Summary Information

US Fish and Wildlife Service

Clear Creek anadromous salmonid monitoring program

Amount sought: $3,373,313

Duration: 36 months

Lead investigator: Mr. Matt Brown, US Fish and Wildlife Service

Short Description

This project is a comprehensive salmonid monitoring program that will provide feedback for the adaptive management and evaluation of restoration actions of the Clear Creek Restoration Program and B2 Water Program, funded by the Central Valley Project Improvement Act (CVPIA), and of the Ecosystem Restoration Program (ERP), Watershed Program, and potentially the Environmental Water Program, funded by CALFED. Five major restoration actions are monitored: increased instream flows, Saeltzer Dam removal, stream channel restoration, gravel augmentation, and erosion control. The three year monitoring program is based on a core of existing monitoring efforts currently funded by CALFED and CVPIA. The program complements a concurrent CALFED monitoring PSP proposal from the Western Shasta Resource Conservation District to provide geomorphological, riparian and avian monitoring of the same restoration actions.

Executive Summary

The proposed comprehensive salmonid monitoring program will provide feedback for the adaptive management and evaluation of restoration actions of the Clear Creek Restoration Program and B2 Water Program, funded by the Central Valley Project Improvement Act (CVPIA), and of the Ecosystem Restoration Program (ERP), Watershed Program, and potentially the Environmental Water Program, funded by CALFED. Five major restoration actions are monitored: increased instream flows, Saeltzer Dam removal, stream channel restoration, gravel augmentation, and erosion control. The three year monitoring program is based on a core of existing monitoring efforts currently funded by CALFED and CVPIA. The program complements a concurrent CALFED monitoring PSP proposal from the Western Shasta Resource Conservation District to provide geomorphological, riparian and avian monitoring of the same restoration actions. The two programs monitor cumulative investments in Clear Creek restoration of more than $28M and more than 0.75 M acre feet of water.

The 12 fisheries monitoring tasks would provide 1) program management, 2) annual escapement estimates, spawning area mapping, and installation, operation and monitoring of a picket weir, 3) juvenile production estimates, estimates of the proportion of anadromous O. mykiss, a redd−scour index, and estimates of condition factor of salmonids, 4) genetic run−designation of adult and juvenile Chinook, 5) habitat use by juvenile Chinook of restoration project, 6) gravel project evaluation relating survival−to−emergence to physical and geochemical conditions in redds, 7) evaluation of benthic macroinvertebrates in augmentation gravel, 8) use of decision analysis modeling to assist in identification of limiting factors, future monitoring needs and evaluation of restoration futures, 9) 2−dimensional modeling of salmonid spawning and rearing habitat to evaluate restoration projects, 10) habitat preferences of juvenile salmonids, 11) evaluation of stranding risk on constructed floodplains and 12) evaluation of juvenile use of constructed scour channels. Learning from the monitoring should improve future restoration efforts in Clear Creek, Shasta County, California and other Central Valley rivers and streams. Our direct collaborators on this project are from Oregon State University, California State University at Sacramento, Alaska Resource &Economic Development, Inc., ESSA Technologies Ltd., and the Sacramento Fish and Wildlife Office and the Coleman National Fish Hatchery of the US Fish and Wildlife Service.

Clear Creek restoration involves four big R species and two at risk species. The proposed monitoring will directly determine if salmonid recovery goals are being met in Clear Creek, especially tasks 2, 3, and 4. Additional goals of the ERP include rehabilitating ecological processes (goal 2) and restoring habitats (goal 4). These goals directly support and are intermediate steps to recovering at−risk species. To meet these goals, ERP seeks to implement actions to restore hydrologic regimes, sediment supply, floodplain form and function, and stream channel form and function. ERP has classified Clear Creek as a “signature opportunity” to implement and learn from such projects. Our proposal includes tasks that will monitor the outcome of these projects in a way that will directly link ecological processes to immediate biotic responses (tasks 5−12). This will aid ERP in meeting their objective of gathering information necessary to inform future restoration efforts. Our monitoring will also evaluate and refine current conceptual models upon which these restoration projects are based. Restoration actions on Clear Creek specifically address 17 separate milestones for the Sacramento Region and research. Tasks included in this proposal will evaluate if the desired outcomes were achieved and progress was made toward reaching the milestones. The CVPIA identified restoration actions to be implemented specifically on Clear Creek such as providing increased instream flows, fish passage, and channel restoration. Therefore, CVPIA invested in numerous restoration actions on Clear Creek. Our proposal will evaluate if the goals of the CVPIA are being met.

Clear Creek Anadromous Salmonid Monitoring Program (2004 ERP Solicitation)

A. Project Description: Project goals and Scope of Work

1. Problem, Goals, and Objectives

Clear Creek has been identified as a "signature opportunity" for restoration by the Ecosystem Restoration Program (ERP). Although the ecosystems and habitats on Clear Creek have been severely degraded by human land use practices, ERP determined it would yield rapid restoration progress and provide critical information needed to inform future efforts in other watersheds. Also, the Central Valley Improvement Act (CVPIA) identifies specific restoration activities to be completed in Clear Creek, indicating that lawmakers also saw its potential for recovering at-risk salmonid species. Since 1995, five ecosystem restoration actions have been funded by CVPIA (USFWS 2001) and the California Bay-Delta Authority (CBDA). These actions are A) increased minimum instream-flow, B) the removal of Saeltzer Dam, C) the Lower Clear Creek Floodway Restoration Project, D) spawning gravel augmentation and E) erosion control projects. The driving force behind these efforts to restore ecosystem processes was the restoration of the threatened Central Valley spring Chinook and steelhead and candidates fall and late-fall Chinook. This proposal focuses on monitoring and learning from the effect of these five restoration actions specifically as they relate to anadromous salmonids. A concurrent proposal being submitted by our cooperating agencies focuses on monitoring effects on geomorphic processes, birds, and plants. Goals and quantitative objectives are provided in Table 1. Our proposed fisheries monitoring is indicated by task number alongside of the affected element.

A. Increased minimum instream-flow. Construction of Whiskeytown Dam in 1963 allowed the diversion of the majority of Clear Creek flows to the Sacramento River via the Spring Creek tunnel (Figure1). Beginning in 1995, CVPIA increased releases from Whiskeytown Reservoir to Clear Creek to increase spawning and rearing habitat for salmon and steelhead (Brown 1996). Since 1999, CVPIA increased releases during the summer to provide water temperatures suitable for juvenile steelhead rearing and adult spring Chinook holding and spawning. The proposed monitoring has been used to determine the timing and evaluate the success of flows provided. Monitoring of salmonid distribution and abundance has shown that the summer flows have been effective (Newton and Brown 2004) and numbers of the threatened salmonids appear to be increasing in Clear Creek. In recent years a picket weir has been used to separate fall and spring Chinook spawning areas to prevent hybridization. Installation timing and location of the weir have relied on the proposed monitoring. Adaptive management of flows and the weir will continue to rely on this monitoring.

Increased flows provided by the (B)2 program of CVPIA from1999 to 2004 have averaged 75,000 acre feet per year. Current costs for environmental water in the Sacramento River basin are $95 an acre foot (Nick Hindman, USFWS, B2 Program Manager, personal communication.), suggesting that the Clear Creek flows could be worth almost $7.2 million per year.

B. Removal of Saeltzer Dam: The primary purpose for removing Saeltzer Dam in 2000 was to improve fish passage, especially for spring Chinook and steelhead which require access to upstream areas for successful restoration. Stream surveys like those in the current proposal have established that only 2% of the fall Chinook but at least 70% of the spring Chinook can now pass the dam site (Newton and Brown 2004). These lower than expected passage rates are due to a natural fish passage barrier directly downstream of the dam site. Continued monitoring is warranted to determine the demographic and genetic impacts of the barrier and the less than complete passage afforded to spring Chinook.

C. Lower Clear Creek Floodway Restoration Project: The Lower Clear Creek Floodway Restoration Project (Project) involves the phased reconstruction of the floodplain and stream channel.

The Project restores approximately 2.9 miles of Clear Creek (McBain & Trush et al. 2000). Phase 1 isolated a pond (former gravel pit) known to strand adult and juvenile salmonids. Phase 2 reconstructed the floodplain of most of the Project area. Phase 3A relocated and reconstructed a 1,400 ft section of stream channel and was completed in September 2002 (Figure 1). Future phases will relocate and reconstruct another two sections of stream channel, the first of which is currently being designed and may be funded by CBDA through a Directed Action. Problems addressed by the Project were caused by extensive mining of instream and floodplain aggregates. Problem include the following:

1. downcutting of the channel to clay hardpan. Conversion of much of this alluvial stream reach characterized by gravels and cobbles to clay hardpan greatly reduced salmonid spawning and rearing habitat and benthic macroinvertebrate habitat. Downcutting also converted functioning floodplain into elevated terraces which were rarely inundated during high flows.

2. simplification of channel morphology. Comparison of historic aerial photographs show that the channel has simplified and provides less variety and complexity of habitat types for all life stages of salmonids.

3. stranding mortality in gravel pits. Gravel pits throughout portions of the floodplain which would inundate during high flows would isolate and strand large numbers of juvenile salmonids.

Fisheries goals for the Project are to 1) improve the quantity and quality of salmonid spawning habitat, 2) improve the quantity and quality of juvenile salmonid rearing habitat and 3) reduce juvenile salmonid stranding on floodplains. Within these goals, nine quantitative objectives and more than 19 performance measures were established to monitor and learn from the Project's effects (Table 1). Monitoring accomplishments to-date include a before vs after analysis of spawning area utilization (Giovannetti et al. 2004), a juvenile habitat use study comparing juvenile densities in the reconstructed channel to two control reaches (Newton et al. 2004), and 2-Dimensional modeling of Weighted Usable Area for salmonid spawning and rearing habitat (Gard 2004). Geomorphic evaluations have also proved useful in evaluating the fisheries benefits of the project (GMA 2003 and GMA 2004). Presentations of each of the above accomplishments have been made at professional conferences (e.g. 2004 Calfed Science Conference) to transfer knowledge gained from implementing the Project. Monitoring results have shown statistically significant benefits to spawning and rearing juveniles.

D. Spawning gravel augmentation: More than 74,500 tons of spawning gravel have been added to 6 sites in Clear Creek since 1995. Gravel placement methods include either "injection" by dumping gravel over creekside cliffs to form talus cones to be entrained into the creek during winter storms or direct "placement" of gravels into the creek to build spawning riffles for immediate use. Funds for these projects have come from CVPIA, the USFWS and Bureau of Land Managment (BLM) Jobs in the Woods Programs, and the CALFED Watershed Program. CVPIA plans to add spawning gravel in perpetuity to compensate for loss of recruitment due to Whiskeytown Dam. The CVPIA goal to conduct annual additions of gravel such that coarse sediment equilibrium is achieved and maintained is being refined through empirical studies and subsequent revision of the Clear Creek Gravel Management Plan to better specify amounts, locations and methods of gravel augmentation.

E. Erosion control: Elevated levels of fine sediment has been identified as a major limiting factor in Clear Creek (DWR 1986). Beginning in 1996, CVPIA and the USFWS and BLM Jobs in the Woods programs funded erosion control projects in the watershed, to reduce the amount of sediment delivered to the stream and its impact on salmonid egg survival. The remaining erosion sites with high potential to deliver sediment to Clear Creek, could not be accessed without building roads. Since road building was considered the chief factor contributing to erosion, the remaining sites have not been treated. In 1996 and 1997, bulk sediment sampling to monitor the long-term effect of restoration actions indicated that fine sediments had decreased from excessively high levels in the 1980's (NRCS 1998). On New

Years Day 1997, a large debris flow (landslide) delivered 200,000 to 1,000,000 cubic yards of coarse sediment to Clear Creek 2 miles below Whiskeytown Dam (Steensen 1997), as well as unmeasured amounts of fine sediment. More recent sediment monitoring indicates that fine sediment levels have been increasing in spawning areas and may be negatively effecting juvenile salmonid productivity as expressed as the number of juveniles produced per adult of escapement (Matt Brown, USFWS, presentation to the Clear Creek Technical Team; unpublished data).

2. Justification (including conceptual model and hypotheses)

The conceptual models presented in Figures 2 and 3 depict the Clear Creek ecosystem response to human impacts and restoration actions. Watershed inputs (e.g. water, sediment, energy, nutrients, LWD, pollution) are the primary variables governing river ecosystems. These inputs determine geomorphic processes which effect geomorphic form thereby creating habitat characteristics which eventually cascade hierarchically down to biotic responses. Figure 2 includes limiting factors and stressors in italics. Figure 3 also locates the hierarchical level targeted by the 5 restoration actions (in bold) we propose to monitor. Our proposed fisheries monitoring is indicated by task number alongside of the affected element (Figure 3, Table 1). Restoration actions at the larger reach-scale (10^2-10^3 channel widths) primarily target watershed inputs and actions at the smaller geomorphic-scale (10 channel widths) target geomorphic attributes. The majority of our proposed monitoring is at the lower three levels; biotic response, habitat characteristics and geomorphic attributes. Our proposal compliments a concurrent proposal for geomorphic, riparian and avian songbird monitoring in Clear Creek by the Western Shasta Resource Conservation District (WSRCD). The proposed geomorphic monitoring includes the expected responses of geomorphic form and process to the restoration actions.

Hypotheses tested are included along with goals, objectives and proposed task number in Table 1, rather than being listed comprehensively in the text. Here we illustrate a few examples describing how our conceptual model of ecosystem processes leads to our restoration actions and then to our monitoring tasks.

We are implementing restoration actions which increase coarse sediment supply, which along with high flows results in a cascade of responses, hopefully including: increased sediment transport, reduced fine sediment, improved inter-gravel flow, improved survival to emergence, improved habitat conditions for benthic macroinvertebrate (BMI) production, increased food availability for salmonids and better growth, survival and productivity for juvenile salmonids resulting ultimately in higher returns of adult fish. Key uncertainties related to our monitoring in this cascade of cause and effect include: do flushing flows decrease fine sediment, will introduced gravels yield improved survival to emergence, will reducing fines or adding gravel improve habitat for BMI, will fish condition improve over time, and will increased juvenile productivity result in increased adult returns? These uncertainties are investigated in tasks 2, 3, 6, and 7.

The Clear Creek Technical Team is in the early stages of planning an adaptive management experiment related to some of the uncertainties in gravel augmentation. Future gravel placement projects may experiment with different size gravels including smaller size fractions down to 1/4 inch, gravels originating from outside of the watershed and un-processed but mercury free gravels. We hope to use Task 6 and Task 7 to monitor such an experiment.

The CALFED Environmental Water Program (EWP) will probably propose to increase Clear Creek mid- range flows in part to mobilize fine sediment (EWP 2004). Our proposed monitoring will look at hypotheses similar to those proposed by EWP. For example, measurements made to test Hypothesis F9 (Augmentation gravel will increase densities of BMI prey for juvenile salmonids, Table 1) could serve as a baseline for EWP Goal 1-Objective ‘e’; “Flows will alter standing biomass and diversity of BMI communities.”

Construction of Whiskeytown Dam in 1963 allowed the diversion of the majority of Clear Creek flows (Figure1). Minimum instream flows were increased beginning in 1995 based on an Instream Flow Incremental Methodology (IFIM) study conducted in the early 1980s. Since CVPIA increased the flows, fall Chinook escapement increased five-fold over the baseline 1967 to 1991 period. Water is a primary watershed input governing process, form and habitat. Instream minimum flows may not be easy to prescribe precisely, but large flow increases will benefit a dewatered stream. Fall spawning flows in the lower channel increased from 25 cfs to 200 cfs due to the combination of increased minimum flows and elimination of the Saeltzer diversion. The increased flows improve water temperatures, increase water depth and stream width, thereby increasing the amount of spawning and rearing habitat. The CVPIA mandates that a new instream flow study be used to provide flows to allow sufficient spawning, incubation, rearing, and outmigration for salmon and steelhead from. The new IFIM is needed to dial the flows in to the optimal level.

While initial monitoring of salmonid distribution and abundance has shown that the summer flows have been effective (Newton and Brown 2004), it is uncertain if Clear Creek will be able to sustain spring Chinook and Steelhead populations over the longer term because: a) Changes proposed in the operations, criteria and plan (USBOR 2004) for the Central Valley Project may increase the temperature of water released into Clear Creek during the late summer, including increased Delta diversions and decreased diversion from the Trinity River to the Sacramento River through Whiskeytown Reservoir. Late summer water temperatures occur during spring Chinook spawning and are a critical limiting factor for spring Chinook; b) spring Chinook in Clear Creek spawn at lower elevation than in any other Central Valley stream because they are prevented from accessing historical spawning grounds by Whiskeytown Dam. Even with cold water from the Trinity River, lower elevations in Clear Creek may not maintain low water temperature during drought cycles or predicted climate change.

It is unclear if environmental conditions downstream of Whiskeytown Dam will produce an anadromous steelhead population of O. mykiss or a non-anadromous rainbow trout population. While the difference in populations may be difficult to detect, it is important as the former has ESA protection and the second does not. The proposed monitoring would describe the life history patterns of the population and potentially describe the environmental factors which lead to anadromy.

The Floodway Project enters the conceptual model at a different level, that of “geomorphic form” (Figure 3). By reconstruction and resizing a stream reach previously degraded by gravel mining, a more natural stream channel is immediately restored. This form then provides habitat and the related biotic responses (e.g. increased spawning and improved egg survival-to-emergence). In addition, by sizing the reconstructed channel to match current watershed inputs including channel forming flows and coarse sediment supply, geomophic processes of a dynamically functioning stream channel are restored. Key uncertainties concerning the Floodway Project include responses of salmonids such as spawning and rearing use, scour channel use, and floodplain stranding rates. Salmonids may not respond as predicted to the designed and constructed habitats. These responses will be investigated by tasks 2, 5, 11, and 12 and will feed back into future stream channel restoration.

3. Previously Funded Monitoring

The core elements of the proposed work have been funded in the past by CVPIA and CALFED. Tasks or major portions of 2, 3, 4, 5, 8, 9, 11 and 12 have been funded by CVPIA and CALFED (Table 1). New tasks 4, 6, 7 and 10 have developed out of recommendations based on past work in the watershed or from recommendations from the CVPIA / CALFED Adaptive Management Forum process or from the CALFED Science Program's Rivers, Rocks, and Restoration Workshop. CVPIA restoration funds available for the Clear Creek Restoration Program will be reduced in the future and will be inadequate to complete desired monitoring.

Task 2, adult salmonid escapement and distribution has been funded by CVPIA since 1999 (Newton and Brown 2004, Giovannetti and Gaither 2004, Giovannetti et al. 2004). CVPIA funding varies from year to year and it is unlikely that funds will be sufficient for this task in the future. Currently this task is only funded through Federal Fiscal Year (FY) 05. Task 3, juvenile salmonid production monitoring by rotary crew trap (RST), was funded by CVPIA from December 1998 until June 2001 (Gaines et al. 2003), when CALFED began funding (Greenwald et al. 2003). Additional funding was provided for a second RST to measure spring Chinook production in 2003 (Brown and Earley 2004). This upper trap established that most spring Chinook production was being mis-categorized as fall Chinook production. Current efforts to improve production estimates are being funded by CVPIA and CALFED, using genetic techniques to determine run, measuring relative growth rates, spawn timing, temperature, and daily temperature units to emergence. This task is currently funded through June of 2006. Task 4 is currently being developed by Dr. Michael Bank of Oregon State University under a contract with the Department of Water Resources looking at adult Chinook from Clear Creek to develop a genetic baseline for run designation. Dr. Banks also has submitted a proposal to CVPIA for similar work with juvenile Chinook from Clear Creek. Task 5 (Newton et al. 2004) and Task 9 (Gard 2004) were funded by CVPIA in 2003 to evaluate the initials benefits of the Floodway Project. All funds for these activities have been expended. The juvenile habitat use study demonstrated higher use of the project than expected by salmonids. 2 dimensional modeling suggests that the Floodway Project will increase spawning habitat 5 fold. The spawning area mapping subtask of Task 2 verified this modeling prediction showing an almost 4 fold increase in actual spawning use. Task 8 is an application of CCDAM, a tool being developed with funds from ERP, EWP and CVPIA. CCDAM funds requested in this proposal are in addition to those anticipated to come from CVPIA and EWP during FY 05. The USFWS Sacramento Field Office IFIM Branch along with the Red Bluff Fish and Wildlife Office (RBFWO) began working on a new Clear Creek IFIM in FY 04. The IFIM branch anticipates continuing field work in FY 06 and 07. Information from the IFIM will inform tasks in this proposal. Fish stranding data like that proposed in Task 11 suggests that lack of complexity and vegetation in the newly constructed floodplains resulted in a lower rate of fish stranding than in natural floodplains. Pilot electrofishing, temperature and hydraulic data for Task 12 suggests that the 3 scour channel types have different biological values and risks.

4. Approach and Scope of Work

The following tasks relate to the goals, objectives and hypotheses in Table 1. Tier 1 tasks are the highest priority, followed by tier 2 and tier 3. By tier, tasks include:

Tier 1	**Tier 2**	**Tier 3**
Task 1: Project Management	Task 6: Gravel quality & STE	Task 10: Juvenile HSIs
Task 2: Adult salmonid escapement and distribution	Task 7: Benthic macroinvertebrates	Task 11: Floodplain stranding
Task 3: Juvenile salmonid production	Task 8: CCDAM	Task 12: Scour channel studies
Task 4: Genetic identification of Chinook run	Task 9: 2D modeling	
Task 5: Juvenile habitat use		

Information from these studies will be shared with the Clear Creek Technical Team information. The team aids in making management decisions, designing experiments, acquiring permits and funding, and coordinating with other programs such as the CVPIA B2, EWP, ERP and the CALFED Watershed Program. These tasks are important in implementing adaptive management of Clear Creek restoration actions. Adaptive management is the systematic, rigorous approach to improving management by implementing policies as planned experiments, monitoring the outcomes of the management interventions, and documenting the results (Taylor it al. 1997).

4.1 **Task 1: Project Management**

Project management will include fiscal and programmatic semi-annual reports submitted to ERP.

4.2. **Task 2: Adult salmonid escapement and distribution**

4.2.1. Problem

Ecosystem restoration actions implemented on Clear Creek are designed to recover at-risk native salmonids such as the threatened Central Valley spring Chinook and steelhead as well as federal candidate species such as the Central Valley fall and late-fall Chinook. Accurate adult population estimates and indexes are essential to evaluate the combined success of restoration actions in Clear Creek and also aid in evaluating restoration actions and harvest regulation in the Central Valley, San Francisco Bay-Delta and the Pacific Ocean. Furthermore, a clear understanding of the temporal and spatial distribution of immigrating adult salmonids and their redds is needed to evaluate individual restoration actions such as instream flow management, fish passage improvements, spawning gravel augmentation, and stream channel reconstruction. The USFWS proposes to implement monitoring studies to evaluate the status and trend, distribution, and behavior of three runs of adult Chinook and steelhead.

4.2.2. Approach

Task 2 has multiple subtasks which include 1) stream surveys, 2) spawning area mapping, and 3) temporary barrier weir operation. Each subtask is needed to determine if one or more qualitative objectives for restoration actions are being met.

4.2.2.1 Sub-task 1: Stream Surveys

Stream surveys will be conducted year round using two techniques; snorkel surveys from April-November and kayak surveys from December-April. Stream surveys will be conducted from Whiskeytown Dam (river mile 18.1) down to river mile (rm) 1.7 and will occur once per month during immigration and holding periods and twice a month during spawning periods. Survey protocols will follow those described in Newton and Brown (2004) and Giovannetti and Gaither (2004). During stream surveys, the coordinates (i.e. spatial distribution) will be recorded for live Chinook, Chinook and steelhead redds, and Chinook and steelhead carcasses. Annual population indexes will be calculated for spring and late-fall Chinook and steelhead. Fall Chinook population estimates are made by the California Department of Fish & Game. Carcasses will be recovered for scale samples, genetic tissue samples, otolith samples (steelhead only), and extraction of coded-wire tags from hatchery fish. Scales will be read to determine the annual age structure of Chinook runs. Age structure is needed to evaluate the effect of restoration actions or environmental factors during a given year. We propose to analyze genetic tissue samples under Task 4 to determine run status for more accurate escapement indexes for Chinook runs. Extensive data will be collected on salmonid redds including depth, velocity, area, substrate size, and substrate origin (i.e. native or augmentation gravel). Redd information will be used to developed Clear Creek specific Habitat Suitability Indexes (HSI's) for redds created by each individual run of Chinook and steelhead. HSI's will be used in 2 dimensional habitat modeling to evaluate the benefits of stream channel restoration and in an ongoing IFIM study. Continuous water temperature data will be collected at a minimum of eight locations to evaluate the effects of managed flows and water temperature on salmonids.

The performance measures for subtask 1 include annual escapement estimates and indices (with age structure); the spatial and temporal distribution of Chinook, redds, and carcasses; the number and percentage of redds in augmentation gravels; the transport distance of augmentation gravel; and water temperatures at holding, spawning, and temperature target compliance locations. These performance measures are needed to monitor the combined success of all restoration actions and the individual success of the actions 1-4 (Table 1).

4.2.2.2 Sub-task 2: Spawning Area Mapping

Spawning area mapping (Giovannetti et al 2004) involves the drawing of Chinook redds and redd aggregates on field copies of high resolution aerial photographs. These drawings are then transferred using computer GIS software onto geo-referenced digital aerial photographs in order to calculate the area of spawning habitat utilized by Chinook. Field drawings are made during the 1st week in December from the confluence with the Sacramento River up to Clear Creek Road Bridge (rm 8.5). Mapping incorporates nearly all of the fall Chinook spawning habitat which is located in the lower alluvial reach. Unlike the upstream canyon reach where GPS locations and measurements can be taken for all individual redds, spawning density is so high in the lower alluvial reach that spawning areas must be mapped. Spawning area mapping allows us to evaluated the success of restoration actions targeted on improving the quantity of spawning habitat in this reach.

The performance measure for subtask 2 (surface area of redds) will be used to help determine the success of restoration actions 1-4 (Table 1). Spawning area mapping will determine if quantitative objectives have been met concerning the goal of increasing the quantity of spawning habitat.

4.2.2.3. Temporary Picket Weir Operation

The construction of Whiskeytown dam prevents spring Chinook from accessing their historic habitat where water temperatures are cool enough for them to hold over the summer. Since 1999, increased minimum flows have been implemented to provide cool water habitat for spring Chinook holding and spawning below Whiskeytown Dam. Limiting spring run to the lower 18 miles of Clear Creek reduced the spatial separation from fall Chinook thus introducing the possibility of hybridization between the runs (Newton and Brown 2004). The installation and monitoring of a temporary picket weir from late August to early November is necessary to spatially separate spring and fall Chinook. The weir also improves our ability to accurately estimate individual population indexes of each run from our stream survey data and collect carcasses for age structure and genetic determination of run status. Separation of spring and fall Chinook is achieved by adaptive management of both the picket weir installation date and timing of flow increases. The timing of both is determined by information from the stream surveys.

4.3 **Task 3: Juvenile Salmonid Production**

4.3.1 Problem

Juvenile salmonid production estimates, combined with adult escapement estimates are essential for detecting population level responses to the combined effect of restoration actions. The production estimates also evaluate success of specific restoration actions such as increased minimum flows (Table 1, hypotheses F1 and F2) and removal of Saeltzer Dam (Table 1, hypotheses F3A and B). The ratio of adults to juveniles is an essential metric for evaluating cumulative environmental impacts on the earliest life stages.

Natural landslides and fine sediment liberated by the Saeltzer Dam removal appear to have reduced

Clear Creek juvenile productivity. Fine sediment levels measured in surveys by USFWS in 2005 or a concurrent proposal by WSRCD will be compared to juvenile production and the productivity ratio of juveniles to adults. We expect that as fine sediment levels decrease, the juvenile productivity ratio will increase to previous high levels. If the link between increased fine sediment and reduced productivity is confirmed and fine sediment levels remain high, further erosion control may be warranted. Juvenile production estimates will provide the critical link between the relationship of percent fines and suitability of gravel for successful incubation.

Clear Creek data also indicates that redd scour during high flow years may be limiting juvenile productivity. We are currently developing a redd-scour index using scour cores distributed in both fall and spring run spawning areas. The index would suggest the degree to which juvenile production is reduced by scour events.

The length criteria commonly used to assign run to juvenile Chinook (Greene 1992) mis-categorize spring and fall Chinook in Clear Creek (Brown and Earley 2004). Therefore accurate production estimates can be made in two ways: 1) production from the upper trap can be assigned solely to spring Chinook, assuming the picket weir successfully blocks fall Chinook from the upper reaches. This requires operation of the upper trap as well as the picket weir. 2) alternative run designation techniques may be developed using genetic techniques. As proposed in Task 4 (Genetic Identification of Chinook runs), analysis of genetic samples will improve our ability to determine runs and apportion passage estimates accordingly.

4.3.2. Approach

Juvenile salmonid production monitoring will primarily be based on the operation of upstream and downstream rotary screw traps and secondarily on genetic analysis (Task 4), otolith microchemistry, and a redd scour study. The task will estimate juvenile production (Greenwald et al. 2003) using trap efficiency trials to expand the trap catch numbers. Condition factor and relative growth rate of Chinook in the upper trap (Brown and Earley 2004) will also be measured. Rotary screw trapping will occur 7 days a week year-round. Mark and recapture trials will be used to measure trap efficiency on a weekly basis or as often as feasible. Since the juvenile monitoring program was implemented in 1998, 288 individual efficiency trials have been conducted.

The current and proposed juvenile production monitoring program is significantly different than RST life history studies or programs only concerned with one or two runs. Production estimates require a more extensive and aggressive sampling regime which requires more staff. Production estimates are proposed for 3 runs of Chinook and steelhead. Cost savings could be achieved through a reduction in the number of production estimates. The upper trap is required to produce spring Chinook estimates, but it can not estimate production of other populations. Reduction of the sampling period of the lower trap from 12 months to 6 months would only allow production estimates of fall Chinook. Without production estimates, monitoring of late-fall Chinook and steelhead would be limited to escapement estimates which are limited by high flows and turbidity during the spawning season.

Previous stream survey observations indicate that Clear Creek has both anadromous (steelhead) and resident rainbow trout (Oncorhynchus mykiss) populations. Differentiating between the two life history patterns is difficult in many Sacramento river tributaries. Several studies have shown that the life history form of an individual *O. mykiss* and its mother can be inferred from the ratio of strontium to calcium (Sr/Ca) in the otolith. Stream surveys (Task 2) will provide an annual *O. mykiss* population index based on redd observations. In order to report a population index specifically for steelhead, we propose using otolith microchemistry analysis of juveniles to determine the ratio of anadromous to resident *O. mykiss* at intervals throughout the spawning season. We propose to collect 10 newly emerged juveniles once a month from late January through late June and 40 larger fish systematically throughout the year for an annual total of 100 juveniles. Samples would be obtained from rotary screw traps. Otoliths would be analyzed in a laboratory specializing in this work such as UC Davis, Oregon State University, or the USGS Alaska Science Center. The number of anadromous and non anadromous *O. mykiss* will be applied to the trap catch, resulting in better estimates of steelhead productivity.

The performance measures from Task 3 are: run-specific production estimates requiring genetic analysis of run and percent maternal anadromy of *O. mykiss*, a redd-scour index, and condition factor of salmonids.

4.4 **Task 4: Genetic identification of Chinook runs**

4.4.1 Problem

Four individual runs of Chinook have been identified in the Central Valley: late-fall, winter, spring and fall run (Fisher 1994, Yoshiyama et al. 1998). Each run receives separate consideration and protection under the Endangered Species Act. It is important that the status and trend of each Chinook run be monitored separately because restoration goals and actions are run-specific. Separate monitoring efforts for each run is challenging due to overlap in timing of immigration, spawning, and juvenile emigration. Length-at-date criteria (Green 1993) have been shown to be inadequate and misleading when used for identifying the run status of juvenile Chinook in Clear Creek (Gaines et al. 2003, Greenwald et al. 2003, Brown and Earley 2004). Newton and Brown (2004) found a temporal and spatial overlap in the distribution of adult spring and fall Chinook making it difficult to differentiate between them during escapement surveys. Also, coded wire tag recoveries on Clear Creek demonstrate that fall and late-fall adult Chinook occupy the same areas from November - January. In 2003 and 2004, a temporary picket weir was installed to separate spring and fall adult Chinook in Clear Creek. The period of weir operation was based on run timing and observed distribution of Chinook. It is unknown exactly how many fall and spring Chinook are on the “wrong” side of the weir.

Genetic analyses have been shown to accurately identify the run status of individual Central Valley Chinook (Hedgecock 2002). Power gains from employing polymorphic microsatellites have substantially enhanced our ability to distinguish among the runs or life history types in Chinook salmon of the Sacramento River (Banks 2005). Loci employed in Banks et al (2000) provided resources for clear distinction of the endangered winter run but did not hold sufficient statistical power for reliable identification of spring run. Only through employing a number of microsatellites released in the last few years (Greig et al. 2003; Naish et al. 2003 and Willamson et al. 2002) and statistical means for resolving which suite of markers provide the best means for discrimination have we been able to improve confidence in spring run ID. Today statistical power for identification of spring run from Butte, Deer and Mill Creek is greater than 95% (Banks and Jacobson 2004).

It is likely that these techniques will be successful for Chinook found in Clear Creek. Tissue samples from Clear Creek adults are currently being analyzed to determine the relationship of these baseline populations to other Central Valley runs. We propose to genetically analyze tissue samples collected from juvenile and adult Chinook in order to calculate separate juvenile production indexes and adult escapement indexes for fall, spring, and late-fall Chinook.

4.4.2. Approach

Genetic tissue samples will be collected while performing Task 2. We propose to genetically analyze a total of 210 tissue samples per year from adult carcasses. All tissue samples collected from potential spring, late-fall, and winter run (rare) Chinook will be analyzed. A subsample from fall Chinook carcasses will be analyzed to detect spring and late fall Chinook that are collected during the fall run survey. Genetic tissue samples will also be collected while performing Task 3. Genetic analysis of 270 samples from the lower trap will assist in estimating run-specific production. Genetic analysis of 100 samples from the upper trap will verify the run and potentially the origin of spring Chinook spawning in the upper reaches.

We propose to employ DNA extraction, amplification and electrophoresis methods described in Banks et al (2000) to derive genetic data for 12 microsatellites. This data will be used to assessing genetic relationship of these juveniles to the other life history types of the Sacramento River System. Our comparative data will include adults for the five primary sub-populations resolved in Banks et al (2000) as well as adult samples from early returns to Clear and Battle creek analyzed as part of a contract with Environmental Services, California Department of Water Resources.

4.5 **Task 5: Juvenile Habitat Use (Floodway Restoration Project)**

4.5.1 Problem

The Floodway Project is designed to restore a naturally functioning alluvial stream channel. Restoration of the incised clay hardpan channel into a naturally functioning gravel and cobble channel should provide improve rearing habitat for juvenile salmonids. Yet, there are uncertainties about specific effects on rearing habitat. These uncertainties include: 1) will the quality of rearing habitat initially decrease during the first year(s) post reconstruction due to the disturbance and reduction in mature riparian vegetation and structure, 2) will channel design features intended to provide rearing habitat be retained, utilized and mitigate for any short-term reduction in rearing habitat quality, and 3) as riparian vegetation and instream structure develop, will the quality of rearing habitat become equal to or great than control reaches outside the restoration reach? This task will address these uncertainties and will be useful in the implementation and design of other large-scale restoration efforts.

4.5.2 Approach

Habitat use surveys will measure juvenile Chinook densities by direct observation in stream reaches including reconstructed channel segments and upstream and downstream control reaches. Control reaches selected for the 2003 habitat use survey evaluating Phase 3A of the Project (Newton et al. 2004) will be used. We propose to conduct habitat use surveys in the 1st and 3rd year of the funding period in spring of 2007 and 2009. These proposed surveys will monitor Phase 3A (constructed in 2002) and Phase 3B (scheduled for construction in 2005 or 2006). We will conduct before controls for Phase 3B in 2005 or 2006 with funds from CVPIA. Each bi-annual survey will include 6 to 8 replicate counts of juvenile Chinook conducted every two weeks from February through April. Survey protocols will follow those described in Newton et al (2004).

The performance measure for Task 5 is differences in juvenile Chinook densities between restored and control reaches in a before / after / control experimental design. Juvenile densities will also be used to evaluate the success of new channel features designed to provide rearing habitat. Task 5 will determine if quantitative objectives for juvenile rearing habitat have been met by the instream phases of the Floodway Project (Table 1).

4.6 **Task 6: Gravel quality and Survival-To-Emergence**

4.6.1 Problem

Current conceptual models (Figures 2 and 3) and the “Geomorphic Evaluation of Clear Creek” (McBain and Trush 2001) identify the loss of coarse sediment in Clear Creek as a probable limiting factor to salmonid production. Additionally, excess amounts of fine sediment (e.g. <6.3 mm) may also be limiting productivity in Clear Creek (DWR 1985, Matt Brown, USFWS, unpublished data) by reducing survival of eggs to emergence from the gravel. For example according to McBain and Trush (2001), spawning gravels were impacted by fine sediment and were "well outside the range suitable for spawning." Restoration actions 2-5 (Table 1) target the improvement of the quantity and quality of spawning gravel. Yet, uncertainty exists as to the influence of these projects on salmonid egg survival. Uncertainties include: 1) what physical factors influence the use of gravel, 2) what factors influence and best predict survival-to-emergence (STE), 3) does gravel augmentation increase scour risk, 4) do clean gravels result in higher STE through improved DO, 5) can gravels be too clean by promoting sediment intrusion, egg agitation or displacement from the redd, and 5) does gravel augmentation improve spawning habitat use? STE is the percentage of fertilized eggs in a given redd which survive and emerge from the gravel as alevins. Laboratory studies have demonstrated that factors influencing STE include percent fines, gravel permeability, apparent velocity, dissolved oxygen, and water temperature. However, we know of no studies demonstrating that augmentation gravels have increased STE. We propose a study that will directly compare STE in augmentation gravels and in native gravel and identify the linkages between key *in situ* physical, hydraulic and chemical parameters and STE. This study will be conducted in cooperation with Dr. Timothy Horner of the Department of Geology at California State University, Sacramento (CSUS). Dr. Horner has performed studies of physical, hydraulic and chemical parameters in Chinook and steelhead redds in the American River.

4.6.2. Approach

Ten artificial redds will be created at each of four sites (40 redds total); two treatment sites and two control sites. Treatment sites will include Phase 3B of the Floodway Project (rm 3.3) and an "injection" type gravel augmentation site. Each treatment site will be paired with a nearby control site considered to be a high quality native spawning riffle. Approximately 1,000 fall Chinook eggs will be planted in each of the 40 redds. Salmon eggs will be obtained from Coleman National Fish Hatchery (CNFH). There are two stages of egg development when eggs are not extremely fragile: 1) within 24 hour of fertilization and 2) after the eyed stage (Piper et al. 1982, Scott Hamelburg, USFWS-CNFH, personal communication). Previous STE have been complicated due to mortality associated with the transport and handling of eyed eggs. Furthermore, eggs planted at the eyed stage have not been subjected to the inter-gravel environment for a large portion of their incubation period. We propose to transport gametes from CNFH to Clear Creek. Newly fertilized eggs will be water hardened for 1.5 hours and immediately planted in the gravel.

Eggs will be deposited into the gravel using a hydraulic egg planting device (Figure 4). Development of this device first began in the 1970's and has been very successful in Alaska (NRS 2003). Tests performed on the device demonstrate high fish survival (White 1980). An evaluation of the device for use in California was made by NRS (2003) and principle advantages are listed in Table 2. Advantages included creating a natural incubating and rearing environment and flexibility to use on a site-specific basis. The device is inserted into the gravel and a water pump is used to flush harmful fine sediment from the vicinity where the eggs are deposited, similar to the removal of fines when a female salmon constructs a redd (Kondolf et al. 1993). Then eggs are released down the central chamber. Once the eggs have settled the device is gently removed allowing eggs to mix with the gravel. Equipment and training will be provided by the non-profit Alaska Resource and Economic Development, Inc. (ARED). Measurement of STE will be accomplished using salmonid fry emergent traps placed over the location of egg deposition. Water temperatures will be monitored to calculate Daily Temperature Units and predict date of emergence. Emergent traps will be installed one week prior to the earliest predicted emergence date and will remain in place until juveniles are not captured on three consecutive days. Trap design specification will be a modification of those describe by Field-Dodgson (1983).

Physical, hydraulic and chemical parameters in the artificial redds will be monitored by professor Timothy Horner and students of CSUS. Measurements at the gravel treatment sites and nearby control sites will identify limiting factors that relate to redd site selection and survivability of eggs, alevin and fry. A total of 45 locations will be instrumented with mini-piezometers. Piezometers will be installed in arrays near the 40 artificial redd locations and near 5 naturally spawned redds. Longitudinal piezometer arrays will consist of upstream, egg pocket, tailspill and downstream monitoring locations, and will include depths of 30 cm and 60 cm in the gravel. A subset of the redds will also be instrumented with lateral transects of piezometers to examine the effects of bank storage and lateral flow through the gravel. Sites will be sampled monthly during the spawning and incubation period, and tracer tests will be conducted before and after the spawning season to estimate groundwater flow and permeability.

Measurements will include surface water depth and velocity, dissolved oxygen (DO) content of surface water and hyporheic water, pH, electrical conductivity (EC), nitrate, nitrite and ammonia levels, and intergravel temperature. Surface water DO values will be recorded, and compared to subsurface (pore water) DO levels using a YSI field meter, peristaltic pump and flow-through chamber. This technique minimizes contamination from atmospheric oxygen, and maintains appropriate flow velocity past the DO probe tip. Temperature will be measured with a Fluke thermocouple meter and type “K” thermocouple wire, inserted into the mini-piezometers. This gives accurate inter-gravel temperature during field sampling events. Upwelling and downwelling conditions and vertical head gradients will be measured using a bubble manometer board (Horner and Bush, 2000). This compares hydraulic head between the river and shallow depths in the gravel bar, and has been identified as a key factor in spawning site selection (Barnard and McBain, 1998; Geist and Dauble, 1998). Surface water depth and velocity will be measured during the spawning season using a Price AA or Pygmy current meters mounted on a topset wading rod (Wilde and Radtke, 1999). Pore water will be collected for immediate analysis of nitrogen species, and a student technician will conduct the analyses with a Hach test kit and portable spectrophotometer. Two additional physical parameters will be measured by the USFWS; scour and gravel size distribution. Scour risk may be higher for redds located in augmentation gravel than in natural riffles. To monitor scour, we will install five scour cores within each treatment and control site. Gravel size distribution, including percent fines, will be determined for each of the 40 artificial redds. Bulk gravel samples will be taken in redds immediately after emergence trapping is completed. Samples will be dry sieved using a Gilson shaker at the RBFWO.

Task 6 performance measures include STE, gravel quality parameters, and scour depth. These performance measures are needed to evaluate the success of restoration actions 2-5 (Table 1) and will fill important knowledge gaps concerning ecological effects of gravel augmentation projects. This experiment will be conducted on two consecutive years, potentially fall of 2006 and 2007.

4.7. **Task 7: Benthic macroinvertebrates in augmentation gravels**

4.7.1. Problem

Little is known of the impact of channel reconstruction and gravel augmentation on the BMI community. Questions include: 1) are there differences in community structure and abundance between restoration and native gravels, 2) are particular species favored in restoration gravels, 3) if some species are favored, do they provide a potential nutrient benefit for salmonids and 4) can BMIs be used as an index of spawning gravel quality? We propose a study of the BMI community structure and abundance at the same four sites (2 treatments and 2 controls) identified in Task 6 plus two additional treatment and control sites. Task 7, by itself, will address questions 1-3 above. If funded with Task 6, question 4 will also be addressed.

4.7.2. Approach

Four BMI samples will be collected at each of eight sites; four treatment sites and four control sites. Treatment sites will be Phase 3B and three gravel augmentation sites. Each treatment site will be paired with an nearby control site. BMI samples will be collected three times a year (spring, summer and fall) for two years. Samples will be collected in the same two years as Task 6 for integration of the two tasks. We also proposed to analyze samples collected prior to gravel enhancement projects (in 2005) at the eight study sites for before/after comparison. Total number of samples to be analyzed would be 192 the first year and 96 the second.

BMI samples will be collected using methods similar to those of the California State Bioassessment Procedure (CSBP, Harrington 1996). Standard CSBP procedure included taking three replicate samples at separate riffles. Because the size of our study sites may vary, our four samples may be taken at 1 to 4 separate riffles. Taxonomic effort will follow that specified in the CSBP Level 2 and the U.S. EPA's Western Pilot EMAP (Peck et al. 2001). Thus, BMIs will be identified to species level where possible. Samples will be analyzed at either the National Aquatic Monitoring Center (Utah State University) or another laboratory following the CSBP. Standard metric will be calculated including; dry biomass, density, % EPT, % chironomids, richness, diversity, evenness and number of tax.

In addition to BMI samples, stomach contents of juvenile Chinook will collected by gastric lavage. Stomach contents will identify prey species and be used to identify impacts of gravel enhancement projects on the food supply of juvenile Chinook. Ten stomach samples will be collected immediately downstream of each of the two treatment/control pairs during each BMI sampling period. A total of 120 stomach samples will be collected each year.

Performance measures for this task include standard metrics for BMI samples. These measures will determine if quantitative objectives have been met for improving juvenile salmonid rearing habitat found under restoration actions 3 and 4 (Table 1).

4.8. **Task 8: Application of the Clear Creek Decision Analysis and Adaptive Management Model (CCDAM) to assist in identification of limiting factors, future monitoring needs and evaluation of restoration futures**

4.8.1. Problem

Well designed monitoring studies and adaptive management experiments are a key element in the adaptive management cycle: Plan ➜Act ➜Monitor/Experiment ➜Evaluate ➜Plan ➜. The Adaptive Management Forum Panel (AM Panel), assembled by AFRP and CBDA to review large-scale channel and riverine habitat restoration projects, suggested that monitoring of these projects 1) focus on those aspects most critical to the success of the restoration and 2) focus on those aspects about which there is the greatest uncertainty. The panel noted that CCDAM was a good way to help focus monitoring studies on these aspects (AMFSTP 2004). A sensitivity analysis of CCDAM parameters is needed to reveal how robust the system behavior is to various environmental parameter, identify how uncertainties propagate through the system and identify which parameters need more accurate specification (AMFSTP 2004). As a result, CCDAM would identify needs to improve or implement new monitoring studies, evaluate limiting factors, and adapt future restoration actions (adaptive management).

4.8.2. Approach

CCDAM is unique in its emphasis on integrating hydrologic, geomorphic, biological and economic components of the Clear Creek system in a single simulation framework (Figure 5). The basis for and details of the CCDAM model is well documented in Alexander et al. (2003). A simplified conceptual model for CCDAM is given in Figure 6. CCDAM can be used to systematically compare the trade-offs between economic, biological, and learning objectives for alternative reservoir operations and gravel augmentation strategies. Further, the model is built on a formal decision analysis framework to enable a more rigorous accounting of uncertainties. CCDAM is not intended to provide precise predictive results. Rather, the model presents the anticipated outcomes associated with different reservoir operation alternatives, gravel injection practices and other model assumptions, allowing these alternatives to be ranked relative to one another. At present, the prototype model generates relevant output for a wide variety of performance measures.

The maturing state of restoration science in Clear Creek has provided a considerable amount of new field data and other observational information. Time is now ripe to incorporate this information into CCDAM and use it to improve rank order performance of the model's channel (sediment transport), fish population and riparian submodels. Following this data update, we propose performing a comprehensive sensitivity analysis (Table 4) to determine which model functional relationships most significantly affect outcomes of flow and gravel management decisions for various objectives (i.e. flood risk management, channel maintenance, fish production, power production, riparian recruitment). This sensitivity analysis would directly support identification of limiting factors and data gaps for the Clear Creek restoration program; information useful for informing decisions on specific future restoration actions and monitoring. These simulations will also be structured to illuminate critical trade-offs and robust flow and gravel augmentation policies (i.e. those that best satisfy multiple objectives). This information will be critical for clarifying the most promising future reservoir operation and gravel management alternatives in the context of (a) current practice and (b) possible higher flow management approaches. Finally, results of the sensitivity and trade-off analysis would be documented in a draft report summarizing the key findings and recommendations and then submitted for review by agency participants and interested stakeholders.

The CCDAM has been independently reviewed by the AM Panel and the CBDA EWP. The Panel strongly recommended that restoration projects develop quantitative conceptual models like CCDAM (AMFSTP 2004). The EWP advocates using CCDAM to evaluate the feasibility of attaining mid-range environmental flows as well as for investigating key geomorphic thresholds and fish population trade-offs (EWP 2004). Furthermore, CVPIA Restoration Fund Roundtable Ad Hoc Workgroup (June 24, 2004 Sacramento) indicated that a "limiting factor and data gaps analysis" should be performed for Clear Creek and that this should be used to inform decisions on specific future restoration actions. Many of the actions and performance measures listed by the Workgroup are included in CCDAM's submodels. Our proposed sensitivity analysis, limiting factor analysis and trade-off study follow through on theses recommendations

4.9. **Task 9: 2-D Modeling (Floodway Restoration Project)**

4.9.1. Problem and approach

A primary goal of the Project is to increase the quantity of salmonid spawning and rearing habitat. 2-dimensional (2-D) modeling based on detailed physical habitat mapping has been used to estimate the amount of spawning and rearing habitat available prior to construction (Gard 2004) and to predict the amount of habitat to be created based on Project conceptual designs (Gard 2004). 2-D modeling will also be used to estimate the amount of habitat created in Phase 3A (Gard in progress). The predicted habitat will be compared to observation of actual adult (Giovannetti et al 2004) and juvenile (Newton et al 2004) habitat use. It is predicted that habitat quantity and quality will improve over time as instream structure and vegetation develop. On the other hand, factors that led to channel degradation including lack of sediment supply, floodplain degradation due to mining and reduced channel forming flows may conspire to degrade the Project over-time. We propose to continue 2-D modeling of habitat to evaluate benefits of the Project including future phases, to track evolution of the new channel over time and to evaluate which of the two main trajectories the project will follow.

4.10. **Task 10: Juvenile Habitat Suitability Index (Floodway Restoration Project)**

4.10.1. Problem and Approach

We propose to continue developing HSI specific for Clear Creek for use in the 2-D model evaluation of the Project proposed in Task 9. 2D modeling of salmonid habitat, requires use of habitat suitability indexes which assign relative habitat value to parameters such as water depth, water velocity, substrate size, distance to cover and adjacent velocity. The HSI are applied to the 2-D hydraulic model output to predict the quality and amount of habitat provided under various flows. Therefore estimation of habitat quantity and quality is highly dependant upon HSI which can vary between watersheds, species and runs. HSI have not been developed for juvenile Chinook or steelhead in a Central Valley stream the size of Clear Creek. The RBFWO is currently collecting data to be used in developing HSI specific for Clear Creek but we anticipate that due to small population sizes it will take about 4 years to collect the minimum number observations required for each life stage of the 4 runs. Incidental observations of juvenile Chinook are made during Task 2 snorkel surveys. These observations will be used along with systematic sampling to choose habitat units for observations. Crews of 3 snorkel the creek looking for juvenile salmonids, mark the locations of juveniles and measure the parameters. Work is time intensive with these rare species.

4.11. **Task 11: Floodplain Stranding (Floodway Restoration Project)**

4.11.1. Problem

Stranding of juvenile salmonids on floodplains during high flow events may be a significant source of mortality. It has been suggested that floodplains constructed in the project may increase stranding because of the lower topographic slope and lack of natural drainage features. On the other hand the constructed slope is distributed consistently throughout the project and the scour channels were designed specifically to reduce stranding. It is unknown how constructed floodplains affect stranding rates and if the stranding rate is greater or less than on natural floodplains. Stranding rates may be affected by design features such as the longitudinal and lateral slope of the constructed floodplain, the location and density of revegetation plots, and the shape and elevation of scour channels created to drain floodplains and return juveniles to the creek. Floodplain stranding studies would compare stranding rates on constructed floodplain with rates on nearby natural floodplains and identify features which strand fish. Knowledge obtained would inform the design of other large-scale floodway restoration efforts.

4.11.2. Approach

Following winter flood events, we will determine stranding rates on at least two constructed and two natural floodplains located between river miles 2.0 and 8.5. Constructed floodplains have been designed to flood at flows greater than about 2,000 or 3,000 cfs. Natural floodplains chosen for this study will flood at flows above 2,000 cfs. Immediately after flood waters recede, field crews will sample designated floodplains for stranded fish eggs and juveniles. Samples will we taken by placing a 1 x 1 meter PVC sampling square at 100 randomly chosen locations on each floodplain. When juveniles are located, fish fork length and stranding substrate diameter will be measured and photographs will be taken. In addition to random sampling, we will also search floodplain areas likely to strand fish (e.g. vegetation, topographic depressions). Surveys will follow high flow events over 4,000 cfs occurring from December through March in all three years of the funding period.

4.12. **Task 12: Scour Channel Studies (Floodway Restoration Project)**

4.12.1. Problem

Scour channels are designed in reconstructed floodplains to provide a clear route for water and fish to return to the creek as floodwaters recede. In addition to preventing stranding of juvenile fish, scour channels may provide valuable salmonid rearing habitat for a portion of the year. To date, three types of scour channels have been constructed including a “broad” channel type (wide, flat bottomed, and shallow), a “V” channel type (narrower and deeper), and a “broad/V combination” channel (wide and shallow with a small “V” notch down the center). Monitoring is needed to determine which design most effectively prevents stranding and provides the highest quality rearing habitat.

4.12.2. Approach
We propose an evaluation of some of the fisheries risks and benefits of these floodplain scour channels. Techniques will include multiple pass/removal estimation of juvenile fish populations, water quality monitoring, and mapping of surface water and connectivity to the creek. Performance measures will include fish density and total population estimates; water temperature, dissolved oxygen, depth, and velocity; presence of salmonid predators; duration and amount of surface flow connected to the creek; and mortality due to isolation/stranding with scour channels. These performance measures will determine if quantitative objectives have been met for improving salmonid rearing habitat on constructed floodplains (Table 1).

5. Feasibility
The RBFWO has experience conducting many aspects of the Clear Creek monitoring studies included in this proposal. Techniques, protocols, and study designs have been tested and revised. We have successfully obtained the necessary state and federal permits to conduct this work for the past several years. Tasks that include monitoring techniques new for the RBFWO include tasks 6 (gravel quality and STE) and 7 (benthic macroinvertebrates). Study designs for these task were developed in coordination with permitting agencies, CNFH (our source for Chinook eggs), and experts in the fields of geomorphology and benthic macroinvertebrates. Experts included professors from CSU Chico, CSU Sacramento, and Utah State University as well as professionals with expertise in implementing similar studies. Nearly all of our monitoring activities will occur on public land held by agencies with which we have a close working relationship. For the one monitoring sites that is privately owned, we have obtained written permission granting us access (see attachments).

6. Expected Outcomes and Products
Annual and final reports are the deliverables for all tasks (see online form). Publications in peer reviewed journals are expected products of Task 4 (genetic analyses) and Task 6 (gravel quality and STE). Also, a masters thesis (CSU Sacramento)is expected from Task 6. Oral or poster presentations of tasks 2-7 and 9 will be given annually at science conferences. Findings of all tasks will be presented frequently at Clear Creek Technical Team meetings and stakeholder meetings.

7. Data Handling, Storage, and Dissemination
Field data are recorded onto paper field sampling forms and originals are retained at the RBFWO. Field data will be entered into electronic data bases using Access (Task 3), or spreadsheet software such as Excel, or Lotus 1-2-3 (all other tasks). Data entry is proofed until an error rate of <1% is achieved. Data will be distributed in data-draft reports, annual reports, Clear Creek Technical Team Meetings, or stakeholder meetings. Data will also be distributed to interested parties upon request. Lower Clear Creek is one of 18 watersheds profiled on the Watershed Information Model (WIM), an interactive Website created by the WSRCD and partners and funded by the CALFED Watershed Subcommittee. Reports are posted on the website.

8. Public Involvement and Outreach
RBFWO staff have presented results of past fisheries monitoring work by giving site tours to local residents, giving numerous newspaper and television interviews, and giving presentations to stakeholder and technical team meetings. In addition, we have contributed to the development of outreach

brochures and a television documentary of fisheries restoration work on Clear Creek. We will continue to seek these same opportunities to present findings of work funded by this proposal package.

9. Work Schedule

The duration of all tasks is 36 months with the exception of Task 8 which will be completed in 24 months. Five tasks involve seasonal field or laboratory work for all three years of the grant period (tasks 2-4, 11, 12). Annual reports will be due one year following the completion of the each field season. Final reports will be due on the final day of the contract period. Table 3 describes the annual field season for each task.

Three tasks involve seasonal field work for two years of the grant period. Field work for task 5 will occur in the 1st and 3rd years. Tasks 6 and 7 will occur during the 1st and 2nd years. Annual reports will be completed either one year following the completion of the each field season (Table 3) or the final day of the contract, whichever comes first.

Three tasks will included field work and analysis throughout the three year grant period but are not based on seasons (tasks 8-10). For examples, 2D Modeling and Juvenile HSI development (tasks 8 and 9) involve combining all field data collected over three years. CCDAM does not have a field component. These tasks will have only a final report due on the final day of the contract.

In some cases, there is significant added benefit if certain tasks are funded jointly under this proposal. For example, funding both adult and juvenile monitoring (tasks 2 and 3) will allow us to evaluate environmental and restoration action impacts occurring in Clear Creek (as opposed to the estuary or ocean). Also, task 4 (genetic analysis) may greatly enhance our ability to make accurate run-specific population indices for adult and juvenile Chinook under task 2 and 3. An added benefit would also be achieved by jointly funding task 6 and 7. If task 6 and 7 were both funded, exploring the use of BMIs as and indicator of spawning gravel quality would be possible.

We expect four tasks to continue past the three year duration of this grant period. These include annual adult escapement monitoring, juvenile production monitoring and associated genetic analysis (tasks 2-4). These tasks are necessary to determine long-term population-level impacts of restoration actions. In addition, we plan to monitor juvenile habitat use at stream channel reconstruction sites every 2 or 3 years over a period of 10 to 12 years post reconstruction. This will evaluated changes to salmonid rearing habitat as these sites mature and riparian structure develops. Available sources of funding will be explored following this grant period.

B. Applicability of CALFED Bay-Delta Program ERP Goals and CVPIA Priorities

1. ERP and CVPIA Priorities

The Multi-Species Conservation Strategy (CBDP 2000) identifies spring, fall, and late-fall Chinook and steelhead as “R” species (a.k.a. big R species). “R” species are those for which CBDA has established the goal to recover within the ERP ecological management zones. Similarly, the ERP goals include recover at-risk species (goal 1) and maintain or enhance harvested species populations (goal 3) such as federally listed salmonids (CBDP 2001). CBDA and CVPIA have undertaken actions necessary to recover these species in Clear Creek. Our proposal will directly determine if salmonid recovery goals are being met in Clear Creek, especially tasks 2, 3, and 4.

Additional goals of the ERP include rehabilitating ecological processes (goal 2) and restoring habitats (goal 4). These goals directly support and are intermediate steps to recovering at-risk species. To meet these goals, ERP seeks to implement actions to restore hydrologic regimes, sediment supply, floodplain form and function, and stream channel form and function. ERP has classified Clear Creek as a "signature opportunity" to implement and learn from such projects. Our proposal includes tasks that will monitor the outcome of these projects in a way that will directly link ecological processes to immediate biotic responses (tasks 5-12). This will aid ERP in meeting their objective of gathering information necessary to inform future restoration efforts. Our monitoring will also evaluate and refine current conceptual models upon which these restoration projects are based.

The Multi-Species Conservation Strategy has 119 milestones to measure progress toward meeting its goals. There are 30 milestones specifically for the Sacramento Region (includes Clear Creek) and 8 for research. Restoration actions on Clear Creek specifically address 17 separate milestones for the Sacramento Region and research (Table 5). Tasks included in this proposal will evaluate if the desired outcomes were achieved and progress was made toward reaching the milestones.

CVPIA considers Clear Creek as a high priority stream for the restoration of Central Valley salmonids, identifying restoration actions to be implemented specifically on Clear Creek such as providing adequate instream flows, fish passage, and channel restoration. Thus CVPIA has invested in numerous restoration actions on Clear Creek. Our proposal will evaluate if the goals of the CVPIA are being met.

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

Task 6 (gravel quality and STE) will be executed in close coordination with CSUS. Faculty and students from CSUS are involved with inter-gravel studies on the American River (BOR and CVPIA funding), and proposed work on the Mokulumne and American Rivers (2004 ERP Solicitation). Task 6 builds on these studies by linking inter-gravel parameters directly to augmentation gravels and STE rates.

Task 8 : CCDAM is the only integrated "meeting place" for hydrologic, geomorphic, economic, fish population and riparian habitat restoration science we are aware of in Clear Creek (Figure 5). There is a continuing need for an overarching forum where various agency scientists, modelers and managers can discuss options and assess trade-offs for flow management in Clear Creek. CCDAM is integrated with restoration actions and monitoring studies of ERP, CVPIA, EWP, and a concurrent proposal by WSRCD for the geomorphic, riparian, and songbird monitoring on Clear Creek. Figure 5 depicts the relationship between CCDAM to each of the Clear Creek restoration and monitoring programs.

3. Additional Information for Proposals Containing Land Acquisition. N/A

C. Qualifications

Matt Brown (All Tasks), Fisheries Biologist with the Fish and Wildlife Service Red Bluff, Fish and Wildlife Office, has worked with the CVPIA Clear Creek Restoration Program since 1995 and oversees associated fisheries monitoring. He also directs the Services' Battle Creek anadromous salmonid monitoring funded by CALFED. Prior to beginning his career with the Service in New Mexico in 1991, Matt worked for the Arizona Game and Fish Department as a Nongame Fish Biologist. He received his M.S. in biology from Arizona State University for his work relating hormones, food availability and sexual receptivity to territorial aggression.

Jess Newton (All Tasks) is a Fisheries Biologist with the USFWS and will direct much of the field work, data analysis and report writing for the proposed tasks. Mr. Newton received a Bachelors of

Science in Fisheries from Humboldt State University in 1997. He then worked for the USGS conducting radio telemetry studies of juvenile Chinook on the lower Snake River. For the past 6 years, he has worked for the USFWS at the Red Bluff Fish & Wildlife Office. His current work includes monitoring the response of juvenile and adult salmonids to a variety of restoration actions on Clear Creek and Battle Creek, tributaries to the upper Sacramento River.

Dr. Michael Banks (Task 4) is a Marine Fisheries Geneticist and Assistant Professor in the Department of Fisheries and Wildlife, Oregon State University. His research and teaching interests center on the application of population genetic principles towards furthering basic knowledge and understanding of marine population processes. Broadly, he's interested in genetic characterization of natural populations, fishery subjects and aquacultural species. He focuses chiefly on methods for resolving hybridized, admixed, or recently diverged populations, and statistical methods for determining component estimates for mixtures of such populations in various contexts. Dr. Banks is particularly interested in evaluating the information content that can be gained from alternate genetic marker types and resolving links between genetic loci and life history variance expressed among species.

Dr. Tim Horner (Task 6) is an Associate Professor in the Geology Department at CSU Sacramento, and has been a member of the department since 1993. He graduated from The Ohio State University in 1992 with a Ph.D. in Geology, and specializes in ground water/surface water interaction, physical and geochemical conditions in salmonid spawning habitat, field instrumentation, and near-surface water geochemistry. His work for the past three years has focused on gravel restoration sites on the American River, with emphasis on physical and geochemical conditions that relate to salmon spawning habitat. A draft report of the first year spawning gravel study is available at: http://www.csus.edu/indiv/h/hornert/, and is *in review* for the California Department of Fish and Game Stream Evaluation Program Technical Publication Series (Horner et al, in review).

Clint Alexander (Task 8) would serve as project manager and technical lead for the CCDAM modeling component of the project. Mr. Alexander is an integration specialist focused on identifying and applying appropriate methods for integrating biological, physical, and economic components of environmental problems into comprehensive decision oriented advice. He specializes in the use of quantitative methods that permit the clear identification and credible accounting of key uncertainties (e.g., probabilistic simulation modeling, statistics, decision analysis and adaptive management). The focal problems for these methods have been large-scale watershed restoration programs and socioeconomic/biological trade-off evaluations related to operational modifications at dams and reservoirs. He has over 10 years of experience in simulation modeling, environmental information system design and trade-off analysis. Since joining ESSA, Mr. Alexander has participated in the project management, design and development of a wide range of data-driven decision support tools. For the majority of these assignments (including CCDAM) he was the principal architect and developer. Mr. Alexander holds a B.Sc. in Ecology and Environmental Biology from the University of British Columbia and a Masters in Resource and Environmental Management (MRM) from Simon Fraser University.

Dr. Yantao Cui (Task 8) is a civil engineer with over thirteen years of experience modeling sediment dynamics and hydraulic effects in regulated rivers. His applied research projects have involved investigation of riverbank erosion, effects of gravel extraction on fluvial geomorphic processes, and the downstream impacts of reservoir management.

D. Cost.

1. Budget- Total cost for the proposal is $3,373,313. All of the tasks can be funded separately. In addition, costs for Task 2 and 3 could be reduced by reducing the number of runs or species for which escapement or production is estimated.

2. Cost Sharing- None at this time.

3. Long-term funding strategy- Long term funding will be necessary for Tasks 2 - 4 on an annual basis, and for Task 5 every 2 or 3 years (see section A. 9. Work Schedule). Potential funding sources would include CALFED, CVPIA, and Fish and Wildlife Service internal funding mechanisms.

E. Compliance with Standard Terms and Conditions

The RBFWO has successfully entered into 7 contracts with CALFED in the last 4 years, and all of them were funded by State agencies, and managed by either DWR or NFWF. Therefore we are confidant that we will be able to work through any contracting difficulties that may arise from the potential issues listed below. We can comply with standard terms and conditions except as indicated below.

Exhibit A - "List of Attachments" - where it references Exhibit B - Attachment 3 - State Travel & Per Diem Expense Guidelines. Federal employees' travel reimbursements must be in accordance with Federal travel regulations.

Exhibit B - "Invoicing and Payment Provisions", on pages 1 of 5 through 5 of 5. The requirement for invoices in triplicate cannot be complied with, nor any special format that differs from the DI-1080 Bill for Collection.

Exhibit B - 6. Performance Retention. The 10% retention requirement remains the same problem it has always been. In the past, our agreements have had the retention clause removed.

Exhibit C - 12. Travel. As indicated above, travel reimbursement for federal employees must be in accordance with Federal travel regulations.

Exhibit D - 11. Insurance. Federal govt. is self insured. This clause should not be applicable.

Exhibit D - 13. Prevailing Wages and Labor Compliance. Federal agencies comply with Federal wage and labor laws. The "State Labor Code Section 1771" may or may not be in conflict with federal laws.

G. Literature Cited

Alexander, C. A. D., D. R. Marmorek, C. N. Peters, and M. Porter. 2003. Clear Creek Decision Analysis and Adaptive Management Model: Design Document, Draft 1.5. Draft report prepared by ESSA Technologies Ltd., Vancouver, BC for U.S. Bureau of Reclamation, Shasta Lake, CA. 116 pp + appendices.

(AMFSTP) Adaptive Management Forum Scientific and Technical Panel. 2004. Adaptive management forum for large-scale channel and riverine habitat restoration projects. Final Report. Information Center for the Environment, University of California, Davis. http://www.delta.dfg.ca.gov/afrp/documents/AMF_%20FINAL_REV5.pdf

Banks, M.A. 2005. Stock identification for the conservation of threatened or endangered species. In: Stock identification methods Eds: Cadrin, S.X., K.D. Friedland and J.R. Waldman. Elsevier Press. pp593-613.

Banks, M.A. and D.P. Jacobson. 2004. Which Genetic Markers and GSI Methods are More Appropriate For Defining Marine Distribution and Migration of Salmon? North Pacific Anadromous Fish Commission Technical Note 5: 39-43.

Banks, M. A., W. Eichert, and J.B. Olsen. 2003. Which genetic loci have greater population assignment power? Bioinformatics 19(11):1436-1438.

Banks, M. A., V.K. Rashbrook, M.J. Calavetta, C.A. Dean, and D. Hedgecock 2000. Analysis of microsatellite DNA resolves genetic structure and diversity of chinook salmon (*Oncorhynchus tshawytscha*) in California's Central Valley. Canadian Journal of Aquatic Science 57: 915-927.

Barnard, K, and S. McBain, 1998, Comprehensive monitoring and assessment program protocol for sampling surface water- ground water interactions in spawning reaches of lowland rivers: accessed 10/12/200 at: http://www.calfed.water.ca.gov/programs/cmarp/a7a12d.html.

Brown, M. R. 1996. Benefits of increased minimum instream flows on Chinook salmon and steelhead in Clear Creek, Shasta County, California 1995-6. USFWS Report. U.S. Fish and Wildlife Service, Northern Central Valley Fishery Resource Office, Red Bluff, California.

Brown, M.R., and J. T. Earley. 2004. Monitoring Juvenile Spring Chinook in Clear Creek, California, from October 2003 to July 2004. Draft USFWS Report. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

CBDP (Calfed Bay-Delta Program). 2000. Multi-species conservation strategy. Final programmatic EIS/EIR technical appendix.

CBDP (Calfed Bay-Delta Program). 2001. Ecosystem Restoration Program draft stage 1 implementation plan.

DWR (California Department of Water Resources). 1986. Clear Creek fishery study. Northern District, Red Bluff.

EWP (Environmental Water Program). 2004. Environmental Water Program draft conceptual proposal for flow acquisition on lower Clear Creek, June 2004. Report by Stillwater Sciences for the EWP Clear Creek Local Proposal Preparation Team.

Field-Dodgson, M. S. 1983. Emergent fry trap for salmon. Progressive Fish Culturist 45(3):175-176.

Fisher, F. W. 1994. Past and present status of Central Valley Chinook salmon. Conservation Biology 8(3):870-873.

Gaines, P.D, R.E. Null, and M.R. Brown. 2003. Estimating the abundance of Clear Creek juvenile Chinook salmon and steelhead trout by the use of rotary screw trap. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California. Progress Report (Vol. 1) February 2003.

Gard, M. 2004. Monitoring of Clear Creek Restoration Projects Using 2-Dimensional Modeling Methodology. US Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.

Geist, D.R., and D.D. Dauble. 1998. Redd site selection and spawning habitat use by fall chinook salmon: the importance of geomorphic features in large rivers. Environmental Management 22:655-669.

GMA (Graham Matthews & Associates). 2003. Clear Creek floodplain rehabilitation project: WY2003 geomorphic monitoring report. Report to the Western Shasta Resource Conservation District.

GMA (Graham Matthews & Associates). 2004. Clear Creek floodplain rehabilitation project: WY2004 geomorphic monitoring report. Report to the Western Shasta Resource Conservation District.

Giovannetti, S. L. and C. S. Gaither. 2004. Central Valley steelhead (*Oncorhynchus mykiss)* redd surveys on Clear Creek and Battle Creek, California. In: Symposium and annual meeting of the California-Nevada and Humboldt Chanters conference program; April 22-24; Redding, California. American Fisheries Society.

Giovannetti, S.L., J. M. Newton, and M. R. Brown. 2004. Chinook spawning area mapping for the Clear Creek Restoration Program, 2000-2003. USFWS Report. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

Greene, S. 1992. Daily fork-length table from data by Frank Fisher, California Department of Fish and Game. California Department of Water Resources, Environmental Services Department, Sacramento.

Greenwald, G. M., J. T. Earley, and M. R. Brown. 2003. Juvenile salmonid monitoring in Clear Creek, California, from July 2001 to July 2002. USFWS Report. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

Greig, C., D.P. Jacobson, and M.A. Banks. 2003. New tetranucleotide microsatellites for fine-scale discrimination among endangered Chinook salmon (Oncorhynchus tshawytscha). Molecular Ecology Notes 3:376-379.

Harrington, J.M. 1996. California state bioassessment procedure. California Department of Fish and Game, Water Pollution Control Laboratory, Rancho Cordova, California.

Hedgecock, D. 2002. Microsatellite DNA for the management and protection of California's Central Valley Chinook salmon (*Oncorhynchus tshawytscha*). Final report for the amendment to agreement No. B-59638. UC Davis, Bodega Bay.

Horner, T.C., and Bush, N.J., 2000. abs., Small scale gain and loss and geochemical variability of pore water in the hyporheic zone of a gravel bar used for salmon spawning in the American River, California. Geological Society of American Abstracts with Programs 32(7): 141.

Kondolf, G., M. J. Sale, and M. G. Wolman. 1993. Modification of fluvial gravel size by spawning salmonids. Water Resources Research 29(7), p. 2265-2274.

McBain and Trush, Graham Matthews and Associates, and North State Resources. 2000. Lower Clear Creek floodway rehabilitation project: channel reconstruction, riparian vegetation, and wetland creation design document. Report to the Clear Creek Restoration Team.

McBain and Trush. 2001. Geomorphic evaluation of lower Clear Creek downstream of Whiskeytown Dam, California. Final report.

NMFS (National Marine Fisheries Service), West Coast Salmon Biological Review Team. 2003. Draft report of Preliminary conclusions regarding the updated status of listed ESUs of West Coast salmon and steelhead. http://www.nwfsc.noaa.gov/trt/brtrpt.htm.

Naish, K. A., and L. K. Park. 2002. Linkage relationships for 35 new microsatellite loci in Chinook salmon Oncorhynchus tshawytscha 33:316-318.

Newton, J. M., and M. R. Brown. 2004. Adult spring Chinook salmon monitoring in Clear Creek, California,1999-2002. USFWS Report. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

Newton, J. M., J. R. Grigg, and M. R. Brown. 2004. Juvenile Chinook Habitat Use in Lower Clear Creek, 2003: fisheries evaluation for Phase 3A of the Lower Clear Creek Floodway Rehabilitation Project. USFWS Report. U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, Red Bluff, California.

NRCS (Natural Resources Conservation Service). 1998. Lower Clear Creek monitoring project summary report, 1997, Shasta County, California.

NRS (Natural Resource Scientists, Inc.). 2003. Evaluation of a proposal for hydraulic salmonid egg deposition. Report to the U.S. Bureau of Reclamation.

Peck, D.V., J.M. Lazorchak, and D.J. Klemm (editors). 2001. Unpublished draft. Environmental Monitoring and Assessment Program -Surface Waters: Western Pilot Study Field Operations Manual for Wadeable Streams. EPA/XXX/X-XX/XXXX. U.S. Environmental Protection Agency, Washington, D.C.

Piper, P. G., and five coauthors. 1982. Fish Hatchery Management. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D. C.

Steensen, David L. 1997. Trip Report- Reconnaissance of Landside and Channel Changes Associated with the 1997 New Years Storm Event; Februarty 3-5, 1997. Memorandum to Superintendent of Whiskeytown National Recreation Area from Geologist, Science and Technical Services Branch, Geologic Resources Division, National Park Service, Denver Colorado.

Taylor, Kremsater and Ellis. 1997. Adaptive management of forests in British Columbia. BC Ministry of Forests.

USBOR (U.S. Bureau of Reclamation). 2004. Long-term Central Valley Project and State Water Project Operating Criteria and Plan. Various drafts dated January 8, February 13, March 18, March 22, May 24, and June 30, 2004. Biological Assessement for ESA section 7(a)(2) consultation. Mid-Pacific Region. Sacramento, CA.

USFWS (U.S. Fish and Wildlife Service). 2001. Final Restoration Plan for the Anadromous Fish Restoration Program. A plan to increase natural production of anadromous fish in the Central Valley of California. Prepared for the Secretary of the Interior by the United States Fish and Wildlife Service with the assistance from the Anadromous Fish and Restoration Program Core Group under authority of the Central Valley Project Improvement Act. Released as a revised draft on May 30,1997 and adopted as final on January 9, 2001.

White, L. E. 1980. Evaluation of a new planting device for salmon eggs. Progressive Fish Culturist 42(3):177-180.

Wilde, F.D., and Radtke, D.B., 1999, Chapter A6. Field Measurements, in Wilde, F.D., Radtke, D.B., Gibs, J., and Iwatsubo, R.T., eds., Techniques of Water Resources Investigations Handbook for Water Resources Investigations Book 9, National Field Manual for the Collection of Water Quality Data: Washington, U.S. Geological Survey, p. T1-T15.

Williamson, K. S., J.F. Cordes, and B. May. 2002. Characterization of microsatellite loci in Chinook salmon (*Oncorhynchus tshawytscha*) and cross-species amplification in other salmonids. Mol. Ecol. Not. 2:17-19.

Yoshiyama, R. M., F. W. Fisher, and P. B. Moyle. 1998. Historical abundance and decline of Chinook salmon in the Central Valley region of California. North American Journal of Fisheries Management 18:487-521.

H. Nonprofit Verification

The USFWS is a federal agency and therefore a nonprofit.

Table 1: Five ecosystem restoration actions taken on Clear Creek, California, with associated goals, objectives, hypotheses, performance measures and proposed monitoring studies. Restorations actions were funded by CVPIA and CBDA. Tasks listed following monitoring methods correspond to tasks presented by the USFWS in this proposal.

RESTORATION ACTION	GOAL	QUANTITATIVE OBJECTIVE	HYPOTHESES	PERFORMANCE MEASURE(S) & MONITORING METHOD	LINKS TO OTHER PROGRAMS
1. Increased minimum instream-flow SCALE = 10-10^3 channel widths	**F1**: Improve the quantity and quality of salmonid spawning & juvenile rearing habitat.	**F1-A**: Provide suitable water temperatures for all life stages of salmonids upstream of river mile 10.9 (≤60 ˚F for adult holding and juvenile rearing and ≤56 ˚F for spawning and egg incubation). Provide suitable spawning temperatures for fall & late-fall Chinook upstream of rm 1.7 (≤56 ˚F).	**F1-A**: Temperature targets can be achieved by flow management.	**F1-A**: Water temperature as measured at >8 locations throughout lower Clear Creek. [TASK 2.1] **F1-A**: The spatial and temporal distribution of salmonids, redds, and carcasses as measured by snorkel & kayak surveys. [TASK 2, 4]	AFRP action1 CVPIA B2 water CCDAM
		F1-B: Maximize the suitable habitat for all life stages of salmonids based on water depth, velocity, substrate, & cover. Flows will balance the needs of the different salmonid species and life histories.	**F1-B**: Flow management will increase the area of habitat utilized by salmonids for spawning and rearing.	**F1-B**: Weighted Usable Area as determined by "River2D" & IFIM. [TASK 9, 10] **F1-B**: Habitat utilization as determined by redd mapping & juvenile habitat use surveys. [TASK 2.2, 5]	CVPIA's IFIM
	F2: Attain ≥"minimum viable population" sizes for Chinook (spring, fall, late-fall runs) and steelhead.	**F2**: Increase salmonid escapement to the following numbers: 1) spring-run: >1000, 2) late-fall-run: >1000, and3) steelhead: >500 redds.	**F2**: Managing flows (and temperatures) will result in an increase in salmonid populations.	**F1&2**: Juvenile salmonid production index as determined by two rotary screw traps. [TASK 3, 4] **F1&2**: Escapement estimates or indices as measured by snorkel, kayak surveys, & walking carcass surveys. [TASK 2, 4]	

Table 1: (continued)

RESTORATION ACTION	GOAL	QUANTITATIVE OBJECTIVE	HYPOTHESES	PERFORMANCE MEASURE(S) & MONITORING METHOD	LINKS TO OTHER PROGRAMS
2. Removal of Saeltzer Dam (S. Dam) SCALE = 10-10^3 channel widths	**F3:** Provide 11.5 miles of habitat for spring Chinook and steelhead	**F3-A**: Establish a minimum viable population (>1,000) of spring Chinook in Clear Creek above S. Dam. **F3-B**: Establish a minimum viable population (>1,000) of steelhead trout in Clear Creek.	**F3-A**: Stray spring-run from other watersheds will contribute in a new population in Clear Creek. **F3-A&B**: Improved passage past S. Dam (with adequate minimum flows) will result in an increase in the steelhead population and the re-establishment of a viable spring Chinook population.	**F3-A&B**: Escapement indices for target species as measured by snorkel and kayak surveys. [TASK 2, 4] **F3-A&B**: Juvenile production of target species as measured by the upstream rotary screw trap. [TASK 3, 4] **F3-A&B**: "River2D's" Weighted Usable Area for salmonid spawning and rearing habitat above Clear Creek Road bridge. [TASK 9, 10] **F3-A**: Genetic identity of potential spring Chinook to accurately differentiate them from fall-run. Tissue collections will be made during snorkel surveys and juvenile trapping. [TASK 2.1, 4] **F3-B**: Otolith analysis to determine proportion of *O. mykiss* that are anadromous. [TASK 3]	CVPIA B12 CBDP milestone 67
	F4: Increase spawning habitat downstream of S. Dam by releasing course sediments stored behind the dam.	**F4**: Attain a 48,000 ft^2 (25%) increase in used spawning habitat downstream of the former S. Dam over the baseline period of 2000-2001.	**F4**: Sediment formerly stored behind S. Dam will be transported downstream and lead to aggradation in the stream channel and new spawning riffles.	**F4**: Spawning habitat utilization (surface area of redds/redd aggregates) as measured by redd mapping (over a 10 year period). [TASK 2.2]	

Table 1: (continued)

RESTORATION ACTION	GOAL	QUANTITATIVE OBJECTIVE	HYPOTHESES	PERFORMANCE MEASURE(S) & MONITORING METHOD	LINKS TO OTHER PROGRAMS
3a: Stream channel reconstruction (Lower Clear Creek Floodway Restoration Project) SCALE = 1-10 & 10-10^2 channel widths	**F5**:Improve the quantity and quality of salmonid spawning habitat.	**F5-A**: Attain at least a 200% increase in spawning habitat use, over baseline period.	**F5-A**: Channel reconstruction will increase spawning habitat use by Chinook.	**F5-A**: Spawning habitat use (surface area of redds/redd aggregates) as measured by redd mapping (over a 10 year period). [TASK 2.2] **F5-A:** Weighted Usable Area as predicted by "River2D" hydraulic modeling. Use redd mapping to validate model. [TASK 9, 10]	**F5-A**: EWP (Goal 2, Obj' a)
		F5-B: Attain egg survival-to-emergence (STE) equal to or greater than outside the project reach.	**F5-B**: Channel reconstruction will result in above average STE.	**F5-B**: STE rates for Chinook eggs hydraulicly placed in artificial redds and gravel quality parameters (e.g. temperature, bed scour, permeability, DO, Nitrogenous waste, and % fines). [TASK 6]	**F5-B**: CCDAM (5.2.3) **F5-B:** EWP (Goal 2, Obj' e)
	F6: Improve the quantity and quality of juvenile rearing habitat.	**F6-A**: Channel features designed to provide juvenile habitat will be retained for >5 years and will be utilized at levels >100% above average densities in control reaches.	**F6-A**: Channel features designed as rearing habitat will contain relatively high densities of juvenile Chinook.	**F6-A&B** : Density of juvenile Chinook as measure by direct observation (habitat use) surveys. [TASK 5]	
		F6-B: Attain average juvenile densities in the reconstructed channel that equal or exceed levels in control reaches.	**F6-B**: Mean juvenile densities in the reconstructed channel will be greater than in control reaches.	**F6-B**: Weighted Usable Area as predicted by "River2D" hydraulic modeling. [TASK 9, 10]	
		F6-C: Attain aquatic macro-invertebrate prey densities in the reconstructed channel at 1) levels >100% above densities in clay hard-pan channel areas and 2) levels greater than densities in natural riffles.	**F6-C**: Spawning gravel lining reconstructed channel reaches will increase the production & diversity of macro-invertebrate food sources for juvenile Chinook.	**F6-C**: Invertebrate production, density & diversity and ratio of predation susceptible to unsusceptible inverts. Measured by standard sampling methods. [TASK 7] **F6-C**: Analyze stomach contents of juvenile Chinook to confirm which invertebrates are prey species. [TASK 7]	**F6-C**: EWP (Goal 2, Obj' e) **F6-C**: CC AMF rpt

Table 1: (continued)

RESTORATION ACTION	GOAL	QUANTITATIVE OBJECTIVE	HYPOTHESES	PERFORMANCE MEASURE(S) & MONITORING METHOD	LINKS TO OTHER PROGRAMS
3b: Floodplain reconstruction (Lower Clear Creek Floodway Restoration Project) SCALE = 1-10 & 10-10^2 channel widths	**F6**: Improve the quantity and quality of juvenile rearing habitat.	**F6-A**: Designed floodplain scour channels will provide seasonal juvenile rearing habitat. **F6-B**: Determine which of 3 scour channel designs provides the most suitable habitat for juvenile salmonids based on fish density and environmental conditions.	**F6-A**: Scour channels, during the wet season, will provide suitable habitat for and be used by juvenile salmonids. **F6-B**: The 3 scour channel designs are not equally suitable for juvenile salmonids.	**F6-A&B**: Fish density, water temperature/depth/velocity, stranding/isolation (connectivity), presence of predators, duration and quantity of wetted area, and dissolved O_2 as measured during electrofishing & seining surveys. [TASK 12]	CVPIA CBDA CBDP milestone 59
	F7: Reduce juvenile salmonid stranding on floodplains.	**F7**: Reconstructed floodplains will reduce juvenile stranding to levels at or below levels found on nearby floodplains.	**F7**: Juvenile stranding rates on constructed floodplains will be lower than on nearby floodplains.	**F7**: Stranding rate (fish/m^2) as measured by floodplain stranding surveys. [TASK 11]	**F7**:CBDP milestone 71
	F8: Improve adult upstream passage conditions through the project reach.	**F8**: Eliminate stranding and passage hindrances for adult Chinook in the project reach.	**F8**: Filling of gravel mining pits in the floodplain will eliminate passage problems for adult salmon through the project reach.	**F8**: Objective met. No stranding or passage problems remain. No monitoring needed.	**F8**:CBDP milestone 67

Table 1: (continued)

RESTORATION ACTION	GOAL	QUANTITATIVE OBJECTIVE	HYPOTHESES	PERFORMANCE MEASURE(S) & MONITORING METHOD	LINKS TO OTHER PROGRAMS
4. Spawning gravel augmentation SCALE =1-10 & 10-10^2 channel widths	**F5**: Improve the quantity and quality salmonid spawning habitat. **F9:** Increase food available for juvenile salmonids.	**F5-A:** Augmentation gravel placed at creek margins will be entrained and create new or improved spawning habitat within 1 year of placement. In the long term, augmentation gravel with transport downstream through the system. **F5-B**: Attain at least a 100% increase in use over baseline period in reaches where augmentation gravel deposits. **F5-C**: Attain egg STE equal to or greater than outside the augmentation site. **F9**: Attain aquatic macroinvertebrate prey densities in augmentation gravel at levels greater than densities in natural riffles.	**F5-A-B**: Augmentation gravel will increase spawning habitat used by Chinook. **F5-C**: STE in augmentation gravel will be above average. **F9**: Augmentation gravel will increase the densities of macro-invertebrate prey for juvenile salmonids.	**F5-A-B**: Habitat use (surface area of redds/redd aggregates) as measured by redd mapping & GPS (over a 10 year period). [TASK 2.2] **F5-C**: STE rates for Chinook eggs hydraulicly placed in artificial redds and gravel quality parameters (e.g. temperature, bed scour, permeability, and % fines). [TASK 6] **F9**: Invertebrate production, density & diversity and ratio of predation susceptible to unsusceptible inverts. Measured by standard sampling methods. [TASK 7] **F9**: Analyze stomach contents of juvenile Chinook to confirm which macroinverts are prey species. [TASK 7]	CBDP rivers, rocks, & restoration workshop CBDP milestone 58 CCDAM **F5-A**: EWP (Goal 1, Obj' a) **F5-B**: CCDAM (5.2.3) **F5-B:** EWP (Goal 1, Obj' e) **F9:** EWP (Goal 1, Obj' e) **F9**: CC AMF rpt
5. Erosion control	**F5:** Improve the quality of salmonid spawning habitat	**F5:** Erosion control projects will reduce fine sediment (<6.3 mm) in spawning gravels to less than 20%.	**F5-C**: Erosion control projects will reduce fines in spawning gravels.	**F5-C**: Percent fines <6.3 and < 0.84 mm as measured by McNeil bulk sediment samples. [TASK 6]	CBDP milestone 76

Table 1: (continued)

RESTORATION ACTION	GOAL	QUANTITATIVE OBJECTIVE	HYPOTHESES	PERFORMANCE MEASURE(S) & MONITORING METHOD	LINKS TO OTHER PROGRAMS
All (combined) SCALE = 10-10^3 Channel Widths	**F-all:** Increase survival and productivity of salmonids in Clear Creek	**F-all-A**: Increase salmonid escapement to the following numbers: 1) spring-run: >1000, 2) late-fall-run: >1000, and 3) steelhead: >500 redds.	**F-all-A&B**: The combined effect of restoration actions will lead to a sustainable increase in juvenile salmonid production and adult escapement .	**F-all-A**: Escapement estimates or indices for spring, fall, and late-fall chinook and steelhead. [TASK 2] **F-all-A**: Annual age structure of returning adults (to determine cause & effect of annual restoration effort on escapement) as determined by fish scale aging. [TASK 2]	CBDP CVPIA
		F-all-B1: Sustain annual juvenile production indexes at level greater than those recorded from 1998-2002 for all salmonids. **F-all-B2**: Increase recruits per spawner to levels greater than those recorded from 1998-2002 for all salmonids.		**F-all-B1&2**: Juvenile production index as measured by the lower rotary screw trap (whole system) and the upper trap (½ system; spring run & steelhead only). [TASK 3]	
		F-all-C: Monitoring studies evaluate the links between the most significant ecosystem attributes and the biotic response (esp. salmonids).	**F-all-C**: Flow, temperature, selected gravel quality parameters, habitat availability are the most significant ecosystem attributes for salmonids.	**F-all-C**: Utilize CCDAM to conduct a *Sensitivity Analysis* of ecosystem attributes. [TASK 8]	**F-all-C**: CCDAM

Table 2: Advantages of the hydraulic egg planting devise as described in "Evaluation of a proposal for hydraulic salmonid egg deposition" (NRS 2003).

Advantages
• relatively low in cost
• relatively easy to use (after training)
• hydraulically flushes harmful sediments from egg incubation areas
• highly mobile, allowing use in remote areas
• flexibility in using the device in a wide variety of stream environments
• simulates natural egg incubation minimizing potential deleterious genetic effects on wild stocks as compared to traditional hatchery rearing practices
• relatively easy to evaluate
• may accelerate fish restoration efforts
• can provide high egg to fry emergence survival as compared to natural spawning and incubation

Table 3: Annual field work schedule for proposed tasks during the three year grant period. "F" symbolizes field work months. Where necessary, F-> and F-\ symbolize the beginning and end of a field season, respectively. Annual reports are due one year following the conclusions of each field season and final reports are due on the last day of the contract period. Tasks without field work are indicated by their expected annual or final report dates.

Year 1	Task	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	Reports						Reports					
	2	F	F	F	F-\	F->	F	F	F	F	F	F	F
	3	F	F	F	F	F	F	F-\	F->	F	F	F	F
	4	Annual Report											
	5		F	F	F								
	6									F	F	F	F
	7				F			F			F		
	8												
	9	F	F	F	F	F	F	F	F				
	10	F	F	F	F	F	F	F	F	F	F-\	F->	F
	11	F	F	F	F	F							F
	12	F	F	F	F	F						F	F
Year 2	**Task**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	Reports						Reports					
	2	F	F	F	F-\	F->	F	F	F	F	F	F	F
	3	F	F	F	F	F	F	F-\	F->	F	F	F	F
	4	Annual Report											
	5												
	6									F	F	F	F
	7				F			F			F		
	8											Final Report	
	9												
	10	F	F	F	F	F	F	F	F	F	F-\	F->	F
	11	F	F	F	F	F							F
	12	F	F	F	F	F						F	F
Year 3	**Task**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	Reports						Reports					
	2	F	F	F	F-\	F->	F	F	F	F	F	F	F
	3	F	F	F	F	F	F	F-\	F->	F	F	F	F
	4	Annual Report											
	5		F	F	F								
	6												
	7												
	8												
	9												
	10	F	F	F	F	F	F	F	F	F	F-\	F->	F
	11	F	F	F	F	F							F
	12	F	F	F	F	F						F	F

Table 4: List of hypotheses/functional relationships that will be examined in sensitivity analysis. [#.#.#] = section number in CCDAM design document; http://www.essa.com/ccdam_design.pdf.

Geomorphic attributes / Sediment transport	
4.2.2; 4.2.4	Sediment supply: Natural/background fine sediment and gravel supply (WSRCD, CVPIA Gravel Management Plan)
4.2.5	Transport equations and rating curves: The Modified Parker-Klingeman-McLean (MPKM) gravel transport equation: α_m, β_m and τ^*_{rg} calibration values. Re-calibrate based on new/alternate field data for coupled surface and substrate grain size distributions. (WSRCD, CVPIA Gravel Management Plan)
4.2.5	Transport equations and rating curves: Transfer function between sand fraction in the subsurface deposit and sand fraction on channel surface.
4.2.5	Transport equations and rating curves: Reference shear stresses for sand and gravel / bedload rating curves: channel width; friction slope (reach average channel bed slope); surface D65; assumed fractions of gravel and sand in channel deposit (subsurface); sediment transport sampling data, including gravel and sand transport rates at different discharges. (WSRCD, CVPIA Gravel Management Plan)
	Sensitivity analysis on weighted average, reach segment cross-sectional geometry.
	Review viable duration of simulations from sediment transport perspective (e.g., 1 yr, 3yrs, 5yrs, 10 yrs)
Fish population response	
5.2.7	Escapement: Different fixed initial spawning abundances or SARS (in place of existing random draw of spawners from a lognormal distribution) (Escapement Task 2)
5.2.3	WUA in IFIM: Updated/alternative WUA relationships for spawning and rearing which better reflect substrate quality. (WUA in IFIM)
5.2.2	Passage/Temperature: Lookup table relating % passage for spring and fall chinook to daily flows and water temperatures / rules for distributing of spawners across the reaches (Temperatures in Task 2)
5.2.4	Survival from egg to emergent fry:
	Tappel & Bjornn's relationship between % emergence and % fines. These relationships are based on laboratory studies. Supplement with other studies relating egg survival rate to % fines to supplement the Tappel and Bjornn approach. (STE Task 6)
5.2.4	Scour risk vs. egg survival. Juvenile production is may be highly sensitive to this relationship. (Scour index for interpreting juvenile production Task 3)
5.2.5	Emergent Fry to Immediate Migrants Out of Clear Creek (Task 3)
	Habitat hypothesis: the number of fry staying to rear in Clear Creek is limited by available rearing habitat. Early-emerging fry occupy available rearing habitat. Once this habitat is fully occupied, emerging fry begin to emigrate from Clear Creek. This hypothesis applies primarily to fall chinook, because other stocks are not close to carrying capacity.
	Flow hypothesis: the revised approach implemented uses a relationship between the fraction of fry leaving and either the maximum absolute flows during the rearing period OR the maximum change in flows during this period. Currently the model is set only for measures of maximum absolute flows and has not at this point been calibrated for changes in flow.
5.2.6	Emergent Fry to Later Migrants Out of Clear Creek (Task 3)
	The survival rate from emergent fry to pre-smolt is assumed to be a density-dependent function.
5.2.6	Rate of fry emigration out of Clear Creek: (Task 3)
Riparian initiation and establishment	
4.6	Stage-discharge rating curves for design and natural cross-sections. Cross-sectional profiles at representative sites. (WSRCD)
	Alternative seed-dispersal windows, tap root growth rates and capillary fringe heights for representative riparian tree species.

Table 5: Milestones of the Multi-Species Conservation Strategy which are addressed by Clear Creek restoration actions.

Sacramento Region Milestones
MILESTONE 55 -- Develop and implement temperature management programs within major tributaries in the Sacramento River Basin. The goal of the programs should be achievement of the ERP temperature targets for salmon and steelhead. The programs shall include provisions to: a) develop accurate and reliable water temperature prediction models; b) evaluate the use of minimum carryover storage levels and other operational tools; c) evaluate the use of new facilities such as temperature control devices; and d) recommend operational and/or physical facilities as a long-term solution.
MILESTONE 57 -- Design and begin implementation of an ecologically based stream flow regulation plan for Yuba River, Butte Creek, Big Chico Creek, Deer Creek, Mill Creek , Antelope Creek, Battle Creek, Cottonwood Creek, and Clear Creek.
MILESTONE 58 -- Complete a fluvial geomorphic assessment of coarse sediment supply needs and sources to maintain, improve, or supplement gravel recruitment and natural sediment transport processes linked to stream channel maintenance, erosion and deposition, maintenance of fish spawning areas, and the regeneration of riparian vegetation. Develop and implement a program to reduce erosion and maintain gravel recruitment on at least one tributary within each EMZ in the Sacramento River Basin.
MILESTONE 59 -- Develop floodplain management plans, including feasibility studies to construct setback levees, to restore and improve opportunities for rivers to inundate their floodplain on a seasonal basis for at least one tributary within each of the EMZs in the Sacramento River Basin. Among the areas to be included are the lower 10 miles of Clear Creek, Antelope Creek, and Deer Creek, and the lower reach of Cottonwood Creek.
MILESTONE 62 -- Develop and implement a program to establish, restore, and maintain riparian habitat to improve floodplain habitat, salmonid shaded riverine aquatic habitat, and instream cover along at least one tributary within each of the following Ecological Management Zones: American River Basin, Butte Basin, Colusa Basin, Cottonwood Creek, Feather River/Sutter Basin, North Sacramento Valley, Sacramento River, and Yolo Basin. While restoring habitat conditions in the American River EMZ, maintain continuous corridors of suitable riparian habitat for valley elderberry longhorn beetle. Protect existing known occurrences of northern California black walnut native stands through conservation easement or purchase. Identify at least 3 protected and managed sites for introduction of additional populations of northern California black walnut; begin introduction and monitor for success. Population creation should be part of a broader effort to restore riparian areas which historically contained walnut.
MILESTONE 64 -- Restore 2 miles of the 10 mile target of riparian habitat restoration along the lower reaches of each of the following tributaries: Battle, Clear, Deer, Mill, Butte, Big Chico, Antelope, Feather, Yuba, and Bear Rivers.
MILESTONE 66 -- Develop and implement a program to address inadequate instream flows for steelhead and Chinook salmon on streams within Sacramento River Basin tributaries. Where appropriate provide adequate flows for Sacramento splittail and green sturgeon.
MILESTONE 67 -- Provide unimpeded upstream and downstream passage for salmon and steelhead on Sacramento River Basin tributaries.
MILESTONE 69 -- Develop and implement a solution to improve passage of upstream migrant adult fish and downstream migrant juvenile fish Battle Creek.
MILESTONE 71 -- Develop a program to reduce or eliminate fish stranding in the Sacramento, Feather and Yuba rivers and the Colusa Basin drain and Sutter Bypass in the active stream channels, floodplains, shallow ponds and borrow areas. Develop protocols for ramping flow reductions. Conduct surveys of stranding under a range of flow conditions and

Table 5: Milestones of the Multi-Species Conservation Strategy which are addressed by Clear Creek restoration actions.

MILESTONE 74 -- Actions to minimize or eliminate inter-substrate low dissolved oxygen conditions in salmonid spawning and rearing habitat, especially in the Mokelumne, Cosumnes, American, Merced, Tuolumne, and Stanislaus Rivers (from Phase II Report and Water Quality Program Plan): · Develop inter-substrate DO testing for salmonid spawning and rearing habitat. · Conduct comprehensive surveys to assess the extent and severity of intersubstrate low DO conditions. · Develop and begin implementing appropriate best management practices (BMPs), including reducing anthropogenic fine sediment loads, to minimize or eliminate inter-substrate low DO conditions.
MILESTONE 76 -- Actions to reduce fine sediment loading to streams, especially Tuolumne, Merced, Stanislaus, Cosumnes, Napa, and Petaluma Rivers, and Sonoma Creek, due to human activities (from Phase II Report and Water Quality Program Plan): · Participate in implementation of USDA sediment reduction program. · Implement sediment reduction BMPs in construction areas, on agricultural lands, for urban storm water runoff, and other specific sites. · Implement stream restoration and revegetation work. · Quantify and determine ecological impacts of sediments in target watersheds, implement corrective actions.
MILESTONE 77 -- Conduct the necessary research to determine no adverse ecological/biological effects threshold concentrations for mercury in sediments and key organisms in the Bay-Delta estuary and its watershed.
Research Milestones
MILESTONE 115 -- Conduct instream flow studies to determine the flows necessary to support all life stages of anadromous and estuarine fish species.
MILESTONE 116 -- Conduct an investigation of in-channel structures that focuses on the following issues: (1) habitat suitability for both predator and prey fishes; (2) predator-prey interactions; and (3) recommendations for reducing predation on juvenile salmonids.
MILESTONE 118 -- Assess the impact of hatchery practices on naturally spawning populations of Chinook salmon and steelhead and operate hatcheries in a manner consistent with safe genetic practices that will maintain genetic integrity of all Central Valley anadromous salmonid populations.
MILESTONE 119 -- Through the use of existing, expanded, and new programs, monitor adult anadromous salmonid returns to each watershed within the MSCS focus area. Monitoring techniques, data compilation and analysis, and reporting should be standardized among researchers and watersheds to the greatest extent possible.

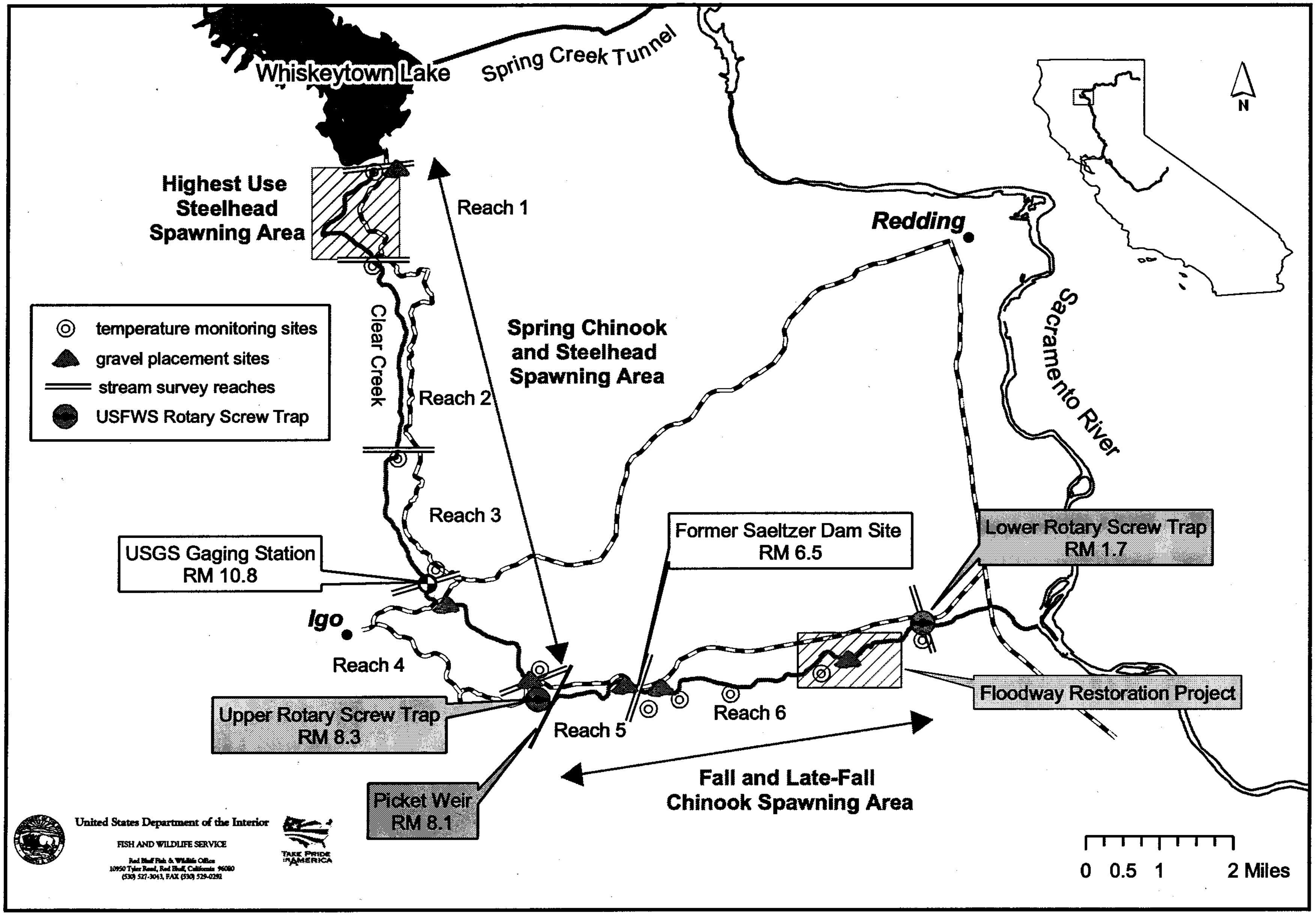

Figure 1: Map of lower Clear Creek, Shasta County, California.

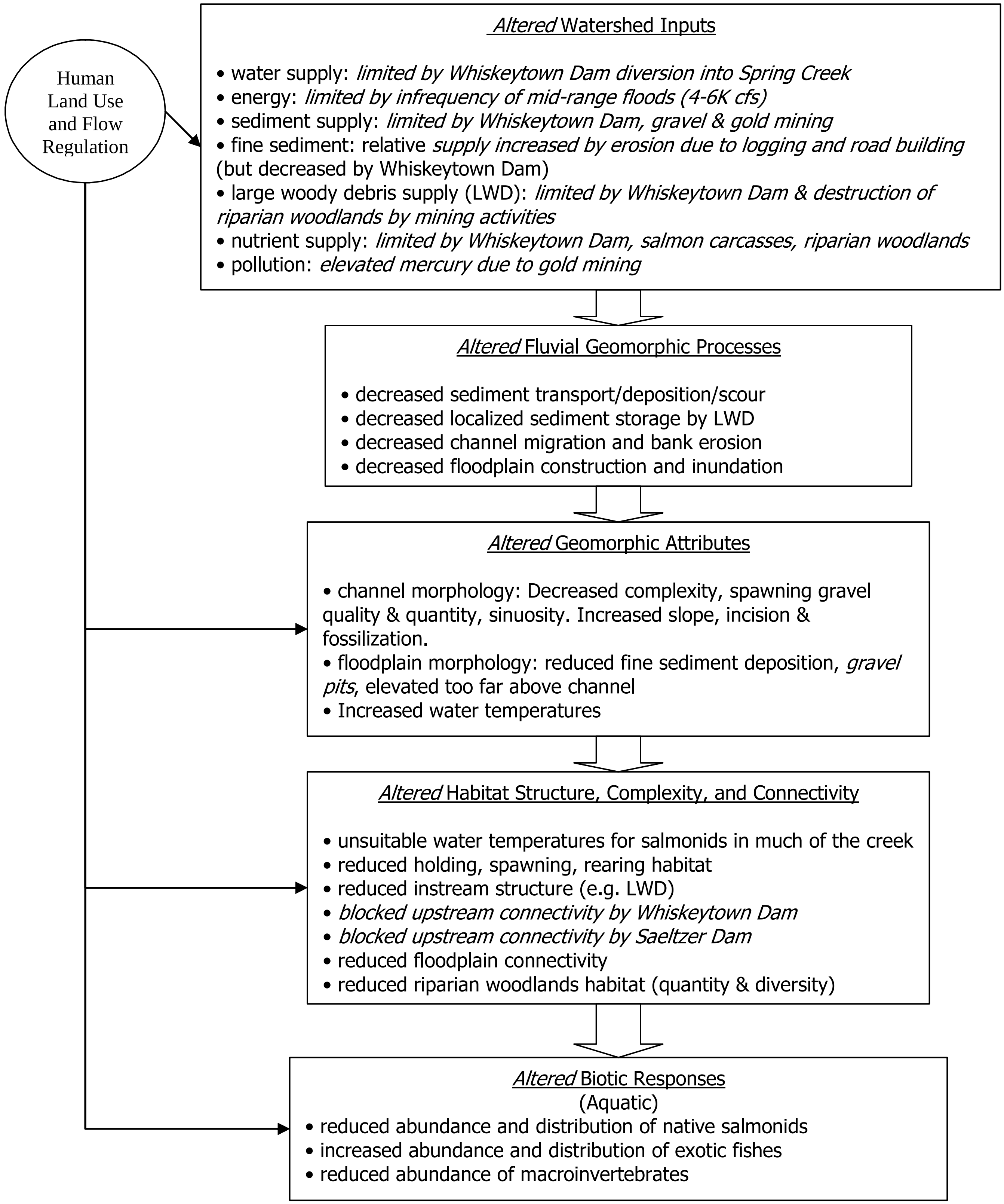

Figure 2: Conceptual model of Clear Creek response to human land use and flow regulation.

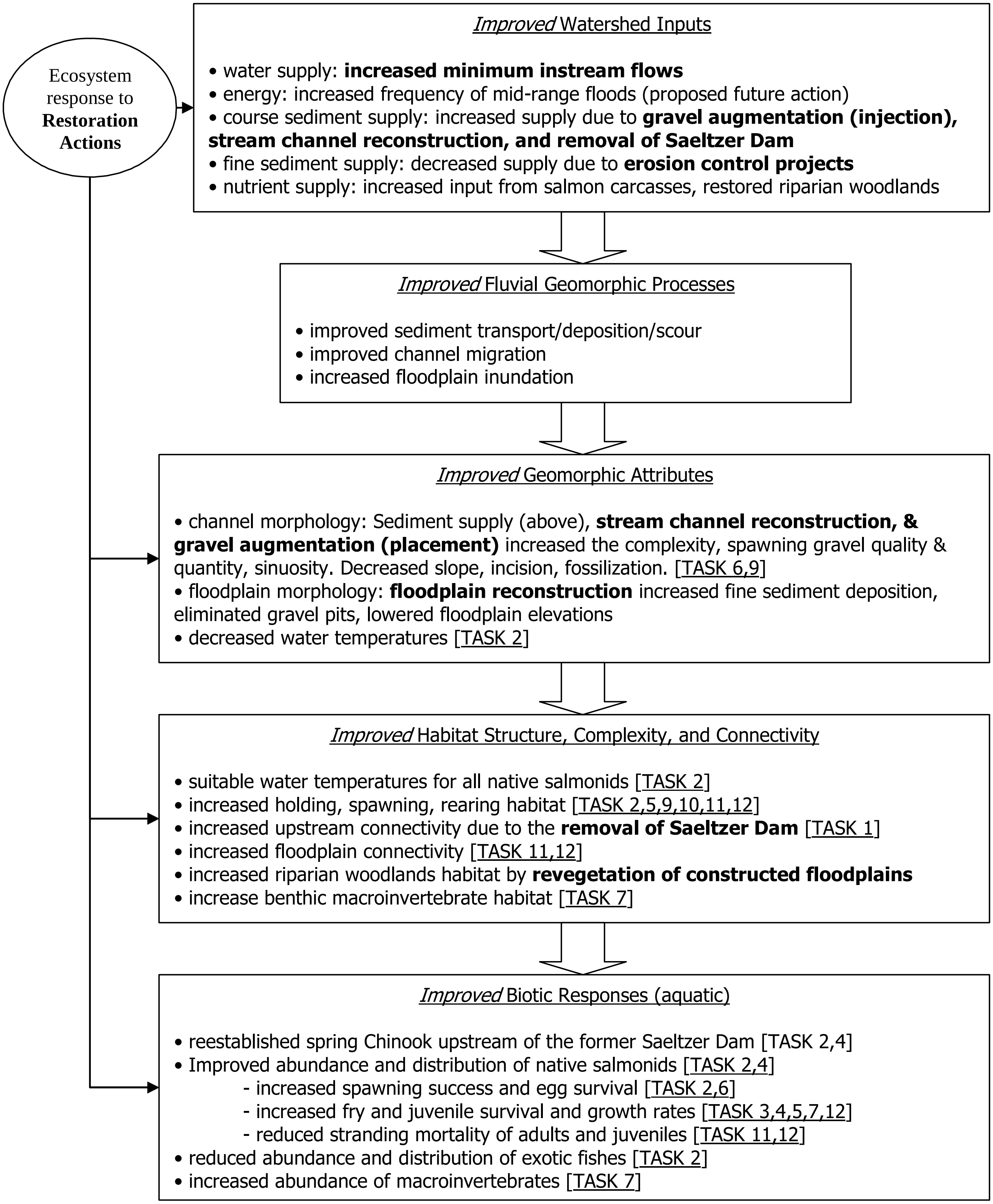

Figure 3: Conceptual model of Clear Creek response to restoration actions.

Figure 4. Picture showing the hydraulic egg planting device.

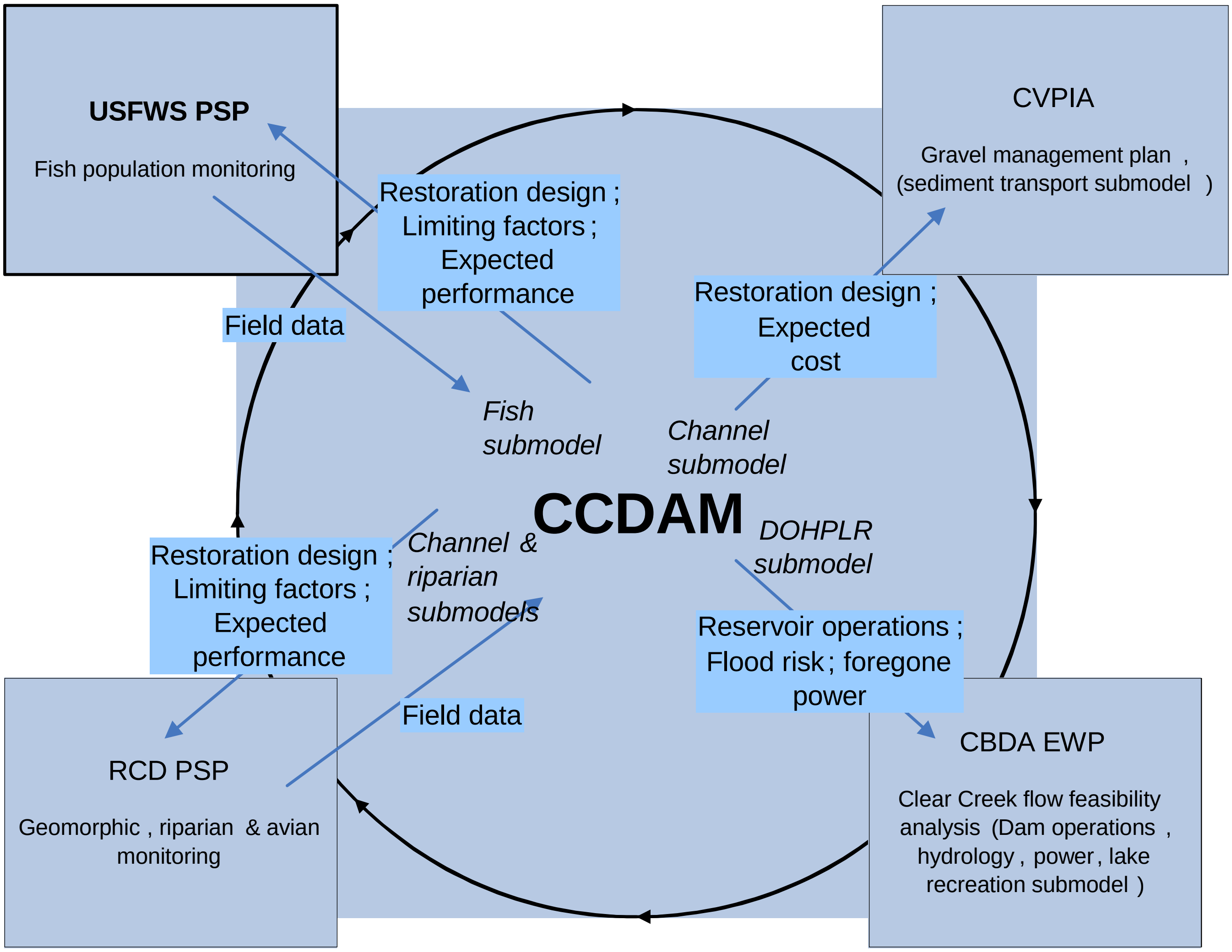

Figure 5: Relationships between major Clear Creek restoration and monitoring efforts. The present PSP would closely coordinate with, and serve as the anchor point for other major efforts. CBDA = California Bay Delta Authority. USFWS = United States Fish and Wildlife Service. RCD = Western Shasta Resource Conservation District.

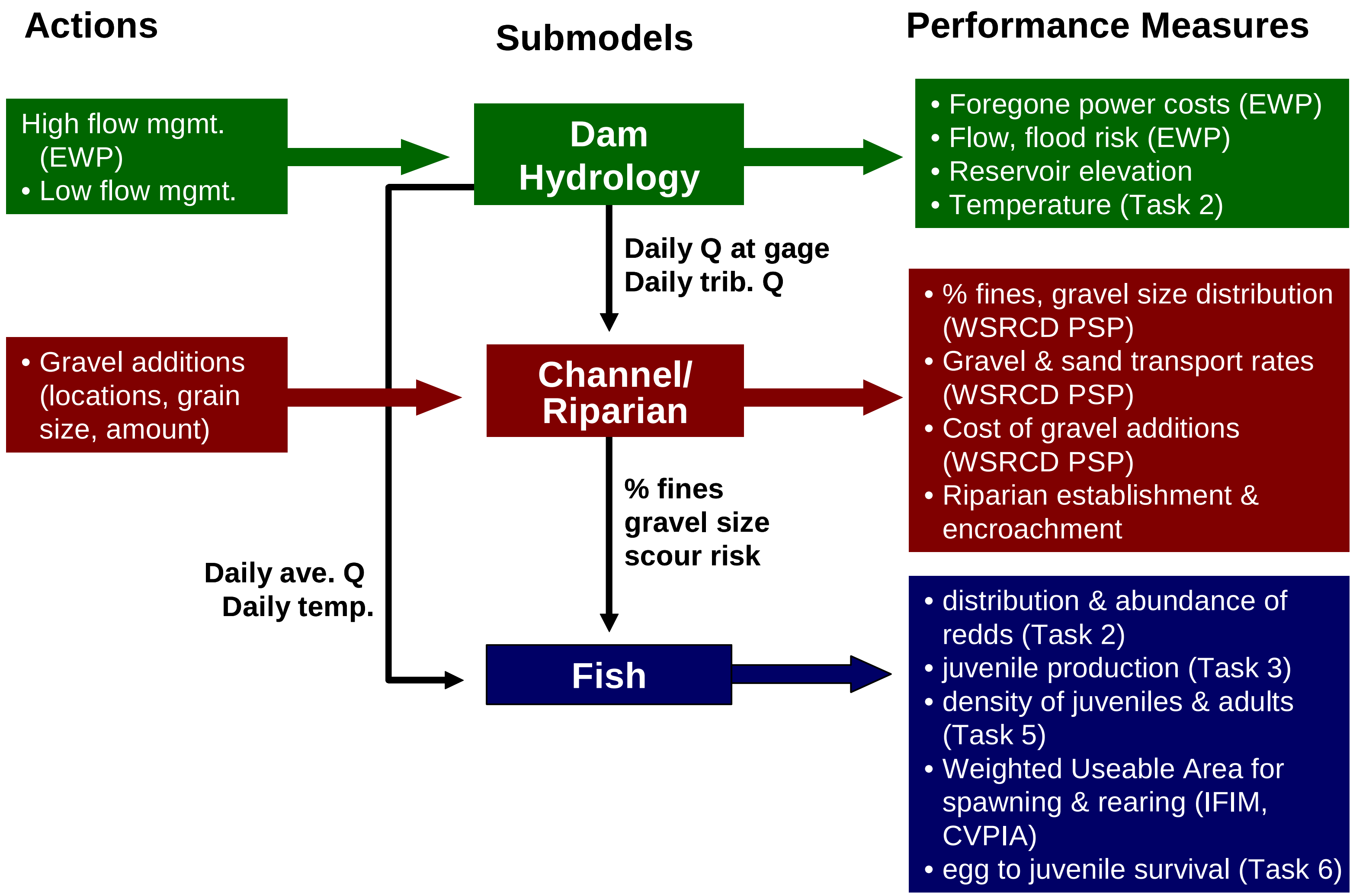

Figure 6: Highly simplified, broad-level conceptual model for CCDAM showing examples of management actions that are hypothesized to restore some of the lost habitat structure and biotic responses. (Details are given in Alexander et al. 2003; http://www.essa.com/ccdam_design.pdf). The numerous functional relationships and alternative hypotheses linking actions and physical processes to biological responses in this model are set within the context of an overall decision analysis. Q = discharge; WUA = weighted usable area; WT = Whiskeytown Reservoir.

Year 1

Task Number	Task Description	Personnel	Number	Direct Labor Hours	Salary (per hour)	Salary (for total task hours)	Benefits (per hour)	Benefits (for total task hours)	Travel	Supplies and Expendables	Other Direct Costs	Total Direct Costs	Indirect Costs	Total Cost to project
X	**Monitor physical and geochemical conditions in restored area.** Install piezometers, conduct tracer tests, measure surface water and pore water parameters (dissolved oxygen, pH, EC, temperature, nitrogen compounds), evaluate data.	Horner	1	190	$39.57	$7,518	$12.66	$2,406	$1,260		$1,200	$12,384	$3,963	$16,347
		Undergraduate student assistant	1	285	$12.00	$3,420	$1.44	$410		$260		$4,090	$1,309	$5,399
		Graduate Student	1	720	$15.00	$10,800	$1.80	$1,296	$2,100	$5,160		$19,356	$6,194	$25,550
	Totals- task #X			1195		$21,738		$4,112	$3,360	$5,420	$1,200	$35,831	$11,466	$47,296
Year 1 summary:				Hours		Salary		Benefits	Travel	Supplies	Other-equipment	Total Direct Costs	Indirect costs	Total Cost to project
				1195		$21,738		$4,112	$3,360	$5,420	$1,200	$35,831	$11,466	$47,296
Year 2														
X	**Monitor physical and geochemical conditions in restored areas.** Repair piezometers, conduct tracer tests, measure surface water and pore water parameters (dissolved oxygen, pH, EC, and temperature), evaluate data.	Horner	1	190	$39.57	$7,518	$12.66	$2,406	$1,260			$11,184	$3,579	$14,763
		Undergraduate student assistant	1	285	$12.00	$3,420	$1.44	$410		$260		$4,090	$1,309	$5,399
		Graduate Student	1	720	$15.00	$10,800	$1.80	$1,296	$2,100	$960		$15,156	$4,850	$20,006
	Totals- task #X			1195		$21,738		$4,112	$3,360	$1,220		$30,431	$9,738	$40,168
Year 2 summary:				Hours		Salary		Benefits	Travel	Supplies	Other-equipment	Total Direct Costs	Indirect costs	Total Cost to project
				1195		$21,738		$4,112	$4,112	$1,220		$30,431	$9,738	$40,168
Project summary:				Hours		Salary		Benefits	Travel	Supplies	Other-equipment	Total Direct Costs	Indirect costs	Total Cost to project
				2390		$43,477		$8,225	$7,472	$6,640	$1,200	$66,261	$21,204	$87,465

Attachment A: Task 6 budget spreadsheet for California Sate University Sacramento work.

CDN labour rate assumption	38	73	25	30				
USD daily salary assumption	239.4	459.9	157.5	189				
Team Member:	Clint Alexander (ESSA)	David Marmorek (ESSA)	Keti Milosheva (ESSA)	Marc Porter (ESSA)	Yantao Cui (Stillwater)			
Role:	Project Manager / Technical Lead	Senior Content Advisor	VB / Access Programmer	Model Analyses / Synthesis	Sediment Transport Expert	**Total Planned Time**	**Total Planned Cost**	
Task/Daily Rate ($USD)	$ 885	$ 1,470	$ 585	$ 668	$ 1,400			
1. Project initiation, model and data review workshop	5	3		5	2	15	$ 14,973	0.094294
2. Data update and load (CCDAM db)	7			8		15	$ 11,535	0.072645
3. Critical model enhancements identified during review	7		10		5	22	$ 19,045	0.119942
4. Testing/sign-off on model updates + define scenarios for full trade-off and sensitivity analysis	8	4.5	5	5	3	25.5	$ 24,158	0.15214
5. Comprehensive sensitivity analysis in support of Limiting Factors Study (simulations)	15	3		15	2	35	$ 30,498	0.192068
6. Summary documentation on critical uncertainties, most robust flow/gravel management options	10	3.5		12	2	27.5	$ 24,805	0.156218
7. Teleconferences / Client Liaison	6	4		5	1	16	$ 15,928	0.100309
8. Project Management, Internal Communications	10	2	1	4	2	19	$ 17,845	0.112385
Total Planned Person Days:	68	20	16	54	17	**175**		
Planned Fees by Team Member:	$ 60,180	$ 29,400	$ 9,360	$ 36,045	$ 23,800		**$ 158,785**	

Project Contingency (15%)	**$**	**17,420**	Select modelling tasks, not task 6 and 8
Funding for 3rd party participants (e.g., to attend meetings)	**$**	**15,300**	Assume 3 professionals @ 950/day, 3 days, time and materials
Planned Disbursements			
Air travel YLW/YVR to RDD	$	6,664	10 person trips
Ground travel	$	800	Taxi or car rental for travel to/from RDD to hotel and meeting location(s).
Per Diems	$	5,148	$143/d @ 2 persons x 6 days + 1 person x 3 days
Communications	$	500	
Printing / Photocopying	$	400	
Total:	**$**	**13,512**	
TOTAL PLANNED COST:	**$**	**205,017**	

Attachment B: Task 8 budget spreadsheet for ESSA's work on CCDAM.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Red Bluff Fish and Wildlife Office
10950 Tyler Road
Red Bluff, California 96080
Phone: (530) 527-3043
FAX: (530) 529-0292

RECEIVED
OCT 26 2004
USFWS
RED BLUFF FWO

ENTRY PERMISSION FORM

Permission is hereby given to the U.S. Fish and Wildlife Service ("Service"), Red Bluff Fish and Wildlife Office ("RBFWO"), and its employees, expressly, to access the property, in possession of those identified below, for the purpose of conducting salmon and steelhead monitoring activities in Clear Creek.

This permission is conditioned upon the acknowledgment and agreement, by all parties, to the following conditions: (a) this permit can be revoked at any time, by either party, upon written notification; (b) that only authorized, uniformed Service employees will enter onto said property; (c) that Service employees shall enter upon the specified property at their own risk; (d) that each Service employee, by his or her entry, waives any and all claims, suits, or causes of action against the property owner that might arise out of such entry and survey activities; and (e) that the Service shall indemnify, defend, and hold the property owner harmless from and against any and all claims of bodily injury or property damage sustained by the Service employee(s).

Property Owner Comingdeer 2001 Family Trust

Address 570 Gary Court

City, State, Zip Redding, CA 96002

Telephone Res. (530) 223-4509, (wk) (530) 244-7263

Signature [signature] Date 10/25/04

Please attach a copy of any additional conditions, restrictions or stipulations to this agreement.

Permit accepted: Red Bluff Fish and Wildlife Office

By Shea Gaither, Title Fishery Biologist

Attachment C: Permission form to access a monitoring site on private land on Clear Creek.

Tasks And Deliverables

Clear Creek anadromous salmonid monitoring program

Task ID	Task Name	Start Month	End Month	Deliverables
1	Project Management	1	36	Semiannual and final reports. Periodic invoices
2	Adult Salmonid Escapement and Distribution	1	36	Two annual reports and a final report
3	Juvenile Salmonid Production	1	36	Two annual reports and a final report
4	Genetic Identification of Chinook runs	1	36	Three annual reports
5	Juvenile Habitat Use	1	36	Two annual reports
6	Spawning Gravel Quality	1	36	Two annual reports
7	Benthic Macroinvertebrates	1	36	Two annual reports
8	CCDAM	1	24	Final report
9	2D Modeling	1	36	Final report
10	Juvenile HSI's	1	36	Final report
11	Floodplain stranding and scour channel analysis	1	36	Two annual reports and a final report
12	Scour channel study	1	36	Two annual reports and a final report

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
$1,429,528	$464,595	$40,500	$161,059	$809,681	$49,000	$0	$0	$2,954,363	$418,950	$3,373,313

Do you have cost share partners already identified?
No.

If yes, list partners and amount contributed by each:

Do you have potential cost share partners?
Yes.

If yes, list partners and amount contributed by each:

CVPIA Clear Creek Restoration Program− unknown

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

Clear Creek anadromous salmonid monitoring program

Clear Creek anadromous salmonid monitoring program

Year 1 (Months 1 To 12)

Task	Labor	Benefits	Travel	Supplies And	Services And	Equipment	Lands	Other	Direct	Indirect	Total

				Expendables	Consultants		And Rights Of Way	Direct Costs	Total	Costs	
1: project management (12 months)	**1528**	**496**	**0**	**0**	**0**	**0**	**0**	**0**	$2,024	**344**	$2,368
2: Adult Salmonid Escapement and Distribution (12 months)	**146731**	**47687**	**6625**	**21201**	**0**	**1500**	**0**	**0**	$223,744	**38036**	$261,780
3: Juvenile Salmonid Production (12 months)	**199087**	**64703**	**6875**	**17841**	**17500**	**1500**	**0**	**0**	$307,506	**52276**	$359,782
4: Genetic Identification of Chinook runs (12 months)	**0**	**0**	**0**	**0**	**30000**	**0**	**0**	**0**	$30,000	**1800**	$31,800
5: Juvenile Habitat Use (12 months)	**49513**	**16092**	**0**	**6560**	**0**	**0**	**0**	**0**	$72,165	**12268**	$84,433
6: Spawning Gravel Quality (12 months)	**32543**	**10576**	**0**	**14312**	**53196**	**0**	**0**	**0**	$110,627	**12955**	$123,582
7: Benthic Macroinvertebrates (12 months)	**13838**	**4497**	**0**	**1834**	**179200**	**0**	**0**	**0**	$199,369	**14181**	$213,550
8: CCDAM (12 months)	**7242**	**2354**	**0**	**960**	**205017**	**0**	**0**	**0**	$215,573	**14095**	$229,668
9: 2D Modeling (12 months)	**0**	**0**	**0**	**0**	**100000**	**0**	**0**	**0**	$100,000	**6000**	$106,000

10: Juvenile HSI's (12 months)	**24176**	**7857**	**0**	**3203**	**0**	**0**	**0**	**0**	$35,236	**5990**	$41,226
11: Floodplain stranding and scour channel analysis (12 months)	**7012**	**2279**	**0**	**929**	**0**	**0**	**0**	**0**	$10,220	**1737**	$11,957
12: Scour channel study (12 months)	**10318**	**3353**	**0**	**1367**	**0**	**0**	**0**	**0**	$15,038	**2557**	$17,595
Totals	**$491,988**	**$159,894**	**$13,500**	**$68,207**	**$584,913**	**$3,000**	**$0**	**$0**	**$1,321,502**	**$162,239**	**$1,483,741**

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: project management (12 months)	**1634**	**531**	**0**	**0**	**0**	**0**	**0**	**0**	$2,165	**368**	$2,533
2: Adult Salmonid Escapement and Distribution (12 months)	**154063**	**50071**	**6625**	**17201**	**0**	**12500**	**0**	**0**	$240,460	**40878**	$281,338
3: Juvenile Salmonid Production (12 months)	**208485**	**67758**	**6875**	**16841**	**17500**	**12500**	**0**	**0**	$329,959	**56093**	$386,052
4: Genetic Identification of Chinook runs (12 months)	**0**	**0**	**0**	**0**	**30000**	**0**	**0**	**0**	$30,000	**1800**	$31,800

5: Juvenile Habitat Use (12 months)	0	0	0	0	0	0	0	0	$0	0	$0
6: Spawning Gravel Quality (12 months)	33578	10913	0	4449	40168	0	0	0	$89,108	10730	$99,838
7: Benthic Macroinvertebrates (12 months)	14674	4769	0	1944	89600	0	0	0	$110,987	9012	$119,999
8: CCDAM (12 months)	0	0	0	0	0	0	0	0	$0	0	$0
9: 2D Modeling (12 months)	0	0	0	0	0	0	0	0	$0	0	$0
10: Juvenile HSI's (12 months)	25197	8189	0	3339	0	0	0	0	$36,725	6243	$42,968
11: Floodplain stranding and scour channel analysis (12 months)	7413	2409	0	982	0	0	0	0	$10,804	1837	$12,641
12: Scour channel study (12 months)	10822	3517	0	1434	0	0	0	0	$15,773	2681	$18,454
Totals	**$455,866**	**$148,157**	**$13,500**	**$46,190**	**$177,268**	**$25,000**	**$0**	**$0**	**$865,981**	**$129,642**	**$995,623**

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: project management (12 months)	**1749**	**568**	**0**	**0**	**0**	**0**	**0**	**0**	$2,317	**394**	$2,711
2: Adult Salmonid Escapement and Distribution (12 months)	**161792**	**52582**	**6625**	**16601**	**0**	**1500**	**0**	**0**	$239,100	**40647**	$279,747
3: Juvenile Salmonid Production (12 months)	**218359**	**70967**	**6875**	**16841**	**17500**	**19500**	**0**	**0**	$350,042	**59507**	$409,549
4: Genetic Identification of Chinook runs (12 months)	**0**	**0**	**0**	**0**	**30000**	**0**	**0**	**0**	$30,000	**1800**	$31,800
5: Juvenile Habitat Use (12 months)	**54320**	**17654**	**0**	**7197**	**0**	**0**	**0**	**0**	$79,171	**13459**	$92,630
6: Spawning Gravel Quality (12 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
7: Benthic Macroinvertebrates (12 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
9: 2D Modeling (12 months)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0	**0**	$0
10: Juvenile HSI's (12 months)	**26263**	**8536**	**0**	**3480**	**0**	**0**	**0**	**0**	$38,279	**6507**	$44,786
11: Floodplain stranding and scour channel analysis	**7840**	**2548**	**0**	**1039**	**0**	**0**	**0**	**0**	$11,427	**1942**	$13,369

(12 months)											
12: Scour channel study (12 months)	**11351**	**3689**	**0**	**1504**	**0**	**0**	**0**	**0**	$16,544	**2813**	$19,357
Totals	**$481,674**	**$156,544**	**$13,500**	**$46,662**	**$47,500**	**$21,000**	**$0**	**$0**	**$766,880**	**$127,069**	**$893,949**

Budget Justification

Clear Creek anadromous salmonid monitoring program

Labor

Task 1 Year 1 Fishery Biologist GS 13 20 34.66 Fishery Biologist GS 12 20 28.20 Other 12 22.00 Task 1 year 2 Fishery Biologist GS 13 20 37.08 Fishery Biologist GS 12 20 30.18 Other 13 22.00 Task 1 year 3 Fishery Biologist GS 13 20 39.68 Fishery Biologist GS 12 20 32.29 Other 14 22.00 Task 2 year 1 Fishery Biologist GS 13 312 34.66 Fishery Biologist GS 12 1040 28.20 Fishery Biologist GS 9 1560 22.25 Fishery Biologist GS 5 3328 13.80 Other 1180 22.00 Task 2 year 2 Fishery Biologist GS 13 312 37.08 Fishery Biologist GS 12 1040 30.18 Fishery Biologist GS 9 1560 23.14 Fishery Biologist GS 5 3328 14.35 Other 1239 22.00 Task 2 year 3 Fishery Biologist GS 13 312 39.68 Fishery Biologist GS 12 1040 32.29 Fishery Biologist GS 9 1560 24.07 Fishery Biologist GS 5 3328 14.92 Other 1301 22.00 Task 3 year 1 Fishery Biologist GS 13 312 34.66 Fishery Biologist GS 12 96 28.20 Fishery Biologist GS 11 1040 25.29 Fishery Biologist GS 9 520 22.25 Fishery Biologist GS 7 1664 17.09 Fishery Biologist GS 5 6240 13.80 Other 1508 22.00 Task 3 year 2 Fishery Biologist GS 13 312 37.08 Fishery Biologist GS 12 96 30.18 Fishery Biologist GS 11 1040 27.06 Fishery Biologist GS 9 520 23.14 Fishery Biologist GS 7 1664 17.77 Fishery Biologist GS 5 6240 14.35 Other 1579 22.00 Task 3 year 3 Fishery Biologist GS 13 312 39.68 Fishery Biologist GS 12 96 32.29 Fishery Biologist GS 11 1040 28.95 Fishery Biologist GS 9 520 24.07 Fishery Biologist GS 7 1664 18.48 Fishery Biologist GS 5 6240 14.92 Other 1654 22.00 Task 4 year 1 none Task 4 year 2 none Task 4 year 3 none Task 5 year 1 Fishery Biologist GS 13 96 34.66 Fishery Biologist GS 12 240 28.20 Fishery Biologist GS 9 240 22.25 Fishery Biologist GS 5 1872 13.80 Other 375 22.00 Task 5 year 3 Fishery Biologist GS 13 96 39.68 Fishery Biologist GS 12 240 32.29 Fishery Biologist GS 9 240 24.07 Fishery Biologist GS 5 1872 14.92 Other 412 22.00 Task 6 year 1 Fishery Biologist GS 13 96 34.66 Fishery Biologist GS 12 400 28.20 Fishery Biologist GS 9 96 22.25 Fishery Biologist GS 5 752 13.80 Other 247 22.00 Task 6 year 2

Fishery Biologist GS 13 96 37.08 Fishery Biologist GS 12 400 30.18 Fishery Biologist GS 9 96 23.14 Fishery Biologist GS 5 706 14.35 Other 254 22.00 Task 7 year 1 Fishery Biologist GS 13 96 34.66 Fishery Biologist GS 12 160 28.20 Fishery Biologist GS 9 32 22.25 Fishery Biologist GS 5 216 13.80 Other 105 22.00 Task 7 year 2 Fishery Biologist GS 13 96 37.08 Fishery Biologist GS 12 160 30.18 Fishery Biologist GS 9 32 23.14 Fishery Biologist GS 5 216 14.35 Other 111 22.00 Task 8 year 1 Fishery Biologist GS 13 96 34.66 Fishery Biologist GS 12 96 28.20 Other 55 22.00 Task 9 year 1 none Task 10 year 1 Fishery Biologist GS 13 24 34.66 Fishery Biologist GS 12 24 28.20 Fishery Biologist GS 9 80 22.25 Fishery Biologist GS 5 1222 13.80 Other 183 22.00 Task 10 year 2 Fishery Biologist GS 13 24 37.08 Fishery Biologist GS 12 24 30.18 Fishery Biologist GS 9 80 23.14 Fishery Biologist GS 5 1222 14.35 Other 191 22.00 Task 10 year 3 Fishery Biologist GS 13 24 39.68 Fishery Biologist GS 12 24 32.29 Fishery Biologist GS 9 80 24.07 Fishery Biologist GS 5 1222 14.92 Other 199 22.00 Task 11 year 1 Fishery Biologist GS 13 32 34.66 Fishery Biologist GS 12 80 28.20 Fishery Biologist GS 9 32 22.25 Fishery Biologist GS 5 128 13.80 Other 53 22.00 Task 11 year 2 Fishery Biologist GS 13 32 37.08 Fishery Biologist GS 12 80 30.18 Fishery Biologist GS 9 32 23.14 Fishery Biologist GS 5 128 14.35 Other 56 22.00 Task 11 year 3 Fishery Biologist GS 13 32 39.68 Fishery Biologist GS 12 80 32.29 Fishery Biologist GS 9 32 24.07 Fishery Biologist GS 5 128 14.92 Other 59 22.00 Task 12 year 1 Fishery Biologist GS 13 40 34.66 Fishery Biologist GS 12 40 28.20 Fishery Biologist GS 9 80 22.25 Fishery Biologist GS 5 312 13.80 Other 78 22.00 Task 12 year 2 Fishery Biologist GS 13 40 37.08 Fishery Biologist GS 12 40 30.18 Fishery Biologist GS 9 80 23.14 Fishery Biologist GS 5 312 14.35 Other 82 22.00 Task 12 year 3 Fishery Biologist GS 13 40 39.68 Fishery Biologist GS 12 40 32.29 Fishery Biologist GS 9 80 24.07 Fishery Biologist GS 5 312 14.92 Other 86 22.00

Benefits

An average benefit rate of 0.325 percent of salary was used to project costs for all positions for all tasks in all years.

Travel

Task 2 in each year− $6,625 for travel to safety, employee, and professional training, professional society meetings, workshops and conferences. Task 3 in each year− $6,875 for travel to safety, employee, and professional training, professional society meetings, workshops and conferences.

Supplies And Expendables

Proposed field supplies for each task and year: Task 2 year 1 $21,201.00 Task 2 year 2 $17,201.00 Task 2 year 3 $16,601.00 Task 3 year 1 $17,841.00 Task 3 year 2 $16,841.00 Task 3 year 3 $16,841.00 Task 5 year 1 $6,560.46 Task 5 year 3 $7,197.44 Task 6 year 1 $3,539.80 Task 6 year 2 $3,751.08 Task 7 year 1 $1,833.52 Task 7 year 2 $1,944.26 Task 8 year 1 $959.52 Task 10 year 1 $3,203.28 Task 10 year 2 $3,338.63 Task 10 year 3 $3,479.87 Task 11 year 1 $929.06 Task 11 year 2 $982.28 Task 11 year 3 $1,038.75 Task 12 year 1 $1,367.17 Task 12 year 2 $1,433.86 Task 12 year 3 $1,504.04

Services And Consultants

Task 3 Years one, two and three− contract for laboratory analysis of otolith microchemistry to determine anadromy status of juvenile "steelhead". 100 samples analyzed at $175.00 each.

Task 4 Years one, two and three− contract with Dr. Michael Banks for genetic run designation of adult and juvenile Chinook including salary and supply costs. $30,000 per year.

Task 6 Year one− training for and lease of egg transport and injection equipment from Alaska Resource &Economic Development, Inc. $5,900.

Task 6 year one− contract with Dr. Tim Horner to monitor physical and geochemical conditions in restored area. See attachment A for budget details. $47,296.

Task 6 year two– contract with Dr. Tim Horner to monitor physical and geochemical conditions in restored area. See attachment A for budget details. $40,168.

Task 7 Years one and two– contract for benthic macroinvertebrate identification laboratory analysis. 224 samples analyzed at $400.00 each.

Task 8 year one– contract with ESSA Technologies Ltd. for "Application of the Clear Creek Decision Analysis and Adaptive Management Model (CCDAM) to assist in identification of limiting factors, future monitoring needs and evaluation of restoration futures". See attachment B for budget details. $205,017.

Task 9 year one– 2 dimensional modeling by Fish and Wildlife Service Sacramento Fish and Wildlife Office, IFIM Branch. Cost based on biologist day rate of $870.84 which includes all overhead.

Equipment

(2) 4X4 field vehicles– $22,000– one split between Tasks 2 and 3, and one split between tasks 5–12. (6) computers– $1,500; 3 for Task 2 and 3 for task 3. (1) 5 foot rotary screw trap with modifications and delivery– $18,000 (1) replacement live box for rotary screw trap– $2,500

Lands And Rights Of Way

None.

Other Direct Costs

None.

Indirect Costs/Overhead

We will be applying indirect rates established at the National level by the US Fish and Wildlife Service. A pass–through

overhead rate of 6% will be applied to subcontracts of $20,000 or more. A general overhead rate of 17% will be applied to all other budget items.

Comments

Environmental Compliance

Clear Creek anadromous salmonid monitoring program

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.

US Fish and Wildlife Service

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	X	X	
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	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	–	–	
permission To Access State Land Agency Name	–	–	
permission To Access Federal Land Agency Name Bureau Of Land Management, National Park Service	X	X	
permission To Access Private Land Landowner Name Comingdeer 2001 Family Trust	X	X	

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

Land Use

Clear Creek anadromous salmonid monitoring program

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.

We have filed a Standard Form 299 "APPLICATION FOR TRANSPORTATION AND UTILITY SYSTEMS AND FACILITIES ON FEDERAL LANDS" with the Bureau of Land Management. We have contacted and obtained written permission for access from private landowners.

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.