Summary Information

Sonoma Ecology Center

Does It Work? Measuring the success of salmonid habitat restoration at multiple scales

Amount sought: $810,324

Duration: 36 months

Lead investigator: Caitlin Cornwall, Sonoma Ecology Center

Short Description

This project will quantify the impact of hundreds of thousands of CALFED dollars for restoration in the Sonoma Creek watershed in terms of actual steelhead (Oncorhynchus mykiss) population recovery. CALFED funding has equipped this project to develop an experimental design capable of measuring local benefits to habitat quality, reach−scale benefits in terms of increased fish productivity, and watershed−scale increases in total steelhead populations. Integrating reach− and watershed−scale approaches will allow this project to quantify the percentage of the fish population derived from treated reaches versus non−treated reaches.

Executive Summary

Does It Work?

Measuring the Success of Salmonid Habitat Restoration at Multiple Scales Application to CALFED Ecosystem Restoration Program, November 2004

Executive Summary

CALFED and other agencies have invested heavily in ecosystem restoration of Bay−Delta watersheds, but few studies quantify the benefits in terms of increases in the abundance of key focal species. The goal of this proposal is to quantify the impact of hundreds of thousands of CALFED dollars for restoration in the Sonoma Creek watershed in terms of actual steelhead (Oncorhynchus mykiss) population recovery. CALFED funding has equipped us to develop an experimental design capable of measuring local benefits to habitat quality, reach−scale benefits in terms of increased fish productivity, and watershed−scale increases in total steelhead populations. Integrating reach− and watershed−scale approaches

will allow us to quantify the percentage of the fish population derived from treated reaches versus non−treated reaches. The results will fill critical data gaps: while steelhead recovery planning is building momentum throughout the Bay Area, there is virtually no experimental evidence for restoration method effectiveness in different stream settings. Our evaluation of restoration success at the local, reach, and watershed scales, based on a conceptual model of linkages between habitat attributes and fish productivity (developed in collaboration with past and present partners including the Sonoma Ecology Center, Stillwater Sciences , UC Berkeley, the Regional Water Quality Control Board, and the California Department of Fish and Game) will provide a framework for guiding adaptive management measures throughout the Bay−Delta region.

CALFED has supported a diverse constituency for enhancing watershed health in the Sonoma Creek watershed, including funding several restoration projects aimed at salmonid recovery. These include 14 instream fish habitat structures on Sonoma Creek and two tributaries, and the removal of a complete fish passage barrier on a third tributary.

The goal of the work proposed here is to test hypotheses regarding the benefits of CALFED restoration projects in order to improve our conceptual model of linkages between habitat attributes and fish productivity, and to improve the success of future management actions. While we have a preliminary baseline for numbers of summer rearing juveniles in reaches treated with habitat structures, we need to collect numbers of out−migrating smolts to estimate actual production from restored reaches. In the case of the barrier removal, we have anectodal evidence that no fish have been sighted upstream of the project in recent history. All measured fish production may be assumed to be a direct result of barrier removal. Measuring numbers of fish transitioning between different life stages over the study period will allow us to construct a population model that may be used as a tool for evaluating the sensitivity of steelhead to a range of management measures.

The objective of our work is not only to improve our understanding of the habitat−population dynamics of Sonoma Creek, but to produce results that will be appicable to evaluating restoration work proposed throughout the Bay−Delta region. Since factors influencing salmonid success in Sonoma Creek occur throughout the Bay−Delta, this watershed provides an excellent laboratory for long−term monitoring of restoration success. This proposal includes vigorous outreach to those who would benefit from the information we will gather. With a dedicated local stewardship infrastructure that can deliver high−quality data and steer adaptive management over the long term, we can also provide a model of how local communities can participate in the ecological restoration of their watershed.

Does It Work?
Measuring the Success of Salmonid Habitat Restoration at Multiple Scales

Application to CALFED Ecosystem Restoration Program, November 2004

A. Project Description: Project Goals and Scope of Work

A1. Problem, Goals, Objectives

Problem Statement

CALFED and other agencies have invested heavily in ecosystem restoration of Bay-Delta watersheds, but few studies are available to quantify benefits in terms of increases in the abundance of key focal species. The goal of this proposal is to quantify the impact of hundreds of thousands of CALFED dollars in the Sonoma Creek watershed in terms of actual steelhead (*Oncorhynchus mykiss*) population recovery. CALFED funding has equipped us to develop an experimental design capable of measuring local benefits to habitat quality, reach-scale benefits in terms of increased fish productivity, and watershed-scale increases in total steelhead populations. Integrating reach- and watershed-scale approaches will allow us to quantify the percentage of the fish population derived from treated reaches versus non-treated reaches. The results will fill critical data gaps: while steelhead recovery planning is building momentum throughout the Bay Area, there is virtually no experimental evidence for restoration method effectiveness in different stream settings (Leidy et al 2003). Our evaluation of restoration success at the local, reach, and watershed scales, based on a conceptual model of linkages between habitat attributes and fish productivity (developed in collaboration with past and present partners including the Sonoma Ecology Center (SEC), Stillwater Sciences (Stillwater) , UC Berkeley, the Regional Water Quality Control Board (Water Board), and the California Department of Fish and Game (CDFG)) will provide a framework for guiding adaptive management measures throughout the Bay-Delta region.

Background

The Sonoma Creek watershed provides a rare opportunity to measure steelhead restoration success, for the following reasons:

1) A critical density of CALFED-funded pilot restoration projects capable of increasing fish productivity in multiple stream reaches has been implemented in the watershed.
2) Baseline data are available on fish populations and potential limiting factors, including flow, sediment, temperature, habitat quality and access, thanks to past CALFED and other funding.
3) The watershed offers a wide variety of stream types for assessment with viable levels of ecological function, capable of registering a population response (for freshwater life stages) within proposed study timelines, yet is small enough to permit cost-effective monitoring.
4) The Sonoma Ecology Center provides a permanent community-based institute for collecting and disseminating research results, maintaining an ongoing program of salmonid monitoring, providing a base for outside academic and agency researchers, and guiding future restoration planning and implementation both within the watershed and throughout the region, even beyond the planning horizon of this proposal.

Sonoma Creek drains a 166 square mile watershed into San Pablo Bay (Fig. 1). The watershed

possesses 465 miles of blue-line streams and 40 miles of tidal sloughs. The watershed is typical of Bay-Delta watersheds in the cause-and-effect mechanisms driving losses of aquatic species, particularly salmonid populations. It is unusual in retaining long reaches of medium to high quality fish habitat, in the variety of stream types represented within a small basin, in the large quantity of available baseline data, and in the local support for environmental restoration on the part of the agricultural community and other stakeholders. A draft Limiting Factors Analysis (LFA) is scheduled for completion by early 2005 that synthesizes all existing data on environmental parameters affecting steelhead. The LFA was funded by the Water Board and collaboratively prepared by Dr. Bill Dietrich of UC Berkeley, Stillwater, and the SEC.

While Sonoma Creek historically yielded large numbers of steelhead trout, CDFG surveys indicate a drastic decline in fish populations over the last century, in concert with intensified land- and water-use pressures. While steelhead trout are now listed as threatened (NMFS 1997 and 1999), the Sonoma Creek watershed continues to provide a refuge for an unusually diverse community of native fish including steelhead (Leidy 1997). This level of fish diversity is virtually unmatched among Bay Area streams, suggesting that Sonoma Creek should be a priority watershed for native fish and aquatic wildlife conservation (Leidy 2000). A quantitative estimate of the population of rearing juvenile steelhead, based on CALFED-funded research, is over 16,000 for the mainstem of Sonoma Creek and three of its tributaries north of Glen Ellen (SEC 2004). However, we do not have any data indicating how many of these juveniles successfully smolt, return to the Pacific Ocean, and then make it back to the Sonoma Creek drainage in order to spawn and maintain a sustainable population.

CALFED has expended $1,555,634 in the Sonoma Creek watershed (Fig. 1) to support a diverse constituency for enhancing watershed health (grants 1998-E02, 2000-E04, 2001-N27, 2002 4600001710), including funding for several restoration projects aimed at salmonid recovery. The restoration projects were designed to address significant limiting factors for the salmonid populations in the watershed identified during the last several years of intensive assessment coordinated by the SEC (SEC 2004). Factors addressed by the projects include: lack of instream shelter and channel complexity, lack of water and high temperatures during summer, barriers to reaching spawning locations, lack of deep pools, and sedimentation of gravels, affecting food resources, winter refuge from high flows, and spawning success.

SEC and project partners (including CDFG, the California Conservation Corps, and the Sonoma County Roads Department) constructed several CALFED-funded restoration projects on Sonoma Creek and tributaries. They include the following (locations shown on Fig. 1):

1) Installation of multiple habitat structures (anchored logs and boulders) to enhance salmonid rearing habitat at series of pools. Objectives are to increase shelter and habitat complexity, improve substrate, and increase pool depth at a site scale and increase usable habitat at a reach scale. Installation was funded in 2001 and completed in 2003.

   Sites include:

   - Sonoma Creek between Glen Ellen and Kenwood. This is a bedrock-dominated reach with perennial flow, some deep pools, and possibly the best over-summering habitat in the watershed.
   - Calabazas Creek. This stream has high habitat value, good summer and winter rearing reaches, and perennial flow in its upper reaches.

?? Graham Creek. This stream has medium to high habitat value, with localized areas of good winter and summer rearing habitat.

2) Migration barrier removal at Asbury Creek. This stream has a high sediment load, reportedly high historic fisheries value, and unknown current fisheries value. Wood baffles were installed in a long culvert which was a complete barrier at the mouth of the stream. Design funded 1998, implementation funded 2000, installed 2002.

Goals and Objectives

The goal of the work proposed here is to test specific hypotheses regarding the benefits of CALFED restoration projects in order to improve our conceptual model of linkages between habitat attributes and fish productivity, leading to improved success of future management actions. While we have a preliminary baseline for numbers of summer rearing juveniles in reaches treated with habitat structures, we need to collect numbers of out-migrating smolts to estimate actual production from restored reaches. In the case of Asbury Creek, we have anectodal evidence that no fish have been sighted in the reach above the barrier removal project in recent history. All fish production may be assumed to be a direct result of barrier removal. Measuring numbers of fish transitioning between different life stages over the study period will allow us to construct a population model that may be used as a tool for evaluating the sensitivity of the steelhead to a range of proposed management measures.

The objective of our work is not only to improve our understanding of the habitat-population dynamics of Sonoma Creek, but to produce results that will be applicable to evaluating restoration work proposed throughout the Bay-Delta region. Since factors influencing salmonid success in Sonoma Creek occur throughout the Bay-Delta, this watershed provides an excellent laboratory for long-term monitoring of restoration success. With the strength of a dedicated local stewardship infrastructure that can deliver high-quality data and steer adaptive management over the long term, we can also provide a model of how local communities can participate in the ecological restoration of their watershed.

A2. Justification

Conceptual Models

Our approach to river and salmonid restoration is based primarily on restoring or reinitiating geomorphic and ecological processes to achieve the restoration goal of self-sustaining target populations. A key objective is to link land use activities with effects on aquatic organisms, where human activities affect watershed inputs leading to changes in important geomorphic properties which in turn alter habitat conditions. Species abundance and population dynamics are linked to these habitat conditions. Our guiding conceptual model addressing the various ecosystem linkages is presented in Figure 2. Most of our attention, however, has been focused specifically on exploring the linkages between changing habitat conditions and the population-level response for all life history stages of the focal species. Our focus in developing the species-specific conceptual model is to use existing data to identify factors that are likely affecting survival at key life history stages. Hypotheses can then be developed to address watershed inputs, geomorphic attributes, and habitat characteristics which may lead to these factors being limiting under current conditions.

Steelhead: The life-history based conceptual model presented here provides a narrative description of the potential density-dependent and density-independent factors affecting each steelhead life stage (Figure 3). The conceptual model is a starting point for exploring available data and developing hypotheses. It is expected that there will be many cases where our general conceptual model does not hold up, requiring subsequent modification to fit the conditions of particular watersheds. The conceptual model and discussion presented here reflect our current understanding based on synthesis and review of existing data, information gained during project implementation, subsequent site visits with academic experts and subcontractors, and conversations with local biologists with knowledge of anadromous salmonids in Sonoma Creek and its tributaries. The studies outlined in Section A4 are designed to provide information necessary to evaluate and refine our conceptual model and to guide management and future restoration activities in the watershed.

Steelhead found in the Sonoma Creek basin belong to the Central California Coast evolutionarily significant unit (ESU) (NMFS 1997), which includes coastal drainages from the Russian River to Aptos Creek, and tributaries to San Francisco and San Pablo bays eastward to the Napa River, excluding the Sacramento-San Joaquin River Basin. This ESU is federally listed as threatened under the Endangered Species Act (NMFS 2000). In the Sonoma Creek basin, records of steelhead distribution indicate the presence of *O. mykiss* in the mainstem and most tributaries. The current extent of anadromous fish access in the watershed is not precisely known, but surveys by SEC in 2003 documented *O. mykiss* in mainstem Sonoma Creek and tributaries throughout the basin (SEC 2004). Important steelhead habitat is currently known to be present in mainstem Sonoma Creek and several tributaries (Leidy et al. 2003, SEC 2002).

Based on late summer surveys, SEC estimates the abundance of rearing juvenile *O. mykiss* in 2002 was greater than 16,000 in the mainstem of Sonoma Creek and three tributaries north of Glen Ellen (SEC 2004). However, there is uncertainty as to how many of these juvenile fish reach maturity and migrate to the Pacific Ocean. Recent fish census data indicates that only about 10% of age 0+ steelhead in the Sonoma Creek basin are surviving to age 1+ (SEC 2004). Although the consistent presence of juvenile steelhead indicates continued natural propagation, survey reports and accounts of long-time local residents have generally indicated a decline in the abundance and distribution of steelhead in the Sonoma Creek watershed (Dawson 2002, Leidy et al. 2003, Dawson 2004). This trend is consistent with the substantial declines reported for steelhead stocks throughout California.

Steelhead can smolt at a variety of ages, but most frequently smolt at ages 1+ and 2+. Therefore, they must spend at least one summer and winter in their natal stream. Steelhead fry tend to establish territories in suitable rearing habitat soon after emergence. The maximum densities of oversummering age 0+ juvenile steelhead that a stream can support are determined by territorial/agonistic behavior, both intraspecific and interspecific with other salmonids when they are present. This behavior results in density-dependent mortality or emigration of juvenile steelhead that do not successfully establish and defend territories. Consequently, the number of age 0+ steelhead that a reach of stream can support is small relative to the average fecundity of an adult female steelhead. For example, in Sonoma Creek the highest density of steelhead reported from 1966-2003 is about 60 fish per 30 meters. An average-size female steelhead might lay 5,500 eggs; if half of these eggs survived to emergence, a single female could fully seed a reach over 1300 meters long at the highest density that has been observed in Sonoma Creek.

Therefore, we would expect that, even with relatively small escapements and high egg mortality, summer habitat will usually be fully seeded with steelhead fry.

Steelhead smolts tend to have much greater survival if they outmigrate as larger age 2+ or age 3+ smolts. Age 1+ smolts may sometimes be common, but they often contribute little to the numbers of returning adults. This differential survival is likely due to the advantages that larger fish, during their first months in the ocen, have in (1) evading predation, either through superior swimming ability or by exceeding the gape size of potential predators, or (2) feeding efficiency. Therefore, production of adult steelhead depends heavily on the amount of habitat suitable for producing age 2+, and to a lesser extent, age 3+ and age 4+ smolts.

In considering steelhead population dynamics, it is important to distinguish between age 1+ smolts and age 1+ downstream migrants, which have different life histories. It is a common life history strategy for juvenile steelhead to migrate downstream in the spring but rear in the estuary for an additional year before smolting. This is true of all age classes of juvenile steelhead but especially common at age 1+. Age 1+ steelhead that rear in the estuary will usually smolt at age 2+ the following spring and, because they may be larger as a result of greater food supply in the estuary, will experience similar if not higher survival to maturity compared with stream-reared age 2+ smolts.

We postulate that juvenile rearing habitat, both summer and winter, is usually more limiting for age 1+ steelhead than for age 0+ steelhead under current and historical (i.e., unaltered) conditions. There may be stream systems or reaches where all available habitat is suitable for both age 0+ and age 1+ steelhead. But even in these cases, the density of age 0+ steelhead that the habitat will support will be higher than for age 1+ steelhead that typically require more space, larger substrate sizes, and greater depth. Age 0+ steelhead can rear in both riffles and pools. Age 1+ steelhead can rear in riffles, but because of the lower risk of predation that greater depth affords, they primarily use pool habitats. Age 0+ steelhead can use shallower habitats and finer substrates (e.g., gravels) than age 1+ steelhead, which, because of their larger size, need coarser cobble/boulder substrate for velocity cover while feeding and escape cover from predators. Because age 0+ steelhead can generally use the habitats suitable for age 1+ steelhead, but age 1+ steelhead can not use shallower and/or finer substrate habitats suitable for age 0+ steelhead, it is unlikely that summer habitat will be in shorter supply for age 0+ than age 1+ steelhead. In situations where summer habitat is suitable for both age classes, competition for space between age 0+ and age 1+ steelhead may restrict the numbers of age 0+ steelhead that the habitat will effectively support. In general, a reach of stream would commonly support far fewer age 1+ than age 0+ steelhead in the summer.

As with summer habitat, a reach of stream will typically support far fewer age 1+ than age 0+ steelhead in the winter. For juvenile steelhead to survive the winter, they must avoid predation and displacement during freshets. Because steelhead tend to spawn in higher gradient reaches (i.e., >3%) with confined stream channels, off-channel water bodies such as sloughs and backwaters are typically rare. Steelhead show a propensity for using in-channel cover provided by cobble and boulder substrates, which are typically common and usually immobile at all but the highest flows in these areas. In watersheds where temperatures become cold (i.e., < 8°C), predation risk becomes much greater because the fish become sluggish and less able to escape predators. Juvenile steelhead will often hide within the substrate (or other cover) during the day, emerging only at night. In colder regions, juvenile steelhead may remain concealed in the

substrate all winter. Refuge from high flows requires a similar type of habitat as concealment cover, but may require access deeper into the streambed to avoid turbulent conditions near the surface or even within first layer of substrate (the implications of embeddedness on availability of winter habitat are discussed in the following paragraphs). Because age 0+ steelhead are smaller and can utilize a wider range of substrate than age 1+ steelhead, it will often be the case that there is more winter habitat available for age 0+ than for age 1+ fish.

In watersheds where, as a result of anthropogenic disturbance, there are increased inputs of coarse and fine sediment to the stream channel and large woody debris is reduced, the disparity between the amount of summer habitat for age 0+ steelhead and age 1+ steelhead is often increased. Pool frequency is reduced with the removal of large woody debris, especially in forced pool-riffle and plane-bed stream reaches. The remaining pools may become shallower as a result of aggradation and the lack of scour-forcing features such as large woody debris. The filling of interstitial spaces of cobble/boulder substrates by gravels and sand can affect summer habitat for both age 0+ and age 1+ steelhead. But because of the larger size and more reclusive nature of age1+ steelhead, their habitat will be reduced at lower levels of embeddedness than for age 0+ steelhead.

Likewise, in the winter, habitat may often become unsuitable for age 1+ steelhead at lower levels of sediment deposition than for age 0+ steelhead. At higher levels of embeddedness, substrate will become unsuitable for both summer and winter rearing, but it will often be more limiting in winter because refuge from displacement during winter freshets typically occurs deeper within the substrate.

We believe it is essential to produce age 2+ or older smolts, and that habitat suitable for producing them (age 1+ summer and/or winter) was historically limiting and, under disturbed conditions, would have become even more so. An important initial focus of an investigation of steelhead population dynamics is to look at the survival of different life stages. For example, if the number of age 1+ steelhead during the late summer is high relative to the number of age 2+ smolts, then an initial hypothesis would be that age 1+ winter habitat is limiting.

Based on the above steelhead conceptual model and existing information on steelhead population structure in the Sonoma Creek basin, we have developed the following hypotheses:

- Either summer habitat or winter habitat for age 1+ steelhead is limiting the number of age 2+ smolts emigrating in spring.
- Restoration helps improve summer and winter rearing habitat for age 1+ steelhead and helps produce more 2+ smolts.
- Removal of migration barriers provides access to habitat capable of producing 2+ smolts.

We believe that habitat- and reach-specific monitoring of anadromous salmonid populations in conjunction with restoration projects in the Sonoma Creek basin will provide important information on the response of these populations to habitat enhancements. In addition to testing the above hypotheses, the proposed monitoring will contribute to knowledge of steelhead population dynamics in other small coastal and estuarine basins. *Sonoma Creek has the potential, due to the level of restoration and monitoring underway or planned, to be an "experimental watershed" where the long term efficacy of steelhead restoration can be tested.* This is especially important in the southern portion of the steelhead range, where runs are especially imperiled and our understanding of the factors limiting their success is lacking. The information obtained will

set the stage for long term monitoring and provide valuable information that is applicable to other streams and rivers in the San Francisco Bay Area and coastal central California streams.

Chinook salmon: Small numbers of adult Chinook salmon (*Oncorhynchus tshawytscha*) have been documented recently in Sonoma Creek (Dawson 2002), but a regular, self-sustaining run of Chinook salmon is not believed to occur in the basin. NMFS believes that fall Chinook salmon found in the neighboring Napa River basin are not self-sustaining and are more likely present on an intermittent basis during periods with favorable stream conditions (NMFS 1999). Restoration and monitoring efforts in the Sonoma Creek watershed have focused on improving habitat conditions and monitoring populations of steelhead. Although monitoring targeted at Chinook salmon is not proposed, we believe that our approach to monitoring steelhead habitat and population response will additionally provide knowledge and experience applicable to future restoration and management beneficial to all salmonids, including Chinook salmon.

A3. Previously Funded Monitoring

Table 1, attached, lists relevant monitoring data at several spatial scales that will be available by fall 2005.

Existing funding for monitoring the restoration projects, generally from CALFED, will be expended by October 2005. This funding will produce limited information: site-scale changes in channel morphology due to construction and visually-estimated salmonid use of the restoration sites. No statistical analysis of the monitoring data is funded, nor any synthesis of the results from the several reaches where restoration occurred. At the time of writing, we have seen only minor topographic changes at the restoration sites. Steelhead and chinook have used most of the enhanced pools to a greater degree than was observed in the project reaches before construction. No fish have been observed above the Asbury fish passage structure. Only one winter has passed since construction for the habitat structures, and two winters for the barrier removal. A longer monitoring period is needed to observe local effects.

A4. Approach and Scope of Work

The tasks reflect nested approach, with each task scaling up from the previous one. Together, the tasks will not merely document the physical fate of each restoration project, but provide information to guide reach- and watershed-scale salmonid recovery efforts throughout the Bay-Delta.

Task 1. Project Management

1.1 Project management: annual presentation to CALFED, 2 newsletter articles to CALFED, semi-annual reports, monthly invoices/reports.
1.2 Subcontract management: Stillwater and other subcontractors (see C. Qualifications).
1.3 Permitting: Section 10 permit from NMFS (see A5. Feasibility).

Task 2. Monitoring Physical Habitat

The purpose of this task to document salmonid habitat conditions in reaches with habitat enhancements (log-and-boulder habitat structures or barrier removal) and in untreated control reaches. The monitoring techniques proposed in this task repeat assessments that were done before restoration projects were implemented, allowing direct observation of changes through time. Reach-scale monitoring provides insight into the habitat characteristics that influence

retention and survival of juvenile salmonids during the winter, how these physical characteristics change following restoration (e.g., response to scouring flow events), and (in combination with later tasks) the response of steelhead populations to physical habitat. This information will be valuable in any future preservation and restoration efforts within this and other watersheds.

2.1 Topographic monitoring

At each restoration site, 3 to 5 cross sections and a longitudinal profile will be surveyed at existing monumented survey locations. During year one, only the habitat enhancements that have not been surveyed since just after construction will be surveyed. During year three, all restoration sites will be surveyed. At the barrier removal site, experienced field personnel will also assess passability during year three, using standard protocols that rate potential barriers based on leap height, water velocity, pool depth, and other factors (CDFG 1998, Part IX; NMFS 2001).

2.2 Habitat monitoring

Physical habitat parameters will be monitored by experienced field personnel during year three in the restoration reaches and control reaches using a CDFG protocol (Flosi, et al. 1998) substantially modified by SEC. SEC has been using and adapting this protocol for 3 seasons. As modified, the protocol records canopy cover, substrate quality for spawning and over-wintering, pool/riffle ratio, pool volume, residual pool depth, incision, Montgomery-Buffington channel classification, channel confinement, invasive plant species, channel dimensions, dominant bank vegetation, vegetation cover at the ground level on the stream banks, and a rating for aquatic shelter/cover).

2.3 Evaluate physical habitat performance measures

Physical habitat data will be tested for several indications of restoration success, as follows:

- ?? Significant net changes at restoration sites before and after enhancement, in channel cross section, width, and depth; pool volume, depth, and area; and shelter/cover.
- ?? Restored reaches have improved shelter ratings, substrate quality, pool volume, and other measurements over their pre-restored condition, and in relation to control reaches
- ?? Barrier removal site achieves a "passable" rating

Task 3. Reach-scale fish monitoring

Quantifying juvenile steelhead abundance and documenting movement from the enhanced (treated) reaches will help determine the success of restoration and barrier removal projects in increasing salmonid production, retention, and survival in these reaches. This will be accomplished with a combination of reach-scale and basin-scale fish monitoring. Reach-scale monitoring is described in this task; basin-scale monitoring is described in Task 4. Reach-scale monitoring data will provide an indication of the relative contribution of each restored habitat unit to overall production in each reach.

The objectives of this task are to (1) document the relative abundance of juvenile steelhead occupying restored (treatment) and unrestored (control) habitats from year to year; (2) document the movement and timing of juvenile steelhead from treatment and control units and correlate these spatial and temporal patterns with streamflow patterns; (3) determine the relative contributions of restored and unrestored habitats to the total number of tagged fish moving downstream; and (4) assess differences in retention and overwintering success of juvenile steelhead of multiple age classes in treatment units compared to control units.

Task 3.1: Juvenile fish sampling and PIT tagging

Juvenile fish sampling will occur annually during the late summer/early fall in streams with restored/enhanced habitats (see Figure 1). A total of 14 enhanced pools and an equal number of untreated control pools will be sampled in Sonoma, Calabazas, and Graham Creeks, for a total of 28 sampled habitat units in these three creeks. In Asbury Creek, sampling will occur at five "treatment" units upstream of the former barrier and five "control" units downstream of the barrier, all randomly selected. Sampling will consist of removing all juvenile salmonids from sample units by multiple passes with one or two backpack electrofishing units (Smith-Root, Model 12). The number of electrofishing units required will be determined by the width of the reach. A crew of three or four people will perform the sampling, depending on whether one or two electrofishing units are required. Sample units will be blocked with nets at the upstream and downstream ends to prevent fish from entering or leaving during sampling. All juvenile salmonids captured will be anesthetized with tricaine methanesulfonate (MS-222) or other suitable methods, counted, and the fork length (FL) to the nearest millimeter and wet weight to the nearest 0.01 g will be measured and recorded.

At each sampled location, all captured salmonids greater than 55 mm FL will be tagged with sterilized 12-mm passive integrated transponder (PIT) tags. Tags will be inserted into the body cavity anterior to the pelvic fin with a 12-gauge hypodermic needle by experienced field personnel. Adipose fins will be clipped on tagged fish to aid identification and estimate PIT tag retention. Fish will be held in covered net pens in the stream channel and examined for mortality, injury, and tag loss before being released where they were captured. Each tag emits a unique signal that will be cross-referenced with the location, date, and fish size and species recorded at the time of tag insertion. The full duplex tags have a detection range of 2 to 3 feet, detectable with hand-held detectors or stationary antennae.

Task 3.2: PIT tag monitoring

Antennae to detect PIT tag signals will be installed at existing culvert or bridge locations in Calabazas, Graham, and Asbury Creeks just upstream of their confluences with Sonoma Creek. On Sonoma Creek, a PIT tag antenna will be installed at SEC's Sonoma Valley Watershed Station, near Glen Ellen. This antenna will be integrated into the fyke trap weir or Vaki fish detection weir (see Task 4). The antenna frame will be incorporated into a culvert structure, or constructed using a framework of 4 x 4 inch posts and 2 x 6 inch joists (Figure 4). Where an antenna framework is necessary, posts will be placed every 10 feet across the stream channel.

After antenna installation, movement of tagged fish will be automatically recorded by the PIT tag antennae and downloaded weekly during the study period. The PIT tag antenna will detect the emigration of individual fish tagged at the treatment and control units. Detection of individually coded tags will facilitate assessment of differential rates of emigration from habitat units with different enhancement treatments and comparison of movement of fish tagged from treatment and control habitats. Locating antennae at the downstream end of tributaries containing restored habitat units will enable us to document movement of tagged fish out of the tributaries. Coupled with outmigrant trapping and additional stationary or handheld PIT tag detector devices at one or more downstream locations on the mainstem (see Task 4), we will also be able to determine whether tagged fish moving out of tributaries remained in the system or emigrated to the estuary.

Task 3.3: Install and monitor stage recorders

Stage recorders (miniTROLL pressure transducers, In-Situ, Inc.) will be installed in Calabazas, Graham, Asbury, and Sonoma Creeks during early fall to record changes in stage during the winter and spring. Installation will coincide with installation of PIT tag detection antennae. Recording intervals of 15 minutes will be used to track rapid changes in stage during winter storms. Stage recorders will be checked monthly to test batteries and prevent/repair damage from high flows or vandalism. Data will be downloaded and batteries changed every 4 months.

Information from the stage recorders and data on fish movement recorded by the PIT tag detectors will be used to correlate fish emigration with winter stream flows. The timing of fish movements will be analyzed in relation to winter flow events, which will be recorded by the stage recorders and correlated with stage/discharge rating curves developed for the study stream.

Task 3.4: Spring fish sampling

Reaches electrofished in late summer/early fall (see Task 3.1) will be resurveyed in the spring prior to the typical smolting period to determine the abundance and location of PIT-tagged fish that have not emigrated or suffered winter displacement or mortality. Hand-held PIT tag detectors will be used to identify tagged fish, and the location and size of fish with PIT tags will be recorded. This will provide an indication of retention and site fidelity and allow correlation with habitat characteristics in individual habitats and stream reaches.

Performance measures

The following performance measures will be used to assess the effects and success of the restoration projects:

- Annual abundance of age 1+ and older steelhead in treated (restored) habitats, as compared with control (unrestored) habitats (i.e., carrying capacity);
- Relative contributions of restored and unrestored habitats to the total number of tagged fish moving downstream; and
- Relative proportion of juvenile steelhead remaining in treated and control habitats following winter high flows.

Correlating the estimates of survival and retention of juvenile salmonids with habitat characteristics in enhanced reaches and unaltered control reaches will help determine the carrying capacity and production potential of the reaches. Reaches with higher levels of survival and retention will serve as models for future restoration and enhancement efforts in the watershed.

Task 4. Monitoring Watershed-Level Success

Task 4.1 Establishing a salmonid population monitoring station

The ultimate goal of salmonid habitat restoration efforts in the watershed is enhancement of salmonid populations. Measuring trends in salmonid production in the watershed via outmigrant monitoring (smolt production) is an appropriate metric for the cumulative benefits of habitat restoration actions. Monitoring at this scale will serve as the basis for regular, long-term monitoring of anadromous salmonid population dynamics. However, total production in the watershed is affected by the number of successful spawners and egg-to-smolt survival rates in the watershed. Because the number of adults returning to spawn is affected by factors outside of

the watershed, the number of smolts produced per spawner (smolt:spawner ratio) is often considered the most appropriate metric or performance measure of the ultimate effectiveness of restoration actions affecting freshwater life history stages. Monitoring of both returning adults and outmigrating smolts is necessary to calculate the smolt:spawner ratio.

Downstream migrant trapping will be conducted in mainstem Sonoma Creek, below the city of Sonoma, at the Leveroni Road bridge. A counting weir will be established that will concentrate fish moving upstream and downstream, directing them through a Vaki RiverWatcher fish counting device and associated digital camera (http://praquasupplies.com/river_wacher.htm). The objective is to document the size of the steelhead and Chinook runs in much of the watershed. A key advantage of the proposed automated counting facility is that it avoids handling of fish, which is required under other standard methods such as outmigrant trapping.

The Vaki RiverWatcher uses an infrared light beam to record the length and height of each fish passing upstream or downstream, and the date, time, and water temperature. A coupled digital camera will be installed for identifying the species of fish passing the unit, verifying direction of movement, and to see if the Vaki is biased against detection of any size classes or species of fish. To maximize the information gained from PIT-tagging of juveniles proposed under Task 3, PIT tag interrogators will be used in conjunction with the Vaki unit. This will allow us to monitor outmigration of fish from the reaches and sites studied under Tasks 2 and 3. Comparison of outmigration rates of PIT-tagged fish at this trap with passage of tagged fish at the PIT tag antennae in each upstream tributary (described in Task 3) will enable us to determine if fish moving downstream from tributaries are emigrating to the ocean or remaining in the basin to rear. All methods (Vaki, digital camera, and PIT) will be used to estimate the number of returning and outmigrating steelhead and Chinook. Figures 4-6 illustrate these methods currently being conducted by Stillwater on the McKenzie River, Oregon.

This task is a pilot study, which, if successful, will demonstrate cost-effective methods for long-term, non-intrusive monitoring of salmonid population trends. Sustained detection of returning tagged fish from different habitat units or tributaries could be used to assess the relative contributions of restoration sites, control sites, or tributaries to overall salmonid production.

4.2 Calibration of Outmigrant Monitoring Methods

The effectiveness of the Vaki-camera-PIT automated counting facility in measuring outmigration will be tested by comparing outmigrant counts with fish trapped just downstream in a standard outmigrant trap (fyke net) (Figure 7). We will conduct at least four trials, each running for at least two days, to test and calibrate the automated counting facility. This can include testing the detection success of PIT-tagged fish by comparing counts of tagged fish at the downstream migrant trap with a handheld PIT tag detector with detections at the automated array.

4.3 Stream Temperature Monitoring

Monitoring water temperature throughout the stream network provides valuable information for (1) assessment of potentially lethal or sublethal acute or chronic high temperatures during the warm summer months, (2) future stream temperature modeling which could detect cumulative effects of land management and riparian restoration actions on stream temperature, and (3) bioenergetic assessment of juvenile growth potential throughout the year. Although some stream temperature data were previously collected at selected stations during summer months during 1998-2002, we propose to expand on these data by installing year-round temperature recorders

(Optic TidBits or equivalent devices) at a minimum of 20 stations, including 6-8 sites on Sonoma Creek and 2-3 sites on each of several important tributaries (e.g., Calabazas, Asbury, Graham, Stuart, Carriger Creeks). Data will be downloaded twice per year, for a minimum of two years.

Performance Measures

Performance measures will build on those identified in Task 3, and will include:

- ?? Number of smolts produced per spawning female (estimated using outmigrant and returning adult counts)
- ?? Number of returning adults and outmigrants. We expect to see an increasing trend over time if habitat restoration has been successful, although ocean conditions and harvesting may obscure or counter trends due to freshwater habitat conditions.
- ?? Number of age 2+ outmigrant steelhead or increase in mean size of outmigrants. We expect the number of outmigrating 2+ fish to increase with successful restoration of overwintering and summer rearing habitat for older/larger juveniles.
- ?? Steady or decreasing trend in summer water temperatures. Various metrics may be used, such as MWAT or number of days exceeding various temperature thresholds.

Task 5. Data Management, Analysis & Writing, and Review

5.1 Data Management

Data collected by hand (i.e., non-digital) in the field will be recorded on standardized data forms developed for each monitoring task. Field data will be entered into computers at SEC or Stillwater within two days of collection. A database application will be developed to control data entry and quality. Data will be stored in geodatabases to enable GIS analysis and relational queries. Data will be stored at SEC by SEC's GIS/Information Services program, made available to project staff, and integrated with other biophysical data from the region when the data is final. All efforts will be used to employ standard data models and attributes to enable integration with other datasets. In particular, we plan to work with the Interagency Ecological Program (IEP). Please see A7. Data Handling, Storage, and Dissemination for more details.

All data collected will undergo standard QA/QC procedures before being entered into the project database and the originals archived. This process includes review of field data forms and notes by field crew personnel, an independent check of data entry to ensure accuracy, and creation of working and back-up copies of original data forms to eliminate possible loss of or tampering with original data. Much of the data collected will be in digital form, downloaded from automated devices (PIT tag detectors, Vaki fish detectors, and pressure transducers) for direct digital storage on computer hard disks with regular backup. This type of data is less susceptible to human transcription error. Standard QA/QC and archiving procedures will nevertheless be used to ensure data are tracked and maintained securely.

5.2 Analysis & Writing

Working together, scientists and specialists at SEC and Stillwater will reduce and analyse the monitoring data, and produce a draft report summarizing the findings and discussing whether and how the performance measures described in the previous tasks were achieved. See A6. Expected Outcomes and Products for more details on the content of the final report. Analysis will produce standard descriptive metrics (e.g., juvenile abundance, movement frequency). Statistical techniques will be appropriate for a multiple paired-study design (i.e., treatment-control).

5.3 Review

At least 3 qualified reviewers will provide detailed input on the draft report, for integration into the final report.

Task 6. Public Involvement and Outreach

6.1 Outreach to Residents in Study Reaches

Sonoma Valley is largely privately owned, so most ecosystem restoration depends on the goodwill of landowners. It is essential, therefore, to educate the local public of the reason for the proposed monitoring, to provide full disclosure of monitoring activities, and to bring the findings back to inform the residents. SEC will hold a workshop/meeting with residents on each stream reach (4 in all), at least 10 smaller meetings with residents, and conduct at least 2 written communications with residents on each reach/tributary to keep them informed of the project's progress. SEC will also keep its confidential database of landowners' and residents' concerns, interests, and agreements up to date.

6.2 Sharing the Findings

Many decision-makers, at several levels, will benefit from learning from the results of this project. These include Sonoma County Water Agency, researchers, state natural resource and water quality agency personnel, conservation and watershed groups, and the general public. Therefore, SEC will publicize the project's methods and findings on its website, in at least 2 online databases (see A7. Data Handling, Storage, and Dissemination for more detail), in at least 3 informational talks for the local general public, in a peer-reviewed journal article, and in annual presentations to CALFED.

A5. Feasibility

Permits

This project requires a Section 10(a)(1)(A) permit for research and scientific purposes from NMFS. SEC's previous work that involved handling listed fish species has been done with partners who had Section 10 permits (CDFG and Entrix, Inc.). SEC submitted an application for a Section 10 permit in 2003. Now that a freeze on issuing permits has been lifted (Leah Mahan, NMFS Santa Rosa office), SEC expects to have it in hand by the time this grant starts. Stillwater Sciences will also apply for a Section 10 permit. During the first year of fieldwork Stillwater and SEC staff will be together during all work that involves handling fish, so either permit will suffice. If there are unforeseen delays in both permit applications, SEC will hire Entrix, Inc. to lead fieldwork until SEC's permit is granted.

Permissions

Signed agreements for access and monitoring from all landowners of restoration projects to be monitored can be viewed at www.sonomaecologycenter.org/research/ERP.

For reach-scale monitoring, we will be accessing approximately 100 private properties. SEC has conducted several rounds of fieldwork on these reaches in the last four years, and has had 75% to 95% success obtaining permission for access, which is more than sufficient to accomplish the proposed work. SEC will renew its existing access agreements—too numerous to attach—as needed. Between the time of writing and the grant start date, SEC will be working intensively

under an existing grant with landowners throughout the Sonoma Creek reach, which will reduce outreach costs. Obtaining and maintaining permission for access to private property is an ongoing, time-consuming process, although each negotiation presents an excellent opportunity for outreach and education about the project.

The locations for PIT tag antennae and downstream migrant trap are on property of Sonoma Developmental Center and Sonoma County. At the Developmental Center, we already have permission for stream monitoring equipment that has been in place for four years. Sonoma County has been a steady partner with SEC in making county roads and road crossings more fish-friendly, but they do not sign agreements in advance of funding. We do not anticipate any problems or delays with these public landowners.

We are not aware of any third party impacts of the proposed work.

A6. Expected Outcomes and Products

Information obtained from the proposed monitoring will be summarized in a final project report at the end of year 3. The report will include (1) background information on current and historical conditions in the basin, (2) review of all hypotheses developed during this effort and previous studies, (3) a summary of the conclusions regarding each hypothesis (i.e., rejected, accepted, or uncertain) and the level of uncertainty associated with these conclusions, (4) conclusions regarding the most important factors currently limiting steelhead populations and general aquatic ecosystem integrity, (5) recommendations regarding specific ecosystem-based restoration strategies for the watershed, and (6) guidance and recommendations for additional long-term monitoring and adaptive management needs in the basin that should be part of the ongoing stakeholder process for watershed restoration.

We also propose an extensive effort to share the results of this project, because the information it collects is so relevant to restoration decision-making. From talks with local landowners to online presentation of detailed datasets, Task 6 discusses several information products from this project.

A7. Data Handling, Storage, and Dissemination

Field data will be entered into computers at SEC or Stillwater within two days of collection. A database application will be developed to control data entry and quality. Data will be stored at SEC by SEC's GIS/Information Services program.

All efforts will be used to employ standard data models and attributes to enable integration with other datasets. In particular, we plan to work with the Interagency Ecological Program (IEP) to organize, store, and make available this project's data. At IEP, data from this project will be combined with a large number of other analytical and biological data, using standardized naming conventions, normalization, geo-referencing and common units. The data will be accessible through a stand-alone interface allowing researchers to query for a full range of potential dependent and independent variables. IEP will also integrate this project's data with many other datasets needed to conduct research and develop indicators relevant to the ecology of the Bay-Delta. Data integration can resolve the ambiguities associated with multiple sources and dramatically reduce the time needed to prepare data for analysis. An integrated database system can substantially save staff time and improve productivity.

Data will be documented and the metadata contributed to the California Spatial Information Library, where users will be instructed to access the data through the new San Pablo Bay

Watershed Information System (currently at www.migcom.com/sanpablo, planned future URL of www.sanpablobay.org). The Watershed Information System will present the data in context with data and information from the San Pablo Bay watershed, to enable viewing and querying by the public. Publicly accessible presentations of the data will hide landowner addresses and identities unless the landowner gives consent. We will also make our data available through CalFish, another online multi-agency data library, and the Natural Resource Projects Inventory.

A8. Public Involvement and Outreach

SEC is a local, community-based nonprofit in a watershed where 85% of the land area is privately owned. We are acutely aware of the need to work alongside the public in every aspect of our activities. SEC enjoys excellent relations with local and regional press, city and county government, and landowners and residents. Task 6 describes methods for sharing the purpose and findings of this project with an array of audiences.

A9. Work Schedule

This is a three-year proposal. The work schedule assumes a time period of November 2005 to November 2008. Milestones by year are listed in the attached Table 2. Tasks 1, 5, and 6 are necessary to accomplish any of the objectives of this proposal. Tasks 2 through 4 all collect information that is currently lacking in the Bay-Delta. Any combination of Tasks 2, 3, and 4 would yield useful information, but we feel that all three are necessary to understand the effects of restoration efforts on steelhead populations. If the full cost of this project cannot be funded, it is possible to eliminate one year of Task 3 and/or Task 4. If further cuts are desired, individual monitoring tasks could eliminated from the whole project.

B. Applicability to CALFED Bay-Delta Program ERP Goals, the ERP Draft Stage 1 Implementation Plan, and CVPIA Priorities

B1. ERP and CVPIA Priorities

ERP Draft Stage 1 Implementation Plan

This work addresses Strategic Goal 1: At-Risk Species. It helps "achieve recovery of at-risk native species," namely steelhead, Chinook salmon, and California freshwater shrimp, by improving the science of fish habitat restoration. The Plan acknowledges the uncertainties in this science. It calls for at-risk species assessments such as those proposed here, "to improve the understanding of the ecological and physical processes affecting at-risk fishery resources."

ERP Priorities for the Bay Region

This project addresses priority BR-5, the need to restore habitats for at-risk species, and, most strongly, priority BR-8, to "use monitoring, evaluations of existing monitoring data, and new investigations to develop improved strategies for restoration Bay fish populations and at-risk species." In Sonoma Valley, at-risk species benefiting from proposed work include freshwater life stages of steelhead, Chinook salmon, and California freshwater shrimp.

Ecosystem Restoration Program Plan, Volume I

Volume I speaks extensively about a vision for restoring Central Valley steelhead, whose spawning and rearing habitats have suffered the same impacts as those in the Sonoma Creek watershed. A short-term objective is to "develop and implement restoration measures and

protections that have a relatively high degree of certainty of increasing number and size of naturally spawning populations." (p. 233) This proposal directly addreses this objective.

"The widespread distribution of steelhead in the Central Valley, the relatively small size of populations in each tributary, and fundamental differences in life history and metapopulation dynamics compared to other listed species all suggest that steelhead monitoring will need to be broader in scope, and longer in duration than for other species." (p. 241) This proposal is highly compatible with the CMARP/IEP Steelhead Project Work Team's monitoring program.

Ecosystem Restoration Program Plan, Volume II

Restoration in Sonoma Creek watershed benefits all species and life-stages using the San Pablo Bay. "All Central Valley anadromous fish pass through the North Bay and rely on it for some stage of their lives... The health of the North Bay affects the health of Sacramento/San Joaquin watersheds and their salmonid populations." (Vol. II, p. 142). Proposed work provides essential additions to "existing region-specific monitoring data on fishes, aquatic ecosystems, wetland communities, and water quality for North Bay..." (BR-8).

ERP Multi-Region Priorities

This project addresses MR-6: "developing conceptual understanding and models that cross multiple regions." Many CALFED watersheds have similar limiting factors affecting their salmonids. Few watersheds in the Bay-Delta, and fewer in the San Francisco Bay watershed, have installed many of the common restoration projects proposed for monitoring here. None, to our knowledge, has tracked the success of such projects over time at multiple spatial scales. Because many watersheds are moving towards these types of installations, the time is ripe to evaluate their effectiveness, in a watershed where cause-and-effect relationships are likely to be applicable throughout much of the Bay-Delta. Not only CALFED, but also CDFG, NOAA, and SWRCB are funding these types of installations.

Multi-Species Conservation Strategy

This proposal improves understanding of "instream flow requirements for salmonids of all ages" and conducts "comprehensive monitoring and assessment" for species of concern.

B2. Relationship to Other Ecosystem Restoration Actions, Monitoring Programs, or System-wide Ecosystem Benefits

The knowledge gained from the proposed monitoring activities will help scientists and resource managers in other Bay-Delta tributaries develop restoration actions to enhance winter velocity refugia and winter and summer rearing habitat for steelhead, and help better assess the potential benefits of barrier removal. Salmonid production areas in the Bay-Delta are the target for restoration funding from CALFED and many other sources. The monitoring proposed here is essential to adaptively manage this region-wide effort to restore the source of the Bay-Delta's salmonids.

Section A6. Data Handling and Task 6 describe in detail the multiple ways information gained during this project will be extensively shared with other fishery and watershed monitoring programs, including IEP, NRPI, CaSIL, CalFish, and others.

B3. Additional Information for Proposals Containing Land Acquisition—NA

C. Qualifications

Sonoma Ecology Center

The Sonoma Ecology Center (www.sonomaecologycenter.org) was founded in 1990. It is a 501(c)3 nonprofit with the mission of working toward sustainable ecological health in the Sonoma Valley through research, education, restoration, and preservation. Particularly since 1996, we have focused on fisheries and water quality in Sonoma Valley. We coordinate with watershed management efforts across the state. We have administered approximately $5 million in grants. Most of the proposed tasks will take place at SEC's Sonoma Valley Watershed Station on Sonoma Creek near Glen Ellen. The Station is a research and education facility with 5,000 sq. ft. of office, lab, and classroom space. Key personnel for this project include the following:

Elisabeth Micheli, PhD
Dr. Micheli has over 15 years experience in the fields of river and watershed planning and restoration. She completed her Ph.D. research on the effect of riparian vegetation on river migration rates in 2000 at UC Berkeley. Her post-doctoral research focused on cut-off dynamics of the Sacramento River. Her most recent research has been on factors limiting salmonids in the Sonoma Creek watershed under the supervision of Professor Bill Dietrich, UC Berkeley and in collaboration with Stillwater Sciences. She has over six years of experience working for USEPA Region IX and the San Francisco Bay Water Quality Control Board. She is the Program Director for Research and Restoration at the Sonoma Ecology Center. Selected publications:

Leidy, R.A., Fiedler, P.L. and Micheli, E.R. 1992. Is wetter better? Bioscience, 42(1): 58-62, 65.

Micheli, E.R. 1994. River and watershed planning: the San Luis Rey River case study. US Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. 114pp. EPA/600/R-94/213.

Kondolf, G.M. and Micheli, E.R. 1995. Evaluating stream restoration projects. Environmental Management, 19(1):1-15.

Micheli, E.R. (ed) In press. Limiting Factors Analysis, Sonoma Creek Watershed. Prepared for the San Francisco Bay Regional Water Quality Control Board with Professsor Bill Dietrich (UC Berkeley) and Stillwater Sciences.

Rebecca Lawton
Ms. Lawton has 14 years of experience in environmental consulting and geology. As a manager, she supervises large and small projects with complex goals, multiple funding sources, diverse partners, and numerous staff and interns. She has many years of focused experience in interpreting fluvial and sedimentary processes and analyzing depositional environments. As an author and editor, she has written countless technical documents. Education: Master of Fine Arts, Mills College, Oakland, California, 1993; Bachelor of Science, Earth Sciences, University of California, Santa Cruz, 1976. Special Training: Application of Basic California Hydrology, University of California, Berkeley, Extension; Natural Channel Design Principles and Applications, International Erosion Control Association; Construction Site Planning and Management for Water Quality Protection, Friends of the San Francisco Estuary. SEC reports include:

2004. Stream Stewards Project: A Five-Year Report of Volunteer Monitoring. Prepared with Michelle Orme and Lisa Micheli.

2004. Turbidity and Sediment Monitoring: HY 2002 through 2004, Sonoma Creek Watershed, California. Prepared with Victor Flores.

2002. Final Report, Volunteer Monitoring of Suspended Sediment Concentration and Turbidity and Watershed Monitoring of Road Remediation in Annadel State Park, Sonoma Creek Watershed, Sonoma County, California. Prepared with Rich Hunter and Jeanna Menze.

Deanne DiPietro
Ms. DiPietro has 10 years experience in environmental data management and information technology solutions. At the California Resources Agency's CERES Program and the UC Davis Information Center for the Environment, Ms. DiPietro led the development of data management systems intended for multiple users with the goal of consolidating and integrating the data at the regional scale. As GIS/Information Services Manager for SEC, she works with regional and national partners in the digital library and geographic information systems community. Relevant publications include the California Weed Mapping Handbook (Schoenig, et al.; 2002), and works on remote sensing of invasive plants using hyperspectral data analysis. Education: B.S., Botany, University of California, Davis, 1984. M.A., Geography; UC Davis, 2002.

Caitlin Cornwall
Ms. Cornwall is SEC's Assistant Director. Since 1997, she has managed technical programs at SEC, providing scientific oversight and quality control. Her experience spans consulting work in wetland and riparian assessment and restoration; academic research on the ecology, hydrology, and geomorphology of streams and riparian plant communities; and conservation biology and project management. Education: M.S., Arizona State University, plant biology.

Restoration specialists
Field crews will consist of four SEC staff (Will Pier, Michelle Orme, Chris Katopothis, and Victor Flores), each of whom have experience through their work at SEC in geomorphological assessment, stream surveying, habitat assessment, snorkeling, and data handling. They also regularly attend workshops and trainings on fisheries ecology and field techniques. These staff will be thoroughly trained by Stillwater Sciences, CDFG, and NOAA Fisheries in additional protocols involving the handling of salmonids. In years two and three, SEC staff will conduct most fieldwork on their own, and supervise dedicated, trained volunteers.

SEC will administer the grant and be the point of contact. SEC will subcontract to Stillwater Sciences, Berkeley, California. We have worked recently with Stillwater on a Limiting Factors Analysis for steelhead in the Sonoma Creek watershed (SEC 2004). Stillwater will oversee statistical design, teach and supervise SEC staff in the first season of each type of monitoring, provide technical oversight for monitoring fieldwork, take the lead on Tasks 3 and 4, collaborate on analysis, co-write the draft and final reports, and facilitate peer review.

Stillwater Sciences

Stillwater Sciences specializes in scientific approaches and technologies for environmental problem-solving in aquatic and terrestrial ecosystems (http://www.stillwatersci.com/). Stillwater has experience in a variety of studies of salmon ecology on numerous rivers in Northern California and the Pacific Northwest, including limiting factors analysis for salmon and steelhead populations, salmonid population modeling, salmon redd superimposition, fry emergence, juvenile temperature tolerance, and juvenile outmigration. Recent projects in the San Francisco Bay-Delta and coastal central California include a watershed analysis and anadromous salmonid limiting factors analysis in support of TMDL development in the Napa River basin, a steelhead limiting factors analysis in Stevens Creek, Santa Clara County, and a limiting factors

analysis and population modeling for coho salmon and steelhead in Lagunitas Creek, Marin County.

Frank Ligon, M.A. Mr. Ligon is an aquatic ecologist and geomorphologist specializing in investigations of the role of fluvial processes and morphology in the ecology of stream fish, invertebrates, and plant communities. Mr Ligon was the project director and lead aquatic scientist for the Napa River Basin Limiting Factors Assessment. He has served as lead scientist, project director or project manager for many of Stillwater's projects that have focused on limiting factor assessment, watershed analysis, and river and watershed restoration.

Bruce Orr, Ph.D. Dr. Orr has over 20 years of experience in population and community ecology of aquatic, terrestrial, and wetland environments in the western United States. His areas of technical expertise include natural resources inventory and management planning, wetlands and freshwater ecology, aquatic entomology, and flora and vegetation of the western United States. Dr. Orr was the project manager for the Napa River Basin Limiting Factors Assessment, and is currently the project director on a steelhead limiting factors assessment in Stevens Creek, Santa Clara County and a coho, steelhead and California freshwater shrimp limiting factors assessment in Lagunitas Creek, Marin County.

Sharon Kramer, Ph.D. Dr. Kramer has over 20 years of experience in aquatic ecology and fisheries biology. Since 1994 her primary focus has been on Pacific salmon and the Endangered Species Act (ESA).

Peter Baker, Ph.D. Dr. Baker has over 15 years experience in applications of mathematics and statistics to fisheries biology. He has extensive experience with chinook salmon populations of Central California; population modeling for other salmonid species, including steelhead; and stream temperature modeling.

A.J. Keith, M.A. Mr. Keith is an ecologist and project manager with over 12 years of experience in aquatic and terrestrial ecology. He specializes in sustainable resource management and conservation planning in freshwater aquatic and forested ecosystems and is currently project manager for the Stevens Creek limiting factors study.

Matt Sloat, M.S. Mr. Sloat is an aquatic ecologist with 7 years of experience in various research projects involving anadromous fish, resident salmonids, and large river fish communities. Mr. Sloat's current work includes watershed-scale limiting factors analyses for threatened stocks of anadromous salmonids in coastal and Central Valley rivers of California. He is the fisheries task leader for Lagunitas Creek coho and steelhead limiting factors studies.

Ethan W. Bell, M.S. As a fisheries biologist, Mr. Bell currently works on several large-scale hydroelectric and watershed assessment projects in the Pacific Northwest. He is instrumental in coordinating and managing field study projects, analyzing collected field data, implementing reference models in the field, as well as researching and writing reports and proposals. He has extensive experience in mark-recapture, PIT-tagging, and outmigrant trapping of salmonids in streams of Northern California and the Pacific Northwest.

SEC will also subcontract to Tessera Consulting, Watershed Sciences, and EME Systems for limited assistance with surveying, geomorphology, and instrumentation, respectively. We have worked with these firms repeatedly and feel confident in their skills and their familiarity with local conditions.

D. Cost

D1. Budget—see online forms

Tasks 1, 5, and 6 are necessary to accomplish any of the objectives of this proposal. Tasks 2 through 4 all collect information that is currently lacking in the Bay-Delta. Any combination of Tasks 2, 3, and 4 would yield useful information, but we feel that all three are necessary to understand the effects of restoration efforts on the steelhead population.

D2. Cost sharing

We have identified $100,000 of committed cost share and $492,400 of pending cost share that will be available during the grant period. Additional sources of cost share will be identified by the time the grant begins, and others will become available during the project. Cost share sources are detailed in the Budget Summary form.

D3. Long-term funding strategy

SEC and others will continue to find funding for watershed-scale and project-scale monitoring in the Sonoma Creek watershed. SEC will be present indefinitely, working on its mission of sustainability in the watershed. Likely local funding sources include Sonoma County, which is pursuing a groundwater management plan for the Sonoma Valley groundwater basin, and a north bay, north coast, or baywide Integrated Regional Water Management program.

E. Compliance with Standard Terms and Conditions

SEC has read the terms of standard ERP grant agreements, as described in the PSP's attachments, and is willing and able to comply with them.

G. Literature Cited—see attachment

H. Nonprofit Verification—See IRS letter at www.sonomaecologycenter.org/research/ERP.

G. Literature Cited

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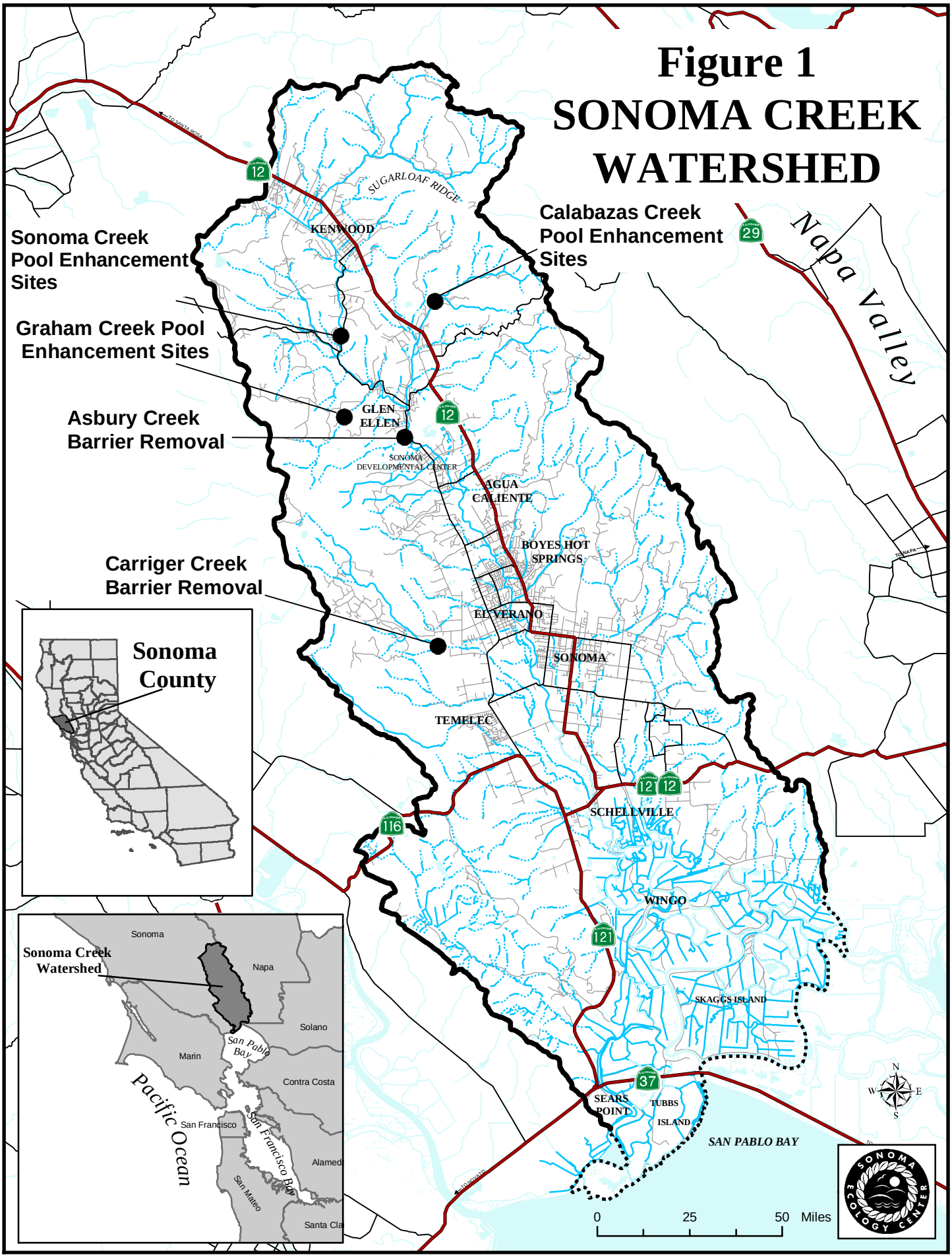
Figure 1
SONOMA CREEK WATERSHED
Sonoma Creek Pool Enhancement Sites
Graham Creek Pool Enhancement Sites
Asbury Creek Barrier Removal
Carriger Creek Barrier Removal
Calabazas Creek Pool Enhancement Sites
SUGARLOAF RIDGE
KENWOOD
GLEN ELLEN
SONOMA DEVELOPMENTAL CENTER
AGUA CALIENTE
BOYES HOT SPRINGS
EL VERANO
SONOMA
TEMELEC
SCHELLVILLE
WINGO
SKAGGS ISLAND
SEARS POINT
TUBBS ISLAND
SAN PABLO BAY
Napa Valley
Sonoma County
Sonoma Creek Watershed
Sonoma
Napa
Solano
Marin
Contra Costa
San Francisco
Alameda
San Mateo
Santa Cla
San Pablo Bay
San Francisco Bay
Pacific Ocean
0 25 50 Miles
SONOMA ECOLOGY CENTER

Table 1. Summary of relevant monitoring data that will be available by fall of 2005.

Scale	Data	Sonoma (habitat)	Calabazas (habitat)	Graham (habitat)	Asbury (barrier)
At resto-ration sites	Longitudinal profile, 3 to 5 cross-sections. As built: After first winter:	 7 of 7 pools 4 of 7 pools	 4 of 4 pools No	 2 of 3 pools No	 Yes Yes
	Visual fish counts after construction	Since 2003	Since 2003	Since 2003	Since 2002
	Monumented photopoints	Since 2003	Since 2003	Since 2003	Since 2002
Reach/ tributary	Geomorphological assessment	2004	2004	2004	2004
	Benthic macroinvertebrates	2002, 2003, 2005	2002, 2003, 2005	2002, 2003, 2005	No
	CDFG habitat survey	1996, 2002	1996	1996	1996
	Summer low flow	2 years	2 years	2 years	No
	Storm suspended sediment sampling	4 years, contin-uous	2 years, grab samples	1 year, grab samples	2 years, grab samples
	Fish census	2003	No	No	No
	Stage-discharge relationship	Yes	Yes	No	Yes
Water-shed	Streamflow gage mid-mainstem, with a record from 1955-1981, 2001-present				
	Sediment source analysis				
	Digital, searchable archive of historical ecology (CDFG records, stream maps, fish- and stream-related newspaper articles and oral histories, drainage network changes)				

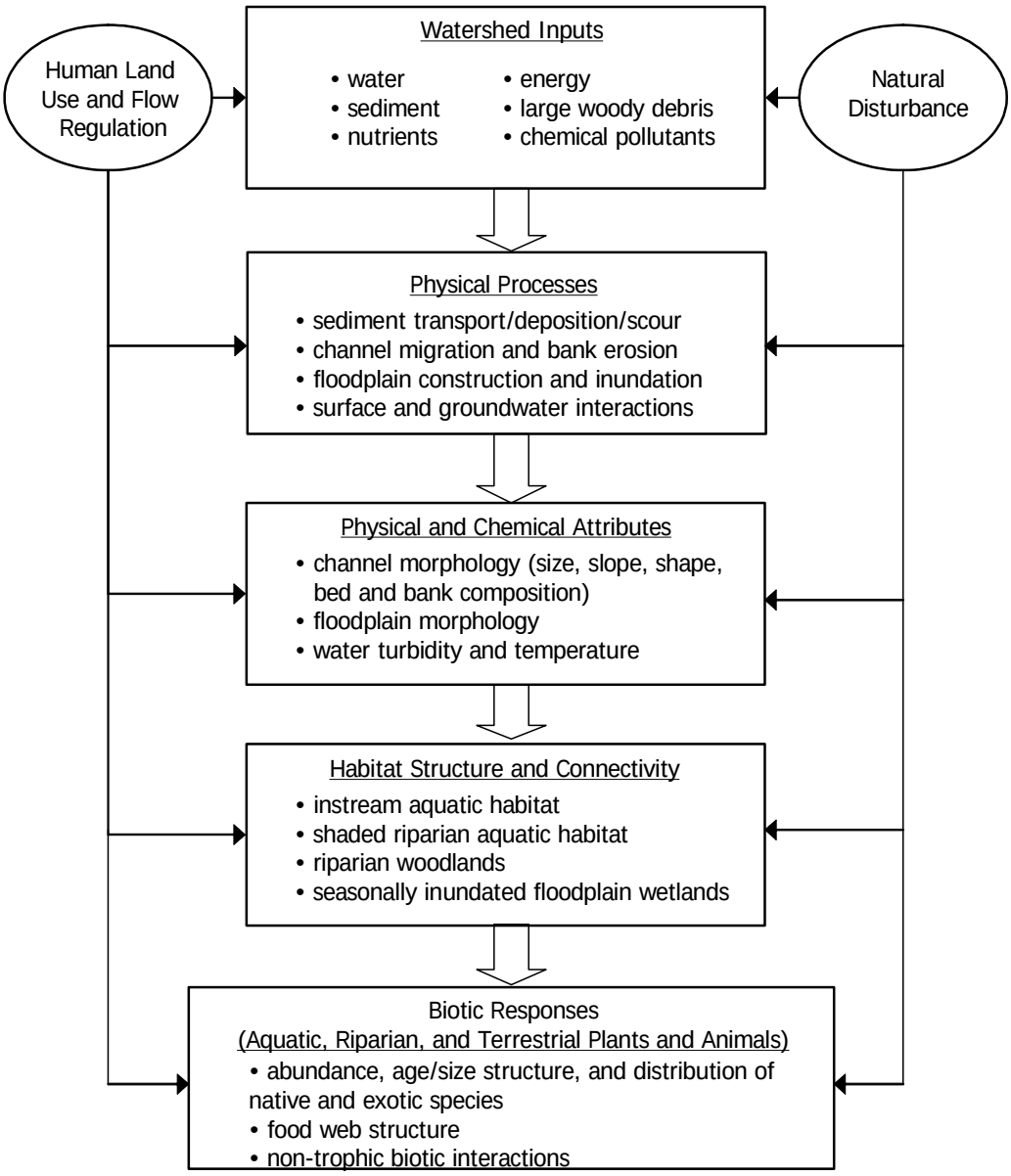

Figure 2. A simple conceptual model of the physical and ecological linkages used in developing biotic response indices of river ecosystem health.

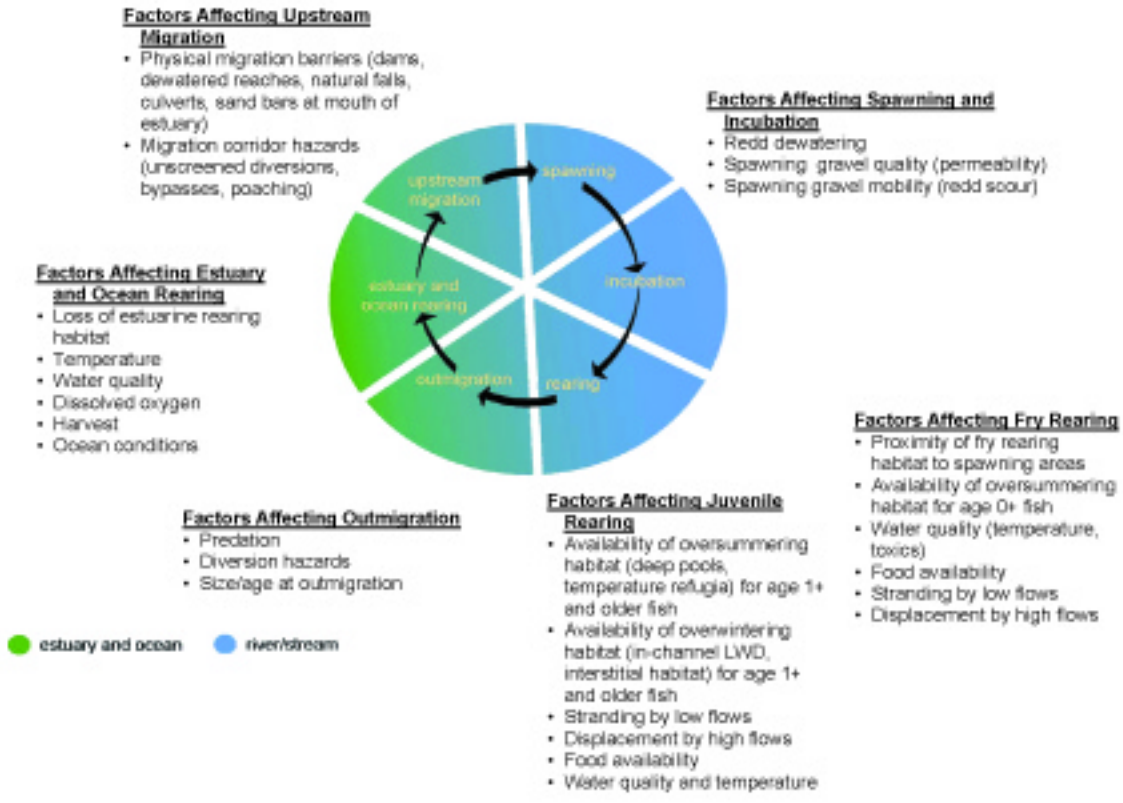

Figure 3. Steelhead life cycle and potential limiting factors in the Sonoma Creek watershed.

Figure 4. Example of structure for PIT tag detection antenna.

Figure 5. Alaska-style weir with Vaki fish detector, McKenzie River, Oregon.

Figure 6. Underwater video image of Vaki fish detector in place, with Alaska-style weir. The Vaki RiverWatcher uses an infrared light beam to record the length and height of each fish passing upstream or downstream, and the date, time, and water temperature. A coupled digital camera will be installed for identifying the species of fish passing the unit, verifying direction of movement, and to see if the Vaki is biased against detection of any size classes or species of fish. More information can be found online at: http://praquasupplies.com/river_wacher.htm.

Figure 7. Fyke net used for outmigrant trapping.

Table 2. Schedule of project milestones, by year.

Year 1 Milestones, November 2005 to November 2006

Task 1: Complete subcontract with Stillwater, obtain Section 10 permit, report to CALFED.
Task 2: Monitor restoration sites.
Task 3: Monitor restoration reaches and controls, with Stillwater providing substantial oversight.
Task 4. Monitor at watershed level, with Stillwater providing substantial oversight.
Task 5: Establish data management structure.
Task 6: Maintain or initiate contact with residents on monitored reaches through onsite meetings and a mailing.

Year 2 Milestones, November 2006 to November 2007

Task 1: Make presentation to CALFED, submit newsletter article to CALFED.
Task 2: No work.
Task 3: SEC oversee fish monitoring, with Stillwater available for guidance.
Task 4. SEC oversee watershed level monitoring, with Stillwater available for guidance.
Task 5: Manage data, coordinate with similar leading efforts in the region.
Task 6: Maintain or initiate contact with residents on monitored reaches by phone, email, and impromptu meetings in the field.

Year 3 Milestones, November 2007 to November 2008

Task 1: Manage grant, report to CALFED, make presentation to CALFED, submit newsletter article to CALFED.
Task 2: Monitor restoration sites.
Task 3: SEC oversee fish monitoring, with Stillwater available for guidance.
Task 4. SEC oversee watershed level monitoring, with Stillwater available for guidance.
Task 5: SEC and Stillwater work together to analyse data, write draft report, get peer review, and write final report.
Task 6: Communicate findings to several audiences as described in Task 6.

Tasks And Deliverables

Does It Work? Measuring the success of salmonid habitat restoration at multiple scales

Task ID	Task Name	Start Month	End Month	Deliverables
1.1	Project Management	1	36	Annual presentation 2 newsletter articles Semi-annual and reports Monthly invoices/reports
1.2	Subcontract Management	1	32	Copy of signed subcontracts
1.3	Section 10 permit	1	12	Copy of permit
2.1	Topographic Monitoring	3	35	Metadata Data accessible via at least 2 relevant regional databases
2.2	Habitat Monitoring	3	35	Metadata Data accessible via at least 2 relevant regional databases
2.3	Physical Habitat Analysis	24	35	See 5.2
3.1	Juvenile fish sampling, PIT tagging	1	35	Data accessible via and compatible with at least 2 relevant regional databases
3.2	PIT tag monitoring	1	35	Data accessible via and compatible with at least 2 relevant regional databases
3.3	Stage recorders	3	35	Data accessible via and compatible with at least 2 relevant regional databases
3.4	Spring fish sampling	5	30	Data accessible via and compatible with at least 2 relevant regional databases
4.1	Population monitoring station	1	35	Data accessible via and compatible with at least 2 relevant regional databases

4.2	Calibration of population monitoring	1	35	Data accessible via and compatible with at least 2 relevant regional databases
4.3	Temperature monitoring	1	35	Data accessible via and compatible with at least 2 relevant regional databases
5.1	Data Management	1	35	Data accessible via and compatible with at least 2 relevant regional databases
5.2	Analysis &Writing	24	35	Draft Final Draft
5.3	Review	30	35	At least 3 qualified reviews
6.1	Outreach to residents	1	35	Workshop/meeting with residents on each stream reach (4 in all) At least 10 smaller meetings with residents At least 2 written communications with residents on each reach/tributary Confidential database of landowners' and residents' concerns, interests, and agreements
6.2	Sharing findings	18	35	Web publication of findings on SEC website and at least 2 others such as NRPI Data submitted to at least 2 regional/statewide databases such as CalFish and IEP Findings presented to at least 3 regional decisionmakers such as Sonoma County Water Agency, CDFG, CALFED, and SWRCB regional staff Conduct 3 evening informational talks for local public. One pier viewed journal article, published.

Comments

If you have comments about budget justification that do not fit elsewhere, enter them here.

Budget Summary

Project Totals

Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
$288,967	$63,576	$619	$1,000	$320,898	$90,475	$0	$0	$765,535	$44,789	$810,324

Do you have cost share partners already identified?
No.

If yes, list partners and amount contributed by each:

These are amounts that will actually be available during the grant period. SWRCB Coastal Nonpoint Source program, $25,000, for landowner outreach and stream restoration planning on Sonoma Creek. Department of Conservation/CALFED Watershed Program, $15,000, for watershed coordinator. SWRCB Coastal Nonpoint Source program, $45,000, for monitoring base flow, benthic macroinvertebrates, and suspended sediment. SWRCB Coastal Nonpoint Source program, $15,000, for sediment source analysis.

Do you have potential cost share partners?
Yes.

If yes, list partners and amount contributed by each:

These are amounts that would actually be available during the grant period. CDFG Fishery Restoration Grant Program, $267,400, for stream habitat restoration in mainstem Sonoma Creek. Rohit Salve, Lawrence Berkeley National Laboratory, $225,000, for groundwater/surface water study including permanent instrumentation.

Are you specifically seeking non−federal cost share funds through this solicitation?
No.

Does It Work? Measuring the success of salmonid habitat restoration at multiple scales

Year 1 (Months 1 To 12)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1.1: project management (12 months)	**6844**	**1506**	**8**	**0**	**11399**	**0**	**0**	**0**	$19,757	**1061**	$20,818
1.2: Subcontract Management (12 months)	**3776**	**831**	**0**	**0**	**0**	**0**	**0**	**0**	$4,607	**585**	$5,192
1.3: Section 10 permit (12 months)	**1328**	**292**	**0**	**0**	**0**	**0**	**0**	**0**	$1,620	**206**	$1,826
2.1: Topographic Monitoring (10 months)	**8260**	**1817**	**14**	**0**	**1500**	**0**	**0**	**0**	$11,591	**1280**	$12,871
2.2: Habitat Monitoring (10 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
3.1: Juvenile fish sampling, PIT tagging (12 months)	**4425**	**974**	**0**	**0**	**24525**	**12750**	**0**	**0**	$42,674	**686**	$43,360
	16505	**3631**	**40**	**0**	**24324**	**16200**	**0**	**0**	$60,700	**2558**	$63,258

3.2: PIT tag monitoring (12 months)											
3.3: Stage recorders (10 months)	**3245**	**714**	**0**	**0**	**6085**	**8000**	**0**	**0**	$18,044	**503**	$18,547
3.4: Spring fish sampling (8 months)	**4425**	**974**	**0**	**0**	**13344**	**0**	**0**	**0**	$18,743	**686**	$19,429
4.1: Population monitoring station (12 months)	**14381**	**3164**	**40**	**0**	**23000**	**50000**	**0**	**0**	$90,585	**2229**	$92,814
4.2: Calibration of population monitoring (12 months)	**0**	**0**	**0**	**0**	**11800**	**1200**	**0**	**0**	$13,000	**0**	$13,000
4.3: Temperature monitoring (12 months)	**0**	**0**	**0**	**0**	**7128**	**2325**	**0**	**0**	$9,453	**0**	$9,453
5.1: Data Management (12 months)	**8363**	**1840**	**0**	**0**	**20791**	**0**	**0**	**0**	$30,994	**1296**	$32,290
6.1: Outreach to residents (12 months)	**6077**	**1337**	**0**	**0**	**0**	**0**	**0**	**0**	$7,414	**942**	$8,356
Totals	**$77,629**	**$17,080**	**$102**	**$0**	**$143,896**	**$90,475**	**$0**	**$0**	**$329,182**	**$12,032**	**$341,214**

Year 2 (Months 13 To 24)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1.1: project management (12 months)	**6372**	**1402**	**0**	**0**	**11399**	**0**	**0**	**0**	$19,173	**988**	$20,161
1.2: Subcontract Management (12 months)	**2360**	**519**	**0**	**0**	**0**	**0**	**0**	**0**	$2,879	**366**	$3,245
2.1: Topographic Monitoring (12 months)	**0**	**0**	**0**	**500**	**0**	**0**	**0**	**0**	$500	**0**	$500
2.2: Habitat Monitoring (12 months)	**0**	**0**	**0**	**500**	**0**	**0**	**0**	**0**	$500	**0**	$500
2.3: Physical Habitat Analysis (1 month)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
3.1: Juvenile fish sampling, PIT tagging (12 months)	**4425**	**974**	**0**	**0**	**13413**	**0**	**0**	**0**	$18,812	**686**	$19,498
3.2: PIT tag monitoring (12 months)	**18585**	**4089**	**88**	**0**	**10279**	**0**	**0**	**0**	$33,041	**2881**	$35,922
3.3: Stage recorders	**538**	**118**	**0**	**0**	**500**	**0**	**0**	**0**	$1,156	**83**	$1,239

(12 months)											
3.4: Spring fish sampling (12 months)	**4425**	**974**	**0**	**0**	**13344**	**0**	**0**	**0**	$18,743	**686**	$19,429
4.1: Population monitoring station (12 months)	**14381**	**3164**	**130**	**0**	**5466**	**0**	**0**	**0**	$23,141	**2229**	$25,370
4.2: Calibration of population monitoring (12 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
4.3: Temperature monitoring (12 months)	**0**	**0**	**0**	**0**	**12917**	**0**	**0**	**0**	$12,917	**0**	$12,917
5.1: Data Management (12 months)	**7331**	**1613**	**0**	**0**	**9385**	**0**	**0**	**0**	$18,329	**1136**	$19,465
5.2: Analysis &Writing (1 month)	**0**	**0**	**0**	**0**	**11529**	**0**	**0**	**0**	$11,529	**0**	$11,529
6.1: Outreach to residents (12 months)	**7464**	**1642**	**0**	**0**	**0**	**0**	**0**	**0**	$9,106	**1157**	$10,263
6.2: Sharing findings (7 months)	**649**	**143**	**0**	**0**	**0**	**0**	**0**	**0**	$792	**101**	$893
Totals	**$66,530**	**$14,638**	**$218**	**$1,000**	**$88,232**	**$0**	**$0**	**$0**	**$170,618**	**$10,313**	**$180,931**

Year 3 (Months 25 To 36)

Task	Labor	Benefits	Travel	Supplies And Expendables	Services And Consultants	Equipment	Lands And Rights Of Way	Other Direct Costs	Direct Total	Indirect Costs	Total
1.1: project management (12 months)	**8260**	**1817**	**0**	**0**	**11399**	**0**	**0**	**0**	$21,476	**1280**	$22,756
1.2: Subcontract Management (8 months)	**2360**	**519**	**0**	**0**	**0**	**0**	**0**	**0**	$2,879	**366**	$3,245
2.1: Topographic Monitoring (11 months)	**8260**	**1817**	**20**	**0**	**0**	**0**	**0**	**0**	$10,097	**1280**	$11,377
2.2: Habitat Monitoring (11 months)	**12390**	**2726**	**50**	**0**	**0**	**0**	**0**	**0**	$15,166	**1920**	$17,086
2.3: Physical Habitat Analysis (11 months)	**6962**	**1532**	**0**	**0**	**0**	**0**	**0**	**0**	$8,494	**1079**	$9,573
3.1: Juvenile fish sampling, PIT tagging (11 months)	**4425**	**974**	**30**	**0**	**13413**	**0**	**0**	**0**	$18,842	**686**	$19,528
3.2: PIT tag monitoring (11 months)	**18585**	**4089**	**100**	**0**	**10279**	**0**	**0**	**0**	$33,053	**2881**	$35,934
3.3: Stage recorders	**538**	**118**	**0**	**0**	**0**	**0**	**0**	**0**	$656	**83**	$739

(11 months)											
3.4: Spring fish sampling (6 months)	**4425**	**974**	**0**	**0**	**13344**	**0**	**0**	**0**	$18,743	**686**	$19,429
4.1: Population monitoring station (11 months)	**14381**	**3164**	**99**	**0**	**5466**	**0**	**0**	**0**	$23,110	**2229**	$25,339
4.2: Calibration of population monitoring (11 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
4.3: Temperature monitoring (11 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
5.1: Data Management (11 months)	**11387**	**2505**	**0**	**0**	**16791**	**0**	**0**	**0**	$30,683	**1765**	$32,448
5.2: Analysis &Writing (11 months)	**22243**	**4893**	**0**	**0**	**17158**	**0**	**0**	**0**	$44,294	**3448**	$47,742
5.3: Review (6 months)	**2360**	**519**	**0**	**0**	**920**	**0**	**0**	**0**	$3,799	**366**	$4,165
6.1: Outreach to residents (11 months)	**9352**	**2057**	**0**	**0**	**0**	**0**	**0**	**0**	$11,409	**1449**	$12,858
6.2: Sharing findings (11 months)	**18880**	**4154**	**0**	**0**	**0**	**0**	**0**	**0**	$23,034	**2926**	$25,960
Totals	**$144,808**	**$31,858**	**$299**	**$0**	**$88,770**	**$0**	**$0**	**$0**	**$265,735**	**$22,444**	**$288,179**

Budget Justification

Does It Work? Measuring the success of salmonid habitat restoration at multiple scales

Labor

Task Year Position Rate hours total 1.1 1 Project Director 59 60 3,540 1.1 1 Project Manager 59 56 3,304 1 Total 6,844 1.1 2 Project Director 59 60 3,540 1.1 2 Project Manager 59 48 2,832 2 Total 6,372 1.1 3 Project Director 59 84 4,956 1.1 3 Project Manager 59 56 3,304 3 Total 8,260 1.2 1 Project Director 59 30 1,770 1.2 1 Project Manager 59 30 1,770 1.2 1 Assistant Director 59 4 236 1 Total 3,776 1.2 2 Project Director 59 12 708 1.2 2 Project Manager 59 24 1,416 1.2 2 Assistant Director 59 4 236 2 Total 2,360 1.2 3 Project Director 59 12 708 1.2 3 Project Manager 59 24 1,416 1.2 3 Assistant Director 59 4 236 3 Total 2,360 1.3 1 Restoration Specialist 44 30 1,328 1 Total 1,328 2.1 1 Information Services Manager 59 3 177 2.1 1 Information Services technician 44 10 443 2.1 1 intern 22 80 1,770 2.1 1 Project Director 59 16 944 2.1 1 Project Manager 59 16 944 2.1 1 Restoration Specialist 44 90 3,983 1 Total 8,260 2.1 2 Information Services Manager 59 0 0 2.1 2 Information Services technician 44 0 0 2.1 2 intern 22 0 0 2.1 2 Project Director 59 0 0 2.1 2 Project Manager 59 0 0 2.1 2 Restoration Specialist 44 0 0 2 Total 0 2.1 3 Information Services Manager 59 3 177 2.1 3 Information Services technician 44 10 443 2.1 3 intern 22 80 1,770 2.1 3 Project Director 59 16 944 2.1 3 Project Manager 59 16 944 2.1 3 Restoration Specialist 44 90 3,983 3 Total 8,260 2.2 1 − 1 Total 0 2.2 2 − 2 Total 0 2.2 3 Information Services Manager 59 8 472 2.2 3 Information Services technician 44 16 708 2.2 3 intern 22 80 1,770 2.2 3 Project Director 59 16 944 2.2 3 Project Manager 59 24 1,416 2.2 3 Restoration Specialist 44 160 7,080 3 Total 12,390 2.3 1 − 0 1 Total 0 2.3 2 − 0 2 Total 0 2.3 3 Information Services Manager 59 16 944 2.3 3 Information Services technician 44 24 1,062 2.3 3 intern 22 0 0 2.3 3 Project Director 59 32 1,888 2.3 3 Project Manager 59 16 944 2.3 3 Restoration Specialist 44 48 2,124 3 Total 6,962 3.1 1 Restoration Specialist 44 80 3,540 3.1 1 Intern 22 40 885 1 Total 4,425 3.1 2 Restoration Specialist 44 80 3,540 3.1

2 Intern 22 40 885 2 Total 4,425 3.1 3 Restoration Specialist 44 80 3,540 3.1 3 Intern 22 40 885 3 Total 4,425 3.2 1 Restoration Specialist 44 308 13,629 3.2 1 Intern 22 130 2,876 1 Total 16,505 3.2 2 Restoration Specialist 44 320 14,160 3.2 2 Intern 22 200 4,425 2 Total 18,585 3.2 3 Restoration Specialist 44 320 14,160 3.2 3 Intern 22 200 4,425 3 Total 18,585 3.3 1 Restoration Specialist 44 50 2,213 3.3 1 Project Manager 59 10 590 3.3 1 Intern 22 20 443 1 Total 3,245 3.3 2 Project Manager 59 2 118 3.3 2 Intern 22 19 420 2 Total 538 3.3 3 Project Manager 59 2 118 3.3 3 Intern 22 19 420 3 Total 538 3.4 1 Restoration Specialist 44 80 3,540 3.4 1 Intern 22 40 885 1 Total 4,425 3.4 2 Restoration Specialist 44 80 3,540 3.4 2 Intern 22 40 885 2 Total 4,425 3.4 3 Restoration Specialist 44 80 3,540 3.4 3 Intern 22 40 885 3 Total 4,425 4.1 1 Restoration Specialist 44 200 8,850 4.1 1 Intern 22 250 5,531 1 Total 14,381 4.1 2 Restoration Specialist 44 200 8,850 4.1 2 Intern 22 250 5,531 2 Total 14,381 4.1 3 Restoration Specialist 44 200 8,850 4.1 3 Intern 22 250 5,531 3 Total 14,381 5.1 1 Information Services Manager 59 30 1,770 5.1 1 Information Services technician 44 30 1,328 5.1 1 Intern 22 30 664 5.1 1 Project Director 59 24 1,416 5.1 1 Project Manager 59 24 1,416 5.1 1 Restoration Specialist 44 40 1,770 1 Total 8,363 5.1 2 Information Services Manager 59 20 1,180 5.1 2 Information Services technician 44 20 885 5.1 2 Intern 22 30 664 5.1 2 Project Director 59 24 1,416 5.1 2 Project Manager 59 24 1,416 5.1 2 Restoration Specialist 44 40 1,770 2 Total 7,331 5.1 3 Information Services Manager 59 40 2,360 5.1 3 Information Services technician 44 40 1,770 5.1 3 Intern 22 40 885 5.1 3 Project Director 59 24 1,416 5.1 3 Project Manager 59 24 1,416 5.1 3 Restoration Specialist 44 80 3,540 3 Total 11,387 5.2 1 − 0 0 1 Total 0 5.2 2 − 0 0 2 Total 0 5.2 3 Information Services Manager 59 16 944 5.2 3 Information Services technician 44 80 3,540 5.2 3 Intern 22 16 354 5.2 3 Project Director 59 160 9,440 5.2 3 Project Manager 59 80 4,720 5.2 3 Restoration Specialist 44 30 1,328 5.2 3 Assistant Director 59 10 590 5.2 3 Historical Ecologist 44 30 1,328 3 Total 22,243 5.3 1 − 0 0 1 Total 0 5.3 2 − 0 0 2 Total 0 5.3 3 Project Director 59 16 944 5.3 3 Project Manager 59 8 472 5.3 3 Information Services technician 44 16 708 5.3 3 Assistant Director 59 4 236 3 Total 2,360 6.1 1 Restoration Specialist 44 84 3,717 6.1 1 Project Manager 59 8 472 6.1 1 Project

Director 59 16 944 6.1 1 Information Services Manager 59 8 472 6.1 1 Information Services technician 44 8 472 1 Total 6,077 6.1 2 Restoration Specialist 44 84 4,956 6.1 2 intern 22 12 266 6.1 2 Project Manager 59 8 472 6.1 2 Project Director 59 16 944 6.1 2 Information Services technician 44 8 354 6.1 2 Information Services Manager 59 8 472 2 Total 7,464 6.1 3 Restoration Specialist 44 144 6,372 6.1 3 intern 22 12 266 6.1 3 Project Manager 59 16 944 6.1 3 Project Director 59 16 944 6.1 3 Information Services Manager 59 8 472 6.1 3 Information Services technician 44 8 354 3 Total 9,352 6.2 1 Restoration Specialist 44 0 0 6.2 1 Project Director 59 0 0 6.2 1 Information Services technician 44 0 0 6.2 1 Information Services Manager 59 0 0 6.2 1 Assistant Director 59 0 0 1 Total 0 6.2 2 Restoration Specialist 44 0 0 6.2 2 Project Director 59 8 472 6.2 2 Information Services technician 44 0 0 6.2 2 Information Services Manager 59 0 0 6.2 2 Assistant Director 59 3 177 2 Total 649 6.2 3 Restoration Specialist 44 80 3,540 6.2 3 Project Director 59 160 9,440 6.2 3 Information Services technician 44 40 1,770 6.2 3 Information Services Manager 59 20 1,180 6.2 3 Assistant Director 59 30 1,770 6.2 3 Project Manager 59 20 1,180 3 Total 18,880 Grand Total 288,967

Benefits

Benefits of 22% includes payroll taxes, Social Security, Medicare, worker's compensation, and health insurance.

Travel

Year rate miles total 1 0.34 300 $102 2 0.34 640 $218 3 0.34 880 $299 $619

Supplies And Expendables

Task Year category amount 2.1 2 Field supplies $500 2.2 2 Field supplies $500

Services And Consultants

Stillwater Sciences, Oakland: oversee statistical design, teach and supervise SEC staff in the first season of each type of fish monitoring, provide technical guidance for fish monitoring, collaborate on analysis, co−author the draft and final reports, and facilitate peer review. Center for Ecosystem Management and Restoration, Oakland: technical review of draft report, $420 Interagency Ecological Program (contact: Karl Jacobs): provide database application for data entry, serve data, $4,000 Tessera Consulting, Livermore: limited consulting on surveying and physical habitat monitoring, $1,500 Watershed Sciences, Berkeley (contact: Laurel Collins): limited consulting on stream geomorphology,$500 EME Systems (contact: Tracy Allen), Emeryville: limited consulting on stage recorder installation and maintenance, $500

Equipment

Equipment (>$1,000 cost, usable lifespan> 3 years)

Task 3.2 PIT tag detector antennae −− $3000 each x 5 = $15,000 total Task 3.3 Pressure transducer −− $2,000 each x 4 = $8,000 total

Task 4.1 Vaki RiverWatcher $35,000 Automated camera system $5,000 (cost could vary from about $3,000 to 8,000 depending on the camera system selected) weir (plus extra net and other supplies) $5,000 PIT tag detector antenna $3,000

Task 4.2 Fyke net $1,200

Lands And Rights Of Way

N/A

Other Direct Costs

N/A

Indirect Costs/Overhead

SEC's overhead rate of 15.5% is charged on wages. It covers the proposed work's portion of the cost of operating SEC, including utilities, computer system, general office support staff, general staff meetings, office supplies, liability insurance, etc.

Comments

Environmental Compliance

Does It Work? Measuring the success of salmonid habitat restoration at multiple scales

CEQA Compliance

Which type of CEQA documentation do you anticipate?
X none
− negative declaration or mitigated negative declaration
− EIR
− categorical exemption

If you are using a categorical exemption, choose all of the applicable classes below.
− Class 1. Operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination. The types of "existing facilities" itemized above are not intended to be all−inclusive of the types of projects which might fall within Class 1. The key consideration is whether the project involves negligible or no expansion of an existing use.
− Class 2. Replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.
− Class 3. Construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable on any legal parcel, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
− Class 4. Minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.
− Class 6. Basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies. These may be strictly for information gathering purposes, or as part of a study leading to an action which a public agency has not

yet approved, adopted, or funded.
− Class 11. Construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

Identify the lead agency.

Is the CEQA environmental impact assessment complete?

If the CEQA environmental impact assessment process is complete, provide the following information about the resulting document.

Document Name
State Clearinghouse Number

If the CEQA environmental impact assessment process is not complete, describe the plan for completing draft and/or final CEQA documents.

NEPA Compliance

Which type of NEPA documentation do you anticipate?
X none
− environmental assessment/FONSI
− EIS
− categorical exclusion

Identify the lead agency or agencies.

If the NEPA environmental impact assessment process is complete, provide the name of the resulting document.

If the NEPA environmental impact assessment process is not complete, describe the plan for completing draft and/or final NEPA documents.

Successful applicants must tier their project's permitting from the CALFED Record of

Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

Local Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
conditional Use Permit	–	–	
variance	–	–	
Subdivision Map Act	–	–	
grading Permit	–	–	
general Plan Amendment	–	–	
specific Plan Approval	–	–	
rezone	–	–	
Williamson Act Contract Cancellation	–	–	
other	–	–	

State Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
scientific Collecting Permit	–	–	
CESA Compliance: 2081	–	–	
CESA Complance: NCCP	–	–	
1602	–	–	
CWA 401 Certification	–	–	
Bay Conservation And Development Commission Permit	–	–	
reclamation Board Approval	–	–	
Delta Protection Commission Notification	–	–	
state Lands Commission Lease Or Permit	–	–	
action Specific Implementation Plan	–	–	

other	–	–	

Federal Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
ESA Compliance Section 7 Consultation	–	–	
ESA Compliance Section 10 Permit	X	–	
Rivers And Harbors Act	–	–	
CWA 404	–	–	
other	–	–	

Permission To Access Property	Required?	Obtained?	Permit Number (If Applicable)
permission To Access City, County Or Other Local Agency Land Agency Name Sonoma County Roads Department, Sonoma County Agricultural Preservation And Open Space District	X	X	
permission To Access State Land Agency Name Sonoma Developmental Center (Department Of General Services)	X	X	
permission To Access Federal Land Agency Name	–	–	
permission To Access Private Land Landowner Name Several: Jack London Group, Elisa And Bob Newman, Michael Webb, Benziger Family Winery, Deborah Emery Family Winery, Krysia Zaroda Logan Family Winery, Peter Narvaez Private Landowner, Curtis Carleton	X	X	

Family Winery, Chris Benziger			

If you have comments about any of these questions, enter them here.

Land Use

Does It Work? Measuring the success of salmonid habitat restoration at multiple scales

Does the project involve land acquisition, either in fee or through easements, to secure sites for monitoring?
X No.
– Yes.

How many acres will be acquired by fee?

How many acres will be acquired by easement?

Describe the entity or organization that will manage the property and provide operations and maintenance services.

Is there an existing plan describing how the land and water will be managed?
– No.
– Yes.

Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?
– No.
X Yes.

Describe briefly the provisions made to secure this access.

Written permission has been obtained from every landowner where the monitored restoration sites occur. These signatures are attached to the project narrative. During past assessment projects, written permission has also been obtained from many of the approximately 80 private landholders where additional monitoring will take place. Many of these will be renewed during the project, and additional permissions will be obtained.

Do the actions in the proposal involve physical changes in the current land use?
X No.

– Yes.

Describe the current zoning, including the zoning designation and the principal permitted uses permitted in the zone.

Describe the general plan land use element designation, including the purpose and uses allowed in the designation.

Describe relevant provisions in other general plan elements affecting the site, if any.

Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?
X No.
– Yes.

Land Designation	Acres	Currently In Production?
Prime Farmland		–
Farmland Of Statewide Importance		–
Unique Farmland		–
Farmland Of Local Importance		–

Is the land affected by the project currently in an agricultural preserve established under the Williamson Act?
X No.
– Yes.

Is the land affected by the project currently under a Williamson Act contract?
– No.
– Yes.

Why is the land use proposed consistent with the contract's terms?

Describe any additional comments you have about the projects land use.

The monitored areas are mostly on private land. One study reach is owned by the Sonoma County Agricultural Preservation and Open Space District.