Watersheds			
Type of Benefit Claimed: Pollinator and herpetofaunal biodiversity			
Measure of Benefit Claimed (Name of Units): Number of Species			
Additional Information about this Measure:			
(a)	(b)	(c)	(d)
Physical Benefits			
Year	**Without Project**	**With Project**	**Change Resulting from Project (b) – (c)**
2013	background		
2014	background		
2015	background	Background +3 species	
2016	background	Background +3 species	
2020 and thereafter	background	Background +3 species	+3 species
Benefit at Elliot Meadow			

References

The following references are provided in PDF form as supplemental materials to this proposal:

- *In the online package these documents are grouped into a single PDF uploaded as part of Attachment 7, entitled* ***Att7_IG2_TechJust_MeadowsRefs_12of12.pdf****.*
- *In the hard copy package these documents are provided on DVD as separate PDFs in the folder entitled* ***"7 – Meadows Project."***

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