

DWR WAREHOUSE

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Executive Summary

Project Title: Identification and Characterization of Water Quality Factors Affecting Beneficial Uses: A Prerequisite to Restoration in the Deer Creek Watershed

Applicant: Gerald Boles

California Department of Water Resources
2440 Main Street
Red Bluff, California 96080

Approach: The proposed project is a water quality assessment program for the Deer Creek watershed to determine changes induced in stream water quality due to land-based activities. Monitoring stations will be established at various locations in the watershed. Descriptive stream condition/habitat assessments will be conducted at each site. Basic water chemistry (minerals, nutrients, minor elements, and physical parameters) will be assessed since these parameters determine the beneficial uses of water and become elevated due to pollution, which often results in deleterious effects to aquatic life and other beneficial uses. Water temperature will be assessed via continuous recorders since this parameter has often been significantly altered from stream management activities and is important for determining the suitability of a water body for survival and reproduction of anadromous fish. Coliform bacteria levels will be assessed since these organisms are indicative of contamination which may impact health. Aquatic macroinvertebrates, which form the basis of the aquatic food web and are excellent indicators of long-term water quality conditions, will be assessed throughout the watershed.

The direct measurement of toxicity to aquatic organisms will determine the ability of the stream to support aquatic life. Toxicity assessment in stream bed sediments and the water column will identify impacts to fish and their food organisms from toxic substances. Fish tissues, which accumulate various toxic substances, will be analyzed to determine the presence of toxic substances which may not be identifiable through other means.

Sedimentation is a major impairment in streams, adversely impacting salmonid reproduction and food organisms. Analyses of sediments in stream gravels will determine areas of impact and aid in identification of sources of sediments.

The project will begin upon execution of a contract and is proposed to continue for a three year period with annual progress reports.

Justification: The proposed project will provide information about system stressors in the Deer Creek watershed which affect priority aquatic species and their habitats. Monitoring water resources in the watershed is essential to detect and document pollution. Water quality affects the beneficial uses of streams, including the beneficial use as fish habitat. Yet, very little water quality data are available for the Deer Creek watershed. Without water quality data, environmental effects to migrating, spawning,

and rearing salmon and steelhead cannot be realistically determined, nor can mitigation be developed until the scope of the problem is defined. Data will be developed by the proposed program that identify current conditions of various resource issues related to water quality, and provide a baseline to determine the effectiveness of mitigation activities in the watershed. Data developed by the proposed project will be used by a variety of agencies and groups to implement mitigation activities to improve habitat conditions related to water quality. This project is important to water resource managers and will provide a strong basis for better decision making by federal, State, and local agencies and environmental groups.

Budget Costs: The total annual cost for this project is \$90,611. Cost sharing from the Anadromous Fish Restoration Program and Department of Water Resources reduces the contribution from CalFed to \$45,361 per year, for a total project cost of \$136,083 for the three year project.

Third Party Impacts: There are no third party impacts associated with the conductance of this project.

Applicant Qualifications: The project manager and field staff have many years of experience with the Department of Water Resources conducting similar projects. The Department has all necessary equipment to conduct the project.

Monitoring and Data Evaluation: Data will be used to determine present effects from stressors to instream aquatic habitat and priority species, and to determine effectiveness of watershed management and mitigation activities. Data from the proposed project will be compared to the sparse historic data that is available to determine long-term changes that may have occurred. Data will also be compared with criteria established for protection of aquatic life and assessment results from the Sacramento River Watershed Program, which is assessing similar parameters in the mainstem of the Sacramento River.

Support/Coordination: Data from the proposed assessment program will be used by the Sacramento River Watershed Program to determine the contribution from Deer Creek to water quality impairment in the Sacramento River. The proposed program is supported by the Deer Creek Watershed Conservancy, Department of Fish and Game, Regional Water Quality Control Board, and Sacramento River Watershed Program.

Compatibility with CalFed Objectives: This project addresses water quality problems which adversely impact high-risk aquatic species and their habitats, including spring-run and late-fall run chinook salmon, steelhead trout, and instream aquatic habitat. The project also provides information necessary for actions to improve and increase aquatic habitats and improve ecological functions, consistent with the objectives in the Ecosystem Restoration Program Plan.

**Identification and Characterization of Water Quality
Factors Affecting Beneficial Uses**

**A Prerequisite to Restoration in the
Deer Creek Watershed**

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Type of Organization: State Government
(Tax Exempt)

Implementation Participants and Collaborators
Deer Creek Conservancy
Department of Fish and Game

RFP Project Group Type: Other Services

July 16, 1997

Project Description

Project Description and Approach:

The Department of Water Resources has, in cooperation with the Deer Creek Watershed Conservancy, Department of Fish and Game, and other interested parties, designed a water quality monitoring program which will thoroughly assess water quality conditions in the Deer Creek watershed. Monitoring stations will be established at strategic locations along the main stem of the creek. The program is designed to run a minimum of three years. A scaled down monitoring program adequate to assess long-term trends in water quality conditions will replace this intensive effort.

The proposed project is a water quality assessment program for the Deer Creek watershed. Basic water chemistry (minerals, nutrients, minor elements, and physical parameters) will be assessed since these parameters determine the beneficial uses of water and become elevated due to pollution, which often results in deleterious effects to aquatic life and other beneficial uses. Water temperature will be assessed since this parameter controls the rate of chemical and biological processes, has often been significantly altered from stream management activities (such as dams and diversions), and is of utmost importance in determining the suitability of a water body for survival and reproduction of anadromous fish.

Coliform bacteria levels will be assessed since these organisms are

indicative of fecal contamination and the possible presence of far more serious microorganisms which may impact health. Aquatic macroinvertebrates form the basis of the aquatic food web and are excellent indicators of long-term water quality conditions since specific communities develop in response to specific stream conditions and perturbations. These organisms will be assessed throughout the watershed.

The direct measurement of toxicity to aquatic organisms will determine the ability of the stream to support aquatic life. Toxicity assessment in stream bed sediments will identify impacts to the benthic community forming the basis of the food web. Water column toxicity assessment will identify direct impacts to fish from toxic substances dissolved or suspended in the water column. Fish tissues accumulate certain toxic substances, often in higher concentrations than found in the environment. Though these substances may not be directly lethal, bioaccumulation may result in death of the fish, impairment of life function such as reproduction, and adverse effects to higher trophic levels (including people) which ingest the fish. Analyses of fish tissues will determine the presence of toxic substances which may not be identifiable through other means.

Sedimentation is a major impairment in streams. Sediments in stream gravels adversely impact salmonid reproduction and organisms (aquatic macroinvertebrates) important as food for fish. Analyses of sediments in stream gravels will determine areas of

impact and aid in identification of sources of sediments.

Monitoring stations will be established at twelve sites on Deer Creek. Descriptive stream condition and habitat assessments will be conducted at each site. Physical parameters will be collected monthly at these stations, including pH, conductivity, dissolved oxygen, and turbidity. Temperature recorders will be placed at eight of the stations.

Water samples will be collected monthly at five stations to assess chemical constituents, including mineral (calcium, sodium, potassium, magnesium, sulfate, chloride, boron, and alkalinity), nutrient (nitrate plus nitrite, ammonia, dissolved orthophosphate, and total phosphorus), and minor element (aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, selenium, and zinc) concentrations.

Monthly bacterial sampling at all twelve locations within the watershed for total and fecal coliform will use the membrane filtration method. Additional biological sampling will include annual aquatic macroinvertebrate sampling at eight locations.

Toxicity tests will include fish tissue sampling, bed sediments, and water column testing at a station near the mouth of the creek and an upstream site important for salmonid holding and spawning. Tissue sampling will use sculpin or the Asiatic clam, *Corbicula*. Water column testing will use Ceriodaphnia and the fathead minnow.

Bed sediment toxicity assessment will use the amphipod *Hyaella*.

Spawning gravels will be sampled at eight sample sites for laboratory determination of particle size distribution. Subsequent monitoring will be conducted to identify specific sources of sediments in impacted reaches.

This monitoring schedule will continue for three years. Additional stations or parameters may be added as data analyses identifies problem reaches within the watershed. Following the first three years of water quality assessment, data analyses may show that some parameters may not be necessary to continue to monitor, thus allowing laboratory expense to be lessened. Future assessments will maintain a base level of monitoring to identify long-term changes, and concentrate additional studies on areas shown to be degraded in order to identify sources of adverse effects and develop remedial actions.

Location of Project: The proposed project includes the entire reach of Deer Creek in Tehama County. Deer Creek originates from Butt Mountain and enters the Sacramento River at RM 230 about a mile north of Woodson Bridge State Park. The creek drains a watershed of about 200 square miles on the eastern side of the Sacramento River. Three dams and four diversion ditches along the lower reaches of the 60 mile long stream divert most of the natural flow during the irrigation season.

Expected Benefit: The proposed project will provide information about system

stressors in the Deer Creek watershed which affect priority aquatic species and their habitats. The stressors for which this project will provide valuable information include: 1) alteration of flows and other effects of water management, including hydrograph alterations, migration barriers and straying; 2) water quality; 3) water temperature; and 4) land use, including grazing, forestry, and agricultural practices. Natural flows in Deer Creek are altered by diverting water for irrigation at three dams and four diversion ditches. These alterations to the natural flow adversely affect water quality, sediment transport, and gravel recruitment. Adverse water quality conditions created by hydrograph modification, especially as related to water temperature modification, result in delaying or blocking migration by anadromous fish. Water temperatures, especially during lower flows, may adversely affect the ability of the creek to provide suitable migration, spawning, and nursery habitat for anadromous fish as well as other aquatic species.

The habitat type affected by stressors in the Deer Creek watershed is primarily instream aquatic habitat. The priority species in this habitat type affected by stressors in the watershed include spring-run, fall-run, and late-fall-run chinook salmon and steelhead trout. This project will provide primary benefits to this habitat type and these species by identifying water quality impairments that are limiting the quality of the habitat and reducing survival of these species. The project provides secondary benefits for adaptive management by establishing baseline conditions to evaluate the effects of other mitigation and

amelioration activities that occur in the watershed. The project also fosters efforts by the Deer Creek Conservancy and Department of Fish and Game by providing basic data for watershed planning and management.

Background and Biological/Technical Justification: Monitoring the water resources in a watershed is essential to detect and document pollution. Monitoring is also necessary to continually assess water quality and the health of the water resource. The most reliable way to determine if changes in land-based activities have affected water quality is to monitor the water resource before, during, and after a change in land management or restoration occurs. At a watershed scale, this relationship between changes in land management and water quality can only be determined by following a strict experimental plan, or monitoring protocol. Detailed tracking of water quality is essential to provide information to decision makers about the effectiveness of nonpoint source pollution control efforts.

Water quality affects the beneficial uses of streams, including the beneficial use as fish habitat. Yet, very little water quality data are available for the Deer Creek watershed. Without water quality data, environmental effects to migrating, spawning, and rearing salmon and steelhead cannot be realistically determined, nor can mitigation be developed until the scope of the problem is defined.

The Deer Creek Conservancy, Department of Fish and Game, and other parties agree that a comprehensive

water quality monitoring program is required in order to assess the overall health of the watershed and the effectiveness of fishery management and restoration activities. Comprehensive baseline data will be invaluable in the event of future disturbances such as chemical spills along transportation corridors, landslides, floods, unusual fish kills, or other catastrophic incidents. The Department of Fish and Game has identified Deer Creek as having "the greatest potential of all Sacramento Valley streams for increasing naturally spawning populations of steelhead and spring-run chinook salmon." The Deer Creek Conservancy was formed to protect and restore the environment in the watershed and is developing a comprehensive management strategy.

Water quality assessment and monitoring are necessary to characterize existing conditions within the watershed, determine contaminants and their origins, and understand the interactions of toxicants and biological components of the ecosystem. Data will be developed by the proposed program that identify current conditions of various resource issues related to water quality, and provide a baseline to determine the effectiveness of mitigation activities in the watershed. This assessment plan will address historic as well as current water quality conditions to define those factors that most affect the water quality conditions within the Deer Creek watershed. Data developed by the proposed project will be used by a variety of agencies and groups to implement mitigation activities to improve habitat conditions related to water quality, including stream temperatures, toxi-

cants, and stream sediments. This project is important to water resource managers and will provide a strong basis for better decision making by federal, State, and local agencies and environmental groups.

The Department of Water Resources had maintained a basic water quality monitoring station near the mouth of Deer Creek for several years. This program, however, provided only minimal inorganic chemical analyses. The Department is embarking on an expanded water quality assessment program in the Deer Creek watershed, in cooperation with the Deer Creek Conservancy, Department of Fish and Game, and other agencies and environmental groups. However, the Department still has insufficient funds to assess all the water quality factors identified in this proposed project, which are similar to those being assessed in the main stem of the Sacramento River by the Sacramento River Watershed Program, that affect habitat conditions and priority species within the Deer Creek watershed.

Proposed Scope of Work: Field sample and data collection for water quality assessments will be conducted according to the schedule presented in Table 1. After collection, samples will be submitted to laboratories for analyses while field data and laboratory results will be entered into a database. The data will be reviewed monthly to insure the program is on schedule and that the data being collected are providing useful information. Progress reports will be made to the CalFed Bay Delta Program and other interested parties at agreed

upon intervals. The project is proposed to continue for three years. An annual report documenting the achievements of the project will be prepared at the end of the first and second years, while a final report will be prepared at the end of the third year of the program.

Monitoring and Data Evaluation: Data generated from this project will establish baseline water quality conditions for the Deer Creek watershed. These data will be used to determine present effects from stressors to instream aquatic habitat and priority species, and to determine effectiveness of watershed management and mitigation activities.

Data from the proposed project will be compared to the sparse historic data that is available to determine long-term changes that may have occurred. Data will also be compared with criteria established for protection of aquatic life and assessment results from the Sacramento River Watershed Program, which is assessing similar parameters in the mainstem of the Sacramento River. Data from the proposed assessment program will be used by the Sacramento River Watershed Program to determine the contribution from Deer Creek to water quality impairment in the Sacramento River.

The proposed assessment program has already been reviewed and approved by the Deer Creek Conservancy, Department of Fish and Game, landowners, and other interested groups and individuals. Monthly progress presentations to the Deer Creek Conservancy and Department of Fish and Game will insure that information

generated from the program is meeting the needs for assessment and mitigation efforts. All draft reports will be reviewed by these groups.

Implementability: Department of Water Resources staff have current valid scientific collecting permits to enable completion of biological assessments for this project. No other environmental permits are required. Access permission to private property has been obtained.

Although climatic conditions affect the flow in Deer Creek, collection of environmental samples in Deer Creek is not impeded by such conditions. Access to assessment sites is generally via paved roads or improved dirt roads. Water quality samples during high flows can be collected from bridges, using appropriate sampling equipment. Other parameters, such as aquatic macroinvertebrates and bulk sediment samples, are scheduled to be collected during low flow conditions.

Local agencies have reviewed and support the proposed project. The project scope and objectives have been presented to governmental agencies, environmental groups, and citizens at meetings of the Deer Creek Conservancy.

Costs and Schedule to Implement Proposed Project

Budget Costs: Costs for the project are distributed as indicated in Table 2. Estimated total cost for this project is \$90,611 per year, including field sample collection, laboratory analyses, and data

processing. The California Department of Water Resources has \$20,000 per year that will be used to partially fund this study, and has been approved for a grant from the Anadromous Fish Restoration Program for \$25,250 per year for three years to partially support this project. The Department is seeking additional funds to cover the remaining unfunded data collection and analyses activities for this assessment project. Funds needed are \$45,361 per year for the three year watershed assessment project. The total requested allocation for the three year water quality assessment of the Deer Creek watershed is \$136,083.

Schedule Milestones: The Department of Water Resources installed thermographs and began inorganic chemical monitoring and laboratory analyses, and coliform analyses in May 1997. Aquatic macroinvertebrate sample collection and analyses will be conducted in September 1997. The start of assessments for water column and bed sediment toxicity, sediment particle size distribution, fish tissue, and pesticide analyses cannot begin until additional funding is secured. These analyses will begin immediately upon contract execution for the additional funding.

Third Party Impacts: No direct third party impacts are associated with this project. However, third parties may be affected as the results of this watershed assessment project are used to remediate sources of impairment. Third parties may bear some of the costs of remediation, or additional grants will be needed to remediate impairment. The extent of costs for remediation of

impairments cannot be determined until the proposed project is implemented and results are obtained.

Applicant Qualifications

The project will be conducted by staff of the Northern District of the California Department of Water Resources. The project will be directed by Gerald Boles, who is Chief of the Water Quality and Biology Section in the Northern District. Jan Kilbuck, an Environmental Specialist II in the Water Quality and Biology Section, will be the lead investigator responsible for field sample collection and data archiving and analyses under direction of the project director. Fraser Sime, an Environmental Specialist III in the same section, will be responsible for overseeing laboratory work for aquatic macroinvertebrate and coliform bacteria analyses. General administrative functions, such as accounting, billing, and contract administration, will be conducted by the Northern District's Administrative Officer, Barbara Polson.

The Deer Creek Conservancy is the primary participant that will help guide the program. The Conservancy is comprised of landowners in the Deer Creek watershed, while the advisory committee has representatives from the Department of Fish and Game, Regional Water Quality Control Board,, Sacramento River Preservation Trust, and other environmental groups and concerned citizens. The Conservancy and advisory committee will review project progress and results, and make recommendations concerning direction for the project.

Biosketches: Gerald Boles has been the supervisor of the Water Quality and Biology Section in the Northern District of the Department of Water Resources since 1990, and has been conducting water quality studies for the Department since 1975. He has a B.A. degree in Microbiology (minor in Chemistry) and a M.A. degree in Biological Sciences. In addition to years of experience with budgets and general supervisory functions, he has supervised and conducted numerous water quality investigations. He is responsible for both the Water Quantity and Quality Measurement Program and the Water Quality Evaluation Program in the Northern District. His duties have required him to develop and implement studies and research projects to determine environmental effects on water quality, wildlife, plants, and fisheries associated with future water supply projects, geothermal development, weather modification, water transfers, and other projects. Some of the projects for which he has been directly responsible include assessment of impacts to the aquatic macroinvertebrate community following the metam sodium chemical spill in the upper Sacramento River in 1991, development and implementation of a water quality assessment program at Lake Almanor in cooperation with Plumas County, long-term water quality monitoring at both Clear and Eagle lakes, evaluation of effects to aquatic resources from cloudseeding in the upper Feather River area, groundwater quality assessments in the Sacramento Valley, Eagle Lake, and Cady Springs areas, and assessment of factors affecting the water quality of a drinking

water supply reservoir. References include Steve Turek, Department of Fish and Game, 2440 Athens Avenue, Redding, California; Lauri Zander, Lahontan Regional Water Quality Control Board, 2501 Lake Tahoe Boulevard, South Lake Tahoe, California; Laura Barnhouse, Plumas County Environmental Health Department, P.O. Box 545, Chester, California; and Dennis Heiman, Central Valley Regional Water Quality Control Board, 415 Knollcrest Drive, Suite 100, Redding, California.

Fraser Sime earned a B.S. degree in Natural Resources Management from California State University, Humboldt and has been employed since 1988 by the Department of Water Resources. He has been involved in all phases of the District's extensive aquatic macroinvertebrate program, including field sampling, taxonomy, program design, and QA/QC. He currently is responsible for the macroinvertebrate and coliform bacteria programs in the District. Some of his projects have involved identification and enumeration of macroinvertebrates from surface water quality monitoring sites, taxonomic identification of fish stomach contents and macroinvertebrate samples collected by other agencies, several lake water quality monitoring programs, and assisting other Environmental Specialists with water quality related projects. He also participates as a docent to local schools in conducting field trips in stream and vernal pool ecology. He is a member of the North American Benthological Society and California Inland Invertebrate Working Group. References include Jim Harrington, Department of Fish and

Game, 2005 Nimbus Road, Rancho Cordova, California; Steve Turek, Department of Fish and Game, 2440 Athens Avenue, Redding, California; Dr. David Lauck, Aquatic Entomologist (formerly Professor of Entomology at CSU, Humboldt), P.O. Box 1255, Parowan, Utah.

necessary for submission with this proposal per Table D1 of the RFP.

Jan Kilbuck has been employed by the Department of Water Resources since 1993. With a B.S. degree in Biological Sciences, he has been extensively involved in the District's water quality monitoring program, as well as thermograph maintenance and data acquisition, aquatic macroinvertebrate collection, and database administration. He currently is responsible for the collection and processing of samples and data that the Department is collecting for the Water Quantity and Quality Measurement Program from throughout northeastern California, as well as in several lake monitoring programs. He is the Water Quality and Biology Section's representative to the Deer Creek Conservancy, and has been the leadperson involved in current assessment activities in the watershed. References include Laura Barnthouse, Plumas County Environmental Health Department, P.O. Box 545, Chester, California; Dr. David Kistner, Department of Biological Sciences, California State University, Chico; and Steve Turek, Department of Fish and Game, 2440 Athens Avenue, Redding, California.

Compliance with Standard Terms

As a public agency, all standard terms and conditions will be approved at signing of the contract. No forms are

Table 1. Proposed Monitoring Schedule for Deer Creek

Station	Temperature	Physical	Chemical	Aquatic Macroinvertebrates	Coliform Bacteria	Toxicity Tests		Sediment Particle size	Fish Tissue	Pesticides
	Recorder					DO, pH, EC, Turbidity, Alkalinity	Minerals, Nutrients, Minor Elements			
									Sculpin or Cotticula	
Deer Cr @ mouth	c	m	m	September	m	m	biannually	September	September	fall & winter
Deer Cr @ Hwy 99	c	m	m	September	m			September		
Deer Cr @ Upper Diversion Dam	c	m	m	September	m			September		fall & winter
Deer Cr @ Ponderosa Way	c	m	m	September	m	m	biannually	September	September	
Deer Cr @ A Line Rd	c	m		September	m			September		
Deer Cr below Meadows	c	m	m	September	m			September		fall & winter
Deer Cr @ Elm Cr Cmpgrd		m			m (1)					
Deer Cr @ Potato Patch Cmpgrd		m			m (1)					
Deer Cr @ Alder Cr Cmpgrd		m			m (1)					
Deer Cr @ Red Bridge on Leininger Rd		m			m (1)					
Deer Cr at Upper Falls	c	m		September	m			September		
Deer Cr @ Apperson Camp	c	m		September	m			September		

c - continuously temperature recorder; serviced monthly

m - monthly sampling and analyses

m (1) - monthly during recreation season

Table 2. Annual Cost distribution for Deer Creek Watershed Assessment

Project Task	Direct Labor Hours	Direct Salary & Benefits	Overhead Labor	Service Contracts	Material & Acquisition	Miscellaneous	Total Cost
Thermographs	96	2,017	2,651	0	0	0	4,764
Water Sampling	96	2,017	2,651	0	500	0	5,264
Inorganic Analysis (1)	0	0	0	13,536	0	0	13,536
Aquatic Macroinvertebrates	178	1,390	1,830	0	500	0	3,898
Coliform bacteria (2)	210	4,414	5,800	0	1,000	0	11,424
Water Column Toxicity (3)				20,640	0	0	20,640
Bed Sediment Toxicity (4)				3,200	0	0	3,200
Sediment Analysis (5)	192	4,036	5,303	4,000	0	0	13,531
Fish Tissue Analysis (6)	128	2,691	3,535	5,000	0	0	11,354
Pesticide Analysis (7)	0	0	0	3,000	0	0	3,000
Total Project Costs		16,565	21,770	49,376	2,000	0	90,611

- 1 - monthly analyses for minerals, nutrients, and minor elements at 5 sites
- 2 - total and fecal coliform analyses at 8 sites each month and 4 sites during recreation season
- 3 - monthly assessment at 2 sites
- 4 - twice per year at 2 sites
- 5 - annual assessment at 8 sites
- 6 - annual assessment at 2 sites
- 7 - analysis at 3 sites during fall and mid-winter

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