

## PSP Cover Sheet

Proposal Title: Implementation of Riparian Corridor Management along the Woodson Bridge Subreach of the Sacramento River

Applicant Name: California Department of Water Resources Attn: Stacy Cepello

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Amount of funding requested: \$687,000 for 3 years

Indicate the Topic for which you are applying (check only one box).

- |   |   |
|---|---|
| <input type="checkbox"/> Fish Passage/Fish Screens      | <input type="checkbox"/> Introduced Species       |
| <input checked="" type="checkbox"/> Habitat Restoration | <input type="checkbox"/> Fish Management/Hatchery |
| <input type="checkbox"/> Local Watershed Stewardship    | <input type="checkbox"/> Environmental Education  |
| <input type="checkbox"/> Water Quality                  |   |

Does the proposal address a specified Focused Action? X Yes        No

What county or counties is the project located in? Tehama

Indicate the geographic area of your proposal (check only one box):

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> Sacramento River Mainstem | <input type="checkbox"/> East Side Trib: _____                  |
| <input type="checkbox"/> Sacramento Trib: _____               | <input type="checkbox"/> Suisun Marsh and Bay _____             |
| <input type="checkbox"/> San Joaquin River Mainstem           | <input type="checkbox"/> North Bay/South Bay: _____             |
| <input type="checkbox"/> San Joaquin Trib: _____              | <input type="checkbox"/> Landscape (entire Bay-Delta watershed) |
| <input type="checkbox"/> Delta: _____                         | <input type="checkbox"/> Other: _____                           |

Indicate the primary species which the proposal addresses (check all that apply):

- |  |   |
|--|---|
| <input type="checkbox"/> San Joaquin and East-side Delta tributaries fall-run chinook salmon | <input checked="" type="checkbox"/> Spring-run chinook salmon |
| <input checked="" type="checkbox"/> Winter-run chinook salmon                                | <input checked="" type="checkbox"/> Fall-run chinook salmon   |
| <input checked="" type="checkbox"/> Late-fall run chinook salmon                             | <input type="checkbox"/> Longfin smelt                        |
| <input type="checkbox"/> Delta smelt   | <input checked="" type="checkbox"/> Steelhead trout           |
| <input type="checkbox"/> Splittail   | <input type="checkbox"/> Striped bass                         |
| <input type="checkbox"/> Green sturgeon  | <input type="checkbox"/> All chinook species                  |
| <input checked="" type="checkbox"/> Migratory birds  | <input type="checkbox"/> All anadromous salmonids             |
| <input checked="" type="checkbox"/> Other: <u>see Table 1 (attached)</u>                     |   |

Specify the ERP strategic objective and target(s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:

See Table 1 (attached)

Indicate the type of applicant (check only one box):

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> State agency         | <input type="checkbox"/> Federal agency |
| <input type="checkbox"/> Public/Non-profit joint venture | <input type="checkbox"/> Non-profit     |
| <input type="checkbox"/> Local government/district       | <input type="checkbox"/> Private party  |
| <input type="checkbox"/> University                      | <input type="checkbox"/> Other: _____   |

Indicate the type of project (check only one box):

- |                                     |  |
|-------------------------------------|--|
| <input type="checkbox"/> Planning   | <input checked="" type="checkbox"/> Implementation |
| <input type="checkbox"/> Monitoring | <input type="checkbox"/> Education                 |
| <input type="checkbox"/> Research   |  |

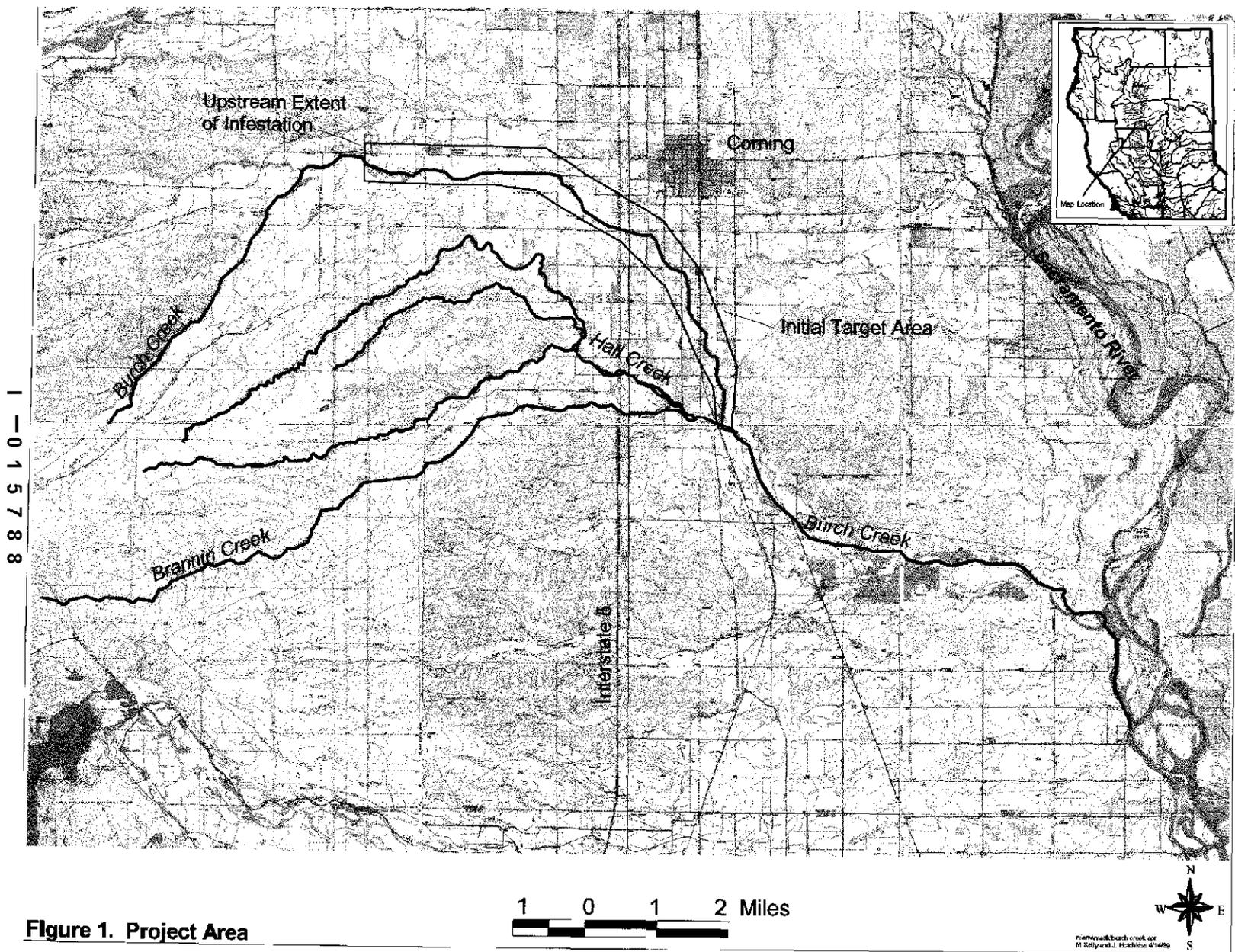
By signing below, the applicant declares the following:

- 1) The truthfulness of all representations in their proposal;
- 2) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and
- 3) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

California Department of Water Resources  
Printed Name of Applicant



\_\_\_\_\_  
Signature of Applicant



**Figure 1. Project Area**

562,725.45 E, 4,420,153.15 N

571,192.57 E, 4,420,153.15 N

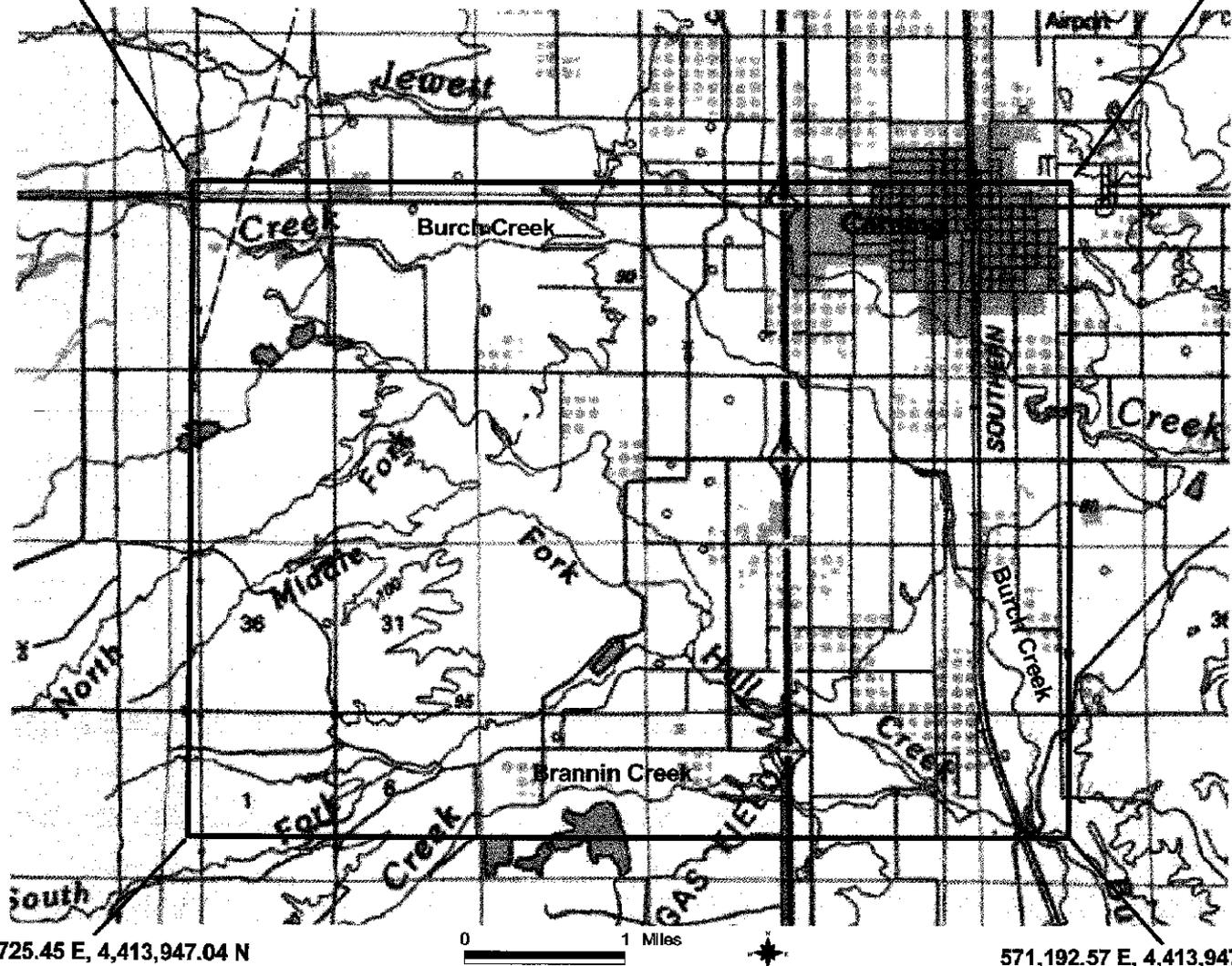


Figure 2. Project Area with UTM Coordinates, 1:100,000 scale from Willows, CA quadrangle

1-015789

1-015789

Table 1. ERPP strategic objectives, stressors and targets addressed by project.

Category	Strategic Objective, Stressor, Target	ER[[ Reference
Ecological Process: Stream Meander	Increase the extent of freely meandering reaches and other pre-1850 river channel forms	Vol. 1, p. 43
Habitat: aquatic, wetland, and riparian habitats	Restore large expanses of all aquatic, wetland, and riparian habitats in the Central Valley and its rivers (including riparian and riverine aquatic, freshwater fish, and essential fish habitat)	Vol. 1, p. 103-104
Species: Sacramento winter-run, spring-run, fall-run, and late-fall run chinook salmon	Restore winter-run, spring run, fall-run, and late-fall run chinook salmon to the Sacramento River and Bay-Delta Estuary	Vol. 1, p. 220-223
steelhead trout	Restore self-sustaining Central Valley steelhead to Central Valley streams and the Bay-Delta estuary	Vol. 1, p. 229
Swainson's hawk	Restore Swainson's hawk populations	Vol. 1, p. 249
Species: Valley Elderberry Longhorn Beetle	Increase and maintain valley elderberry-beetle habitat	Vol. 1, p. 286-287
Species: western yellow-billed cuckoo	Restore populations of yellow-billed cuckoo throughout its historical range in the Central Valley	Vol. 1, p. 304
Species: bank swallow	Increase the number of breeding colonies of bank swallow in the Central Valley	Vol. 1, p. 307
Species: least Bell's vireo	Restore least Bell's vireo to representative habitats throughout its former range	Vol. 1, p. 312
Species: California yellow warbler	Restore and protect habitats used by neotropical migrant birds for breeding and forage in the Central Valley	Vol. 1, p. 314
Species: little willow flycatcher	Restore little willow flycatcher populations to habitats throughout its former range in central California	Vol. 1, p. 317-318
Species: native resident fish species	Reverse the decline of native resident fishes	Vol. 1, p. 347
Species: shorebird and wading bird guild	Provide high quality habitat and transition zone [habitat] that allow shorebirds [and wading bird] access to both feeding and nesting	Vol. 1, p. 355-356
Species: waterfowl	Enhance populations of waterfowl for harvest by hunting and for nonconsumptive recreation.	Vol. 1, p. 360
Species: neotropical migratory bird guild	Restore and protect habitats used by neotropical migrant birds for breeding and forage in the Bay-Delta watershed.	Vol. 1, p. 363
Stressor: invasive riparian plants	Eliminate, or control to a level of little significance, all undesirable non-native species, where feasible.	Vol. 1, p. 478
Stressor: levees, bridges and bank protection	Reestablish frequent inundation of floodplains by removing, breaching, or setting back levees [or bank protection]	Vol. 1, p. 439

**TITLE PAGE**

**Title of Project:** Implementation of Riparian Corridor Management along the  
Woodson Bridge Subreach of the Sacramento River

**Primary Contact:**

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**Collaborators**

Tehama County  
City of Corning  
John Muir Institute for the Environment  
Sacramento River Advisory Council  
California Department of Parks and Recreation  
University of California, Davis

**Type of Organization and Tax Status**  
state agency

**Tax Identification Number**  
52-1692634

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4/16/99

## EXECUTIVE SUMMARY

The California Department of Water Resources requests \$690,000 to implement riparian corridor management within the Woodson Bridge subreach of the Sacramento River (Figures 1 and 2). The project will be implemented through the site-specific planning process already initiated for this subreach, under the Sacramento River Riparian Habitat (SB1086) Program. This proposal directly addresses the **CALFED Stage I Action to protect, enhance and restore the meander belt between Red Bluff and Chico Landing**, and is consistent with SB1086's vision of an inner river zone with a limited meander, and the goal to establish a continuous riparian corridor. In addition, it fulfills the SB1086 recommended action for site-specific management planning at the subreach level.

The ecological and biological objective of this project is **to help protect and expand natural processes associated with the meanderbelt and associated floodplain of the Sacramento River**. This project is a site-specific planning effort as envisioned by the Sacramento River Advisory Council (SB 1086) in the delineation of the Sacramento River Conservation Area Handbook. The protection of riparian forests and restoration of natural ecological function will help to reconnect floodplain habitats with the main river channel, contribute to a channel and floodplain configuration providing instream habitat conditions that shaded riverine aquatic habitat. A continuous and functioning riparian forest corridor will stabilize the channel; help shape submerged aquatic habitat structure; benefit the aquatic environment by contributing shade, overhead canopy, and instream cover for fish. This meandering corridor contributes to natural sediment transport, erosion, and deposition. Through these processes, this project will protect and increase the quality and quantity of essential spawning, rearing, and migratory pathways for a host of aquatic and terrestrial at-risk species.

The project is essentially very simple. **Rock revetment that no longer serves its intended purpose and contributes to downstream erosion threatening both a rare valley oak woodland and Woodson Bridge is removed and is strategically placed where it protects both the bridge and the City of Corning's sewer outfall**. By removing the rock from the upstream bank the river channel will be allowed to once again meander freely through its alluvial floodplain. Initial predictions (DWR, 1998) indicate that if allowed to meander at this location the river will eventually recapture Kopta Slough, on the western edge of the historic meander belt (geologic control). This would potentially provide a number of benefits, including reduced erosion on the east bank of the Woodson Bridge SRA (reducing loss of the valley oak woodland), creating or expanding a number of aquatic/wetland habitat types, creating conditions for the development of shaded riverine aquatic and bank swallow nesting habitat, and reestablishing the process of riparian forest succession to a substantial area of publicly owned land.

The project includes the collection and development of baseline hydrographic and geological data, relocation of obsolete rock revetment to a location where it is needed to

protect public infrastructure, the development of geomorphic, hydraulic, and biological models for the subreach, and the development of long-term management recommendations. ***The California Department of Water Resources will oversee the project, collect the baseline data, and develop the hydraulic model. DWR will contract with a local entity such as Tehama County or the City of Corning to implement the rock relocation portion of the project. Research Scientists at the University of California Davis Department of Geology and John Muir Institute for the Environment will do the geomorphic and biological modeling.***

This meander restoration project will be implemented as an experiment in river management, with appropriate baseline information, ***stringent field monitoring*** backed up with extensive remote sensing data, and ***theoretical numerical, empirical, and GIS based landscape scale models*** to predict, assess, and compare possible outcomes. These models, which collectively will predict the most important physical and biological parameters for future management decisions, will be grounded in detailed physical and biological data collected from the project site.

Potential third-party impacts could include a shifting of erosion away from the State Park, County Park, Caltrans, City of Corning and private landowners, to other landowners. However, implementation of this project will result in a limited river meander corridor that should overall reduce erosion impacts on private landowners and public infrastructure.

This project has been coordinated with:

- Sacramento River Advisory Council (SB1086)
- adjacent landowners
- City of Corning
- Tehama County
- Reclamation Board
- California Department of Parks and Recreation
- Wildlife Conservation Board
- California Department of Transportation
- State Lands Commission
- Regional Water Quality Control Board
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Environmental Protection Agency
- California Department of Fish and Game
- Sacramento River Partners
- Sacramento River Preservation Trust
- The Nature Conservancy

## **PROJECT DESCRIPTION**

### **Proposed Scope of Work**

The California Department of Water Resources requests \$690,000 to implement riparian corridor management within the Woodson Bridge subreach of the Sacramento River (Figures 1 and 2). The project will be implemented through the site-specific planning process already initiated for this subreach, under the Sacramento River Riparian Habitat (SB1086) Program. This proposal directly addresses the **CALFED Stage I Action to protect, enhance and restore the meander belt between Red Bluff and Chico Landing**, and is consistent with SB1086's vision of an inner river zone with a limited meander, and the goal to establish a continuous riparian corridor. In addition, it fulfills the SB1086 recommended action for site-specific management planning. The project includes the collection and development of baseline hydrographic and geological data, relocation of obsolete rock revetment to a location where it is needed to protect public infrastructure, the development of geomorphic, hydraulic, and biological models for the subreach, and the development of long-term management recommendations.

Changes in river management have resulted in flooding and erosion problems at the active bend in this reach, adjacent to Woodson Bridge State Recreation Area. Current efforts look to identify alternatives to traditional bank protection techniques (rocking), and present a unique opportunity to identify and implement non-traditional methods which will also help restore natural river processes.

As the first implementation project being coordinated through the SB1086 Riparian Habitat Committee, **the public outreach and agency coordination** component of this project is being performed by the Sacramento River Conservation Area Coordinator. The Coordinator is currently being funded under an existing two-year CALFED grant. The Coordinator is working closely with local landowners, city, county, state, and federal agencies, and public interest groups to ensure that the project addresses important concerns. Implemented in close cooperation with the Sacramento River Conservation Area Coordinator, this project will include five tasks:

#### **Task 1. Project Management**

The California Department of Water Resources will be managing the project, including coordinating data collection, implementation, modeling and reporting activities. They will also be responsible for obtaining the necessary permits and ensuring that the project is in compliance with local, state and federal regulations. The final component of this task is the development of long-term solution recommendations based on project results, during the third year of the program.

#### **Task 2. Baseline Data Collection and Development; Hydraulic Modeling.**

Conducted by the California Department of Water Resources, this task includes : 1) assembling and developing baseline data prior to the bank protection relocation, in the first project year; 2) developing a hydraulic model in the second project year for the subreach to be used in the modeling work; and, 3) collecting data on subsurface geology and erosion, and developing erosion projections.

This task includes collecting bathymetric data, postprocessing preexisting

photogrammetry, production of detailed hydrography, collection of subsurface geologic data, erosion monitoring and projection, and development of a subreach hydraulic model. Topography will be based on photography and surveying being conducted under CALFED's Offstream Storage Program. Photography and ground control will be available prior to project implementation. Photography and ground control for this subreach will be photogrammetrically converted into a digital terrain model (DTM).

Bathymetry will be collected using a GPS integrated transducer from a fully outfitted hydrographic survey boat. Typically, channel surveys are conducted using a zigzag (bank to bank) pattern with additional longitudinal profiles as necessary. The resulting bathymetric digital terrain model (DTM) can generate 2' contours.

Development of the hydraulic model includes merging the bathymetric digital terrain model (DTM) with the photogrammetrically developed DTM into a finite element network at roughly twice the level of accuracy needed to conduct flood modeling for FEMA. The U.S. Army Corps of Engineers is developing hydraulic modeling (Hydraulic Engineering Center HEC RAS) of the Sacramento/San Joaquin flood control systems at roughly this level of detail (2' contours in and near the channel, 5' contours farther out in the flood plain). These surveys would allow for the extension of the COE's hydraulic model to the Woodson Bridge subreach project area.

Geologic drilling and trenching will be done in the vicinity of the channel cutoff area as projected by DWR (DWR, 1991). In addition, erosion will be monitored at the rock removal site (west bank), at the currently eroding bank at Woodson Bridge State Recreation Area and County Park (east bank), and immediately downstream of Woodson Bridge (east bank). Erosion rates will be calibrated using flow frequency and duration records and used to develop projections for the subreach.

### Task 3: River Channel Restoration

This project task will be subcontracted with Tehama County or the City of Corning and will be implemented during the first year of the project after additional geologic information is obtained, and permitting requirements are met. It includes **restoration of shaded riverine aquatic habitat and natural river process** at Kopta Slough through removal of existing rock revetment, and the **protection of a county road and city sewage outfall** through placement of rock revetment on the west side of the river immediately downstream of Woodson Bridge.

Rock revetment that no longer serves its intended purpose and contributes to downstream erosion threatening both a rare valley oak woodland and Woodson Bridge is removed and is strategically placed where it protects both the bridge and the City of Corning's sewer outfall. By removing the rock from the upstream bank the river channel will be allowed to once again meander through its alluvial floodplain. Initial projections (DWR, 1998) indicate that if allowed to meander at this location the river will eventually recapture Kopta Slough, on the western edge of the historic meander belt (geologic control). This would provide a number of benefits, including reduced erosion on the east bank of the Woodson Bridge SRA (reducing loss of the valley oak woodland), creating or expanding a number of aquatic/wetland habitat types, creating conditions for the development of shaded riverine aquatic and bank swallow nesting habitat, and reestablishing the process of riparian forest succession to a substantial area of publicly owned land.

#### **Task 4: Geomorphic computer model**

This task will be carried out for the three-year duration of the project by the University of California, Department of Geology, to address long-term adaptive management scenarios and take into account potential third party impacts for the subreach. The computer model, based on the mechanics of flow and sediment transport in curved river channels (i.e. Johannesson and Parker, 1989; Larsen, 1995; Larsen and Dietrich, 1996); will be used to simulate migration of the river in the study reach. This model relies on mathematical modeling of the physical processes that determine channel shifting in an active alluvial river. A version of this model has been successfully used on studies of the Mississippi River (Larsen, 1995), and is the process of being adapted for use on the Sacramento River (DWR, 1998). The output provides practical predictions of the channel planform location in future time periods. Calibration of site-specific bank erosion characteristics can be done through the use of historical planform locations, and direct bank erosion studies (i.e. Larsen and Micheli, 1997). The inputs required for the model are a characteristic discharge (like the 2-year recurrence interval flow), a reach average width, depth, slope, and bed particle size. Previous work with this model has shown it to be effective in modeling the meander migration of the Sacramento River (Larsen et al., 1997a, 1997b, 1999a [in manuscript], 1999b [in manuscript]).

In addition to providing practical predictions for design purposes, the model will include a public education demonstration package, to demonstrate to stakeholders the effect of various management actions. The subcontractor will develop a computer program with interactive user control and visual output of meander migration modeling for public outreach and communication.

#### **Task 5: Biological model**

This task will be carried out during the first two years of the project by the University of California, Davis (John Muir Institute for the Environment). The goal of this predictive linked riparian ecosystem model is to forecast the potential ecological responses of riparian forest structure (succession) to river channel movement and flooding regime. To accomplish this goal it is necessary to quantify the main mechanistic relationships from a historical perspective using historical data sets (for model calibration and validation). Since the land cover classification system used for mapping the landscape is derived from the California Wildlife Habitat Relationship System (CWHR) the riparian ecosystem model may be used to measure trends in habitat conditions for selected terrestrial vertebrate indicator species.

#### **Location and/or Geographic Boundaries of the Project**

The project location is on the Sacramento River, River Mile 213 - 223 in the vicinity of Woodson Bridge where it crosses the Sacramento River at South Avenue, in Tehama County east of Corning (Figures 1 and 2). The project **is within the Chico Landing To Red Bluff Ecological Management Unit, within the Sacramento River Ecological Zone**. It is a relatively unstable geomorphic subreach, lying between two relatively stable subreaches of the river. The project area is within the Chico Landing to Red Bluff Reach of the Sacramento River Conservation Area as described in the *Sacramento River Conservation Area Handbook*

## **ECOLOGICAL/BIOLOGICAL BENEFITS**

### **Ecological/Biological Objectives**

The ecological and biological objective of this project is to help protect and expand natural processes associated with the meanderbelt and associated floodplain of the Sacramento River. Stressors addressed by this project include: **bank protection**, which reduces bank swallow nesting habitat, can alter the physical form of the channel, reduce gravel recruitment, prevent riparian vegetation succession, reduce instream habitat diversity and reduce the amount of shaded riverine aquatic habitat;; **predation and competition**, by increasing the amount of naturally occurring and self-sustaining shaded riverine aquatic habitat which provides cover for juvenile salmonids; and, **invasive riparian plants**, by allowing the natural restorative processes of erosion, deposition, flooding and riparian plant community succession to occur along a portion of the project area;

**Species/Habitats/Benefits** The project will provide significant benefits for the following priority species: winter-run, spring-run, late-fall-run and fall-run chinook salmon; splittail; steelhead trout; green sturgeon, resident fish, American shad, Swainson's hawk, western yellow-billed cuckoo, bank swallow, shorebird and wading bird guilds, neo-tropical migratory birds, upland game, valley elderberry longhorn beetle, and bald eagle. The project directly improves **riparian and riverine aquatic, freshwater fish, and essential fish habitats**. The project also restores natural channel migration to approximately one mile of the meander corridor of the Sacramento River, contributing to the regeneration riparian habitat, and an increase in natural shaded riverine aquatic habitat.

### ***Scientific hypotheses***

- Allowing channel meander in appropriate places creates and transforms aquatic and terrestrial habitats naturally. Increasing the extent of the active meander zone will result in the increased creation of sloughs, shaded riverine aquatic habitat, large woody debris, gravel recruitment, hydraulic diversity (channel complexity), neo-tropical nesting habitat, floodplain building and forest succession.
- Allowing channel meander creates a diverse mosaic of habitat types and sizes at a landscape scale. These changes can be predicted with a level of accuracy required to effect management of target species.
- Reducing direct hydraulic sheer stress to the alluvial (east) bank of the Woodson Bridge State Recreation Area will reduce bank recession rates and preserve rare valley oak woodland and alleviate the need to protect the east bridge abutment.
- Comparison of results of numerical modeling at UCD with empirical geomorphic predictions by DWR
- Erosion coefficients calculated by optimization of calibration will correspond with land-use/geology types

**Durability of Benefits** A dynamic meanderbelt along the Sacramento River depends on restoration of natural processes in order to be self-sustaining. The length of

time that the river channel within a meanderbelt system will remain in one place varies in relation to a large number of variables. One of the purposes of the modeling component is to determine the stability of the river channel in any particular configuration.

### Linkages

**SB1086.** This project was initiated through SB1086, a collaborative effort of local landowners, agencies and other interested parties, which has been working since 1987 to establish a plan to preserve and manage a continuous riparian ecosystem along a 222-mile segment of the Sacramento River. This proposal builds on a 1998 CALFED grant that funded a Sacramento River Conservation Area Coordinator to coordinate restoration efforts with landowners and agencies. With the completion of the draft Sacramento River Conservation Area Handbook, the SB1086 program is moving into an implementation phase that includes forming a locally-based nonprofit riparian habitat management organization. Addressing ongoing erosion at the Woodson Bridge State Recreation Area through restoration of channel process will be one of the first tasks of the organization.

**U.S. Army Corps of Engineers (USACOE) Comprehensive Study.** A portion of this project involves coordinating with the USACOE to develop a long-term management recommendation for this subreach. This recommendation could be implemented through a Section 1135 project (below) or the Comprehensive Study.

**U.S. Army Corps of Engineers 1135 Project.** The Sacramento River Conservation Area Coordinator is currently working with the USACOE on a project under section 1135 of the Water Resources Development Act (Project Modifications for the Improvement of the Environment) to modify the requirements for the maintenance of Chico Landing to Red Bluff Project rock revetment. This 1135 project could contribute to the short-term implementation component of this project.

This project addresses the Ecosystem Restoration Program strategic objectives, listed on Page 2 (Table 1).

### System-Wide Ecosystem Benefits

This project benefits ecosystem-wide programs such as the Sacramento River Riparian Habitat Program, Central Valley Project Improvement Act, the Sacramento River National Wildlife Refuge, the California Riparian Habitat Conservation Program and the U.S. Army Corps of Engineers Comprehensive Study.

### Compatibility with Non-Ecosystem Objectives

This project is consistent with the SB 1086 approach of balancing environmental needs with those of the local community. Non-ecosystem benefits of this project include reducing erosion at public facilities such as Woodson Bridge, the City of Corning sewage outfall, the Woodson Bridge State Recreation Area, and Tehama County Sacramento River Park.

## **TECHNICAL FEASIBILITY AND TIMING**

Alternatives to this project that were evaluated and not selected include:

1. *Installing bank protection at the Woodson Bridge State Recreation Area and the Tehama County Park to halt erosion.* This alternative was not selected because of the high expense, cumulative impact, and minimal environmental benefit.
2. *Allowing the river to migrate within a limited meander, installing trenched rock or future bank protection on the east side within the Woodson Bridge State Recreation Area.* This alternative was not selected because of the high expense of installing trenched rock, cumulative impact and the inability to provide assurances that rock would be installed when the river reached a certain point.
3. *Digging a channel to reconnect the main river channel with Kopta Slough.* This alternative was not selected because of the high expense and uncertainty as to the stability of the constructed channel alignment and potential hydraulic effects.
4. *Letting the river continue current meander patterns (no action alternative).* This alternative was not selected because the river is eroding the bank at the Woodson Bridge State Recreation at a rapid rate, and also eroding at the western abutment of Woodson Bridge, in part due to the obsolete upstream rock revetment at Kopta Slough.

The proposed alternative was selected because it offers a relatively inexpensive solution which will result in multiple third-party benefits with a demonstrable benefit to the Sacramento River ecosystem. This proposal will allow for study of geomorphic and hydraulic effects without precluding the implementation of further action based on information obtained. It is the alternative most suited to an adaptive management approach.

The following regulatory issues will be addressed during the implementation of this project include:

- NEPA compliance, including: consultation with the National Marine Fisheries Service regarding impacts to spring-run, winter-run, fall- and late-fall run chinook salmon and steelhead trout; consultation with U.S. Fish and Wildlife Service regarding impacts to federally-listed threatened and endangered species such as Swainson's hawk and valley elderberry longhorn beetle.
- CEQA compliance, including consultation with the California Department of Fish and Game regarding state-listed threatened and endangered species such as western yellow-billed cuckoo and bank swallow.
- Development of a Streambed Alteration Agreement with the California Department of Fish and Game;
- Regional Water Quality Control Board Certification
- Reclamation Board Permit
- State Lands Commission Permit
- CalTrans Encroachment Permit

## **MONITORING AND DATA COLLECTION METHODOLOGY**

The project is essentially very simple. Rock revetment that no longer serves its intended purpose and contributes to downstream erosion threatening both a rare valley oak woodland and Woodson Bridge is removed and is strategically placed where it protects both the bridge and the City of Corning's sewer outfall. By removing the rock from the upstream bank the river channel will be allowed to once again meander freely through its alluvial floodplain. Initial predictions (DWR, 1998) indicate that if allowed to meander at this location the river will eventually recapture Kopta Slough, on the western edge of the historic meander belt (geologic control). This would potentially provide a number of benefits, including reduced erosion on the east bank of the Woodson Bridge SRA (reducing loss of the valley oak woodland), creating or expanding a number of aquatic/wetland habitat types, creating conditions for the development of shaded riverine aquatic and bank swallow nesting habitat, and reestablishing the process of riparian forest succession to a substantial area of publicly owned land.

The Woodson Bridge SRA Long-Term Solutions Study (Working Draft) identified this action as the environmentally superior alternative among the eight studied. It is also the most suited to an adaptive management approach. It is a logical extension of the Palisades Demonstration Bank Protection Project, which was itself a form of adaptive management. The proposed action does not preclude any future course of action and is compatible with, or possibly the first step in, a long-term management solution for this subreach.

This meander restoration project will be implemented as an experiment in river management, with appropriate baseline information, stringent field monitoring backed up with extensive remote sensing data, and theoretical numerical, empirical, and GIS based landscape scale models to predict, assess, and compare possible outcomes. These models, which collectively will predict the most important physical and biological parameters for future management decisions, will be grounded in physical and biological data collected from the project site.

Although some of the required technology is highly sophisticated and the modeling cutting-edge, the essential approach to monitoring, data collection, and hypothesis testing is relatively simple. Background and baseline data of the appropriate scale and resolution will be collected to refine physical and biological models and provide a basis to test the hypotheses (Table 2). These data include detailed geology, bathymetry, topography, hydrology, stage measurements, habitat types and areas, and change in critical physical and biological parameters over time. These data will then be incorporated into hydraulic, geomorphic, and biological (landscape scale) models to assess the most likely outcome of meander restoration in the subreach. To the degree that these models accurately predict the physical and biological changes resulting from the proposed action, stakeholder groups will develop confidence in using the respective models to guide future management in this subreach. The first such decision will be whether to physically reconnect the main river channel directly to Kopta Slough or to allow the channel to migrate freely within its own time frame. A substantial lack of agreement between predictive modeling and measured outcomes will result in reevaluation of conceptual models and/or underlying modeling assumptions.

Some aspects of hypotheses testing will become evident in the first year or two after implementation, such as development of shaded riverine aquatic and bank swallow habitat. The broader geomorphic and landscape scale effects will develop over a period of years that include bankfull or overbank flows. Monitoring for these longer term signatures through bank recession surveys, remote sensing, and photogrammetric techniques should be assimilated into CALFED's Comprehensive Monitoring, Assessment, and Research Program.

California Department of Water Resources  
Riparian Corridor Management, Woodson Bridge Subreach, Sacramento River

Table 2. Monitoring and Data Collection Methodology

Hypothesis/Question to be Evaluated	Monitoring Parameter and Data Collection	Data Evaluation Approach	Comments/Data Priority
Allowing channel meandering in appropriate places creates and transforms aquatic and terrestrial habitats naturally. Increasing the extent of the active meander zone will result in the increased creation of sloughs, shaded riverine aquatic habitat, large woody debris, gravel recruitment, hydraulic diversity (channel complexity), avian neotropical nesting habitat, floodplain building and forest succession.	Linear feet of retired non-critical bank stabilization will be measured relative to total channel area, shaded riverine aquatic habitat, recruitment of gravel and large woody debris, fluvial geomorphic characteristics, bank swallow nesting, forest regeneration and succession.	Correlations will be sought between the cumulative totals for restoration of natural processes and habitat areas.	This is the prototype study for restoring the natural meandering process to a critical management area along the Sacramento River. It is based on the adaptive management principals of studying the effects of a concrete action and developing tangible models to guide future activities. Collecting data from this action for input into predictive modeling efforts is of the highest priority.
Reducing direct hydraulic shear stress to the alluvial (east) bank of the Woodson Bridge State Recreation Area will reduce bank recession rates and preserve rare valley oak woodland and alleviate the need to protect the east bridge abutment.	Directly and indirectly (using remote sensing) measure the bank recession rates and gross changes in channel planform throughout the study reach. Develop detailed topography and geology. Acquire detailed hydrology and river stage data.	Develop predictive empirical and theoretical (numerical) models of channel movement over time based on historic and current erosion rates, detailed field information and hydraulic modeling. Compare the predictive results to actual field data.	The effectiveness of the proposed action in altering the rate of erosion at the Woodson Bridge SRA east bank will be a critical factor in determining future management actions.
Comparison of results of numerical modeling at UCD with empirical geomorphic predictions by DWR	Centerline of planform configurations of both model predictions.	Numerical method of testing model performance.	Where models disagree, determine the strengths/weaknesses of each.
Erosion coefficients calculated by optimization of calibration will correspond with land-use/geology types	Results of calibration for erosion coefficient will be compared with data from digitized land-use/geology data.	Plot functional relationship between land use and erosion coefficient (as shown in Larsen and Micheli, 1997)	Where land-use/geology does not directly correlate with calibrated erosion coefficients, it indicates areas where we need to identify key migration rate factors.
Allowing channel meander creates a diverse mosaic of habitat types and sizes at a landscape level.	Aerial photography, photogrammetry and ground truthing will be used to quantify landscape parameters including habitat type, habitat area, and change through time	GIS analysis involving various cartographic techniques will be used to evaluate total and net change in measured parameters.	Modeling of potential changes in measured parameters will provide detailed information that will assist in guiding future species management actions.

1-015801

## **LOCAL INVOLVEMENT**

Considerable local involvement on this project has taken place during the Woodson Bridge Alternatives Analysis investigation conducted by the California Department of Water Resources. A series of public and agency coordination meetings were held on the issue in the Corning area between July 1997 and April 1999. Coordination has taken place with:

- Sacramento River Advisory Council (SB1086) (Attachment A)
- adjacent landowners
- City of Corning
- Tehama County
- Reclamation Board
- California Department of Parks and Recreation
- Wildlife Conservation Board
- California Department of Transportation
- State Lands Commission
- Regional Water Quality Control Board
- U.S. Fish and Wildlife Service
- U.S. Army Corps of Engineers
- Environmental Protection Agency
- California Department of Fish and Game
- Sacramento River Partners
- Sacramento River Preservation Trust
- The Nature Conservancy
- Sacramento Valley Landowners Association

The Tehama County Board of Supervisors and Planning Departments have been notified of the project (Attachment B).

Potential third-party impacts could include a shifting of erosion away from the State Recreation Area, County Park, Caltrans, City of Corning and private landowners, to other landowners. However, implementation of this project will result in a limited river meander corridor that should overall reduce erosion impacts on private landowners and public infrastructure.

**COST**

**Budget**

Task	Direct labor hours	Direct salary and Benefits	Service Contracts	Material and acquisition costs	Misc. and other direct costs	Overhead and indirect costs	Total cost
Task 1: Project Management	1400	\$51,200			\$500	\$28,700	\$80,400
Task 2: Develop Baseline Information	2300	\$92,700			\$500	\$51,900	\$145,100
Task 3: Construction			\$120,000				\$120,000
Task 4: Geomorphic Modeling			\$203,500				\$203,500
Task 5: Biological Modeling			\$138,000				\$138,000
<b>TOTAL</b>	<b>3,700</b>	<b>\$143,900</b>	<b>461,500</b>		<b>\$1,000</b>	<b>\$80,600</b>	<b>\$687,000</b>

California Department of Water Resources  
*Riparian Corridor Management, Woodson Bridge Subreach, Sacramento River*

TASK	<u>1<sup>st</sup> Qtr.</u> <u>2000</u>	<u>2<sup>nd</sup> Qtr.</u> <u>2000</u>	<u>3<sup>rd</sup> Qtr.</u> <u>2000</u>	<u>4<sup>th</sup> Qtr.</u> <u>2000</u>	<u>1<sup>st</sup> Qtr.</u> <u>2001</u>	<u>2<sup>nd</sup> Qtr.</u> <u>2001</u>	<u>3<sup>rd</sup> Qtr.</u> <u>2001</u>	<u>4<sup>th</sup> Qtr.</u> <u>2001</u>	<u>1<sup>st</sup> Qtr.</u> <u>2002</u>	<u>2<sup>nd</sup> Qtr.</u> <u>2002</u>	<u>3<sup>rd</sup> Qtr.</u> <u>2002</u>	<u>4<sup>th</sup> Qtr.</u> <u>2002</u>	<u>Total</u> <u>Budget</u>
<u>1. Project Management</u>	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>	<u>10,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,000</u>	<u>5,100</u>	<u>5,100</u>	<u>5,100</u>	<u>5,100</u>	<u>80,400</u>
<u>2. Develop Baseline Information</u>	<u>25,000</u>	<u>25,000</u>	<u>25,000</u>	<u>25,000</u>	<u>22,000</u>	<u>18,100</u>			<u>1,000</u>	<u>1,000</u>	<u>1,000</u>	<u>1,000</u>	<u>145,100</u>
<u>3. Construction</u>				<u>120,000</u>									<u>120,000</u>
<u>4. Geomorphic Modeling</u>		<u>25,100</u>	<u>25,200</u>	<u>25,200</u>	<u>25,200</u>	<u>12,500</u>	<u>12,500</u>	<u>12,500</u>	<u>12,500</u>	<u>17,600</u>	<u>17,600</u>	<u>17,600</u>	<u>203,500</u>
<u>5. Biological Modeling</u>		<u>25,000</u>	<u>25,000</u>	<u>25,000</u>	<u>25,000</u>	<u>20,000</u>	<u>18,000</u>						<u>138,000</u>
<u>TOTAL</u>	<u>25,000</u>	<u>85,100</u>	<u>85,200</u>	<u>205,200</u>	<u>80,200</u>	<u>57,600</u>	<u>35,500</u>	<u>17,500</u>	<u>17,600</u>	<u>22,700</u>	<u>22,700</u>	<u>22,700</u>	<u>\$687,000</u>

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## **SCHEDULE**

### **Task 1: Project Management**

*Year One Milestones:* Complete all subcontracts: UCD, JMIE, construction (interagency); complete all permitting requirements; complete required environmental documentation, obtain permits. Cost: \$40,000

*Year Two Milestones:* Integrate baseline information with various modeling efforts; continue coordination efforts between subcontractors. Cost: \$20,000

*Year Three Milestones:* Completion of long-term management recommendations report: Cost: \$20,400

### **Task 2: Develop Baseline Information**

*Year One Milestones:* Complete initial field studies; obtain photogrammetric products. Cost: \$100,000

*Year Two Milestones:* Complete hydraulic modeling. Cost: \$50,100. Summarize field monitoring in memorandum report. \$4,000.

### **Task 3: Construction**

*Year One Milestones:* Complete contracts. Remove and place rock revetment per specifications. Cost: \$120,000.

### **Task 4: Geomorphic Modeling**

*Year One Milestones:* Develop meandering model for subreach, including calibration and validation. Cost: \$75,500.

*Year Two Milestones:* Application of meander migration model to simulate alternative bank stabilization. Comparison of results of numerical model with empirical geomorphic predictions. Cost: \$62,700.

*Year Three Milestones:* Erosion coefficient calculated by optimization of calibration will correspond with landuse/geology types. Cost: \$63,300.

### **Task 5: Biological Modeling**

*Year One Milestones:* Acquire necessary baseline and historic data and develop landscape model for subreach. Cost \$75,000.

*Year Two Milestones:* Application of landscape model to simulate changes resulting from alternative river management scenarios. Cost: \$63,000.

## **APPLICANT QUALIFICATIONS**

### California Department of Water Resources

Project Management and coordination will be the responsibility of DWR Northern District Office. The Northern District Office has extensive experience in fisheries and riparian vegetation restoration projects throughout Northern California including the Sacramento River. The Northern District office has staff qualified in the areas of botany, hydrology, hydrogeology and has conducted extensive botanical and fluvial-geomorphic field studies along the Sacramento river. DWR Northern District has provided technical support and contract administration to SB1086 since the program was begun over 10 years ago.

The Project Manager will be Stacy Cepello, Environmental Specialist IV, who is the lead person for the environmental services section of the Northern District Office. Stacy has over 12 years of experience on fisheries and riparian restoration projects in the Sacramento Valley. The project manager will draw on the staff expertise and resources available in the Northern District Office for support.

The Administrative Project Manager will be Barbara Polson, Chief of the Administrative Branch of DWR's Northern District Office.

### Subcontractors

Eric W. Larsen received his Ph.D. in 1995 from the Environmental Water Resources Division of the Civil Engineering program at UC Berkeley. He has worked extensively as a consultant in the field of geomorphology and river restoration. From 1997 to the present he has been an Assistant Research Geomorphologist in the Department of Geology, UC Davis. His current research interests include application of continuum mechanics to channel migration in meandering rivers. Based on this research, he has constructed the meander migration model that will be used in this project.

Steven E. Greco received his B.S. in Landscape Architecture in 1987 and his M.S. in Ecology in 1993. He is currently a Ph.D. candidate in Ecology at UC Davis, with degree completion expected in September 1999. He has a broad research interest in landscape ecology and GIS-based ecosystem analysis. His current research is on riparian forest and floodplain habitat dynamics in response to historic and present flooding regimes.

## REFERENCES

California Department of Water Resources, Northern District, *Woodson Bridge State Recreation Area Long-term Solution Study, Working Draft*. November, 1998.

Larsen, E. W. 1995, *The Mechanics and Modeling of River Meander Migration*: Ph.D. Dissertation, University of California at Berkeley.

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Larsen, E. W., Mount, J. F., and Schaldow, G. S. 1997, *Hydraulic Controls on River Meander Migration*: Proceedings, Association of Engineering Geologists, p. 120.

Larsen, E. W., Schladow, G.S. and Mount, J.F. 1997, *The Geomorphic Influence of Bank Revetment on Channel Migration: Upper Sacramento River, Miles 218-206*. International Association of Hydraulic Research (IAHR) XXVI Congress: San Francisco, California.

Larsen, E. W., Mount, J. F., and Schaldow, G. S. in manuscript: *Meander Migration of the Upper Sacramento River: Sensitivity to Changing Hydraulic Variables*.

Larsen, E. W., Greco, S.E., and Barker, C.H. in manuscript: *Channel Migration of the Sacramento River near Woodson Bridge State Recreation Area: A Case Study of Alternative Channel Management Strategies*.

Sacramento River Advisory Council, *draft Sacramento River Conservation Area Handbook*, May 1998.

**SACRAMENTO RIVER ADVISORY COUNCIL**

c/o CALIFORNIA DEPARTMENT OF WATER RESOURCES  
2440 MAIN STREET  
RED BLUFF, CALIFORNIA 96080

Denny Burgarz, Chair • (916) 864-7342 • dburgarz@water.ca.gov  
Art Sandt, Sacramento River Conservation Area Coordinator • (916) 864-7381 • art@sandt@water.ca.gov

April 15, 1999

Mr. Lester Snow, Executive Director  
CALFED Bay Delta Program  
1416 Ninth Street  
Sacramento, CA 95814

**Re: Implementation of Riparian Corridor Management along the Woodson Subreach  
of the Sacramento River**

**Proponent: California Department of Water Resources**

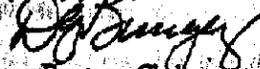
Dear Mr. Snow:

Based on the information provided by the project proponent of this project and with the understanding of continued studies and hydrologic and hydraulic review we find that this project is consistent with and furthers the objectives of the Sacramento River Conservation Area (SB1086) as outlined in the SRCA Handbook. An essential part of this effort continues to be close coordination with affected public and private landowners, government agencies, and other groups and individuals. The essence of the Sacramento River Conservation Area (SB1086) process is communication and coordination from a wide variety of interests along the river.

This proposal has been presented to both the Advisory Council and its' Riparian Habitat Committee, and the Council has authorized me to forward its' actions on this proposal.

Thank you for your consideration.

Very truly yours,



Denny Burgarz, Chair  
Sacramento River Conservation Area Advisory Council

cc: California Department of Water Resources

## DEPARTMENT OF WATER RESOURCES

NORTHERN DISTRICT  
2440 MAIN STREET  
RED BLUFF, CA 96080-2398

April 15, 1999

Mr. Ross M. Turner, Chair  
Tehama County Board of Supervisors  
Post Office Box 250  
633 Washington Street  
Red Bluff, California 96080

Dear Mr. Turner:

This is to let you know that the California Department of Water Resources is submitting two funding proposals to the CALFED Bay-Delta Program that fall within the borders of Tehama County. These projects are being coordinated with the County.

The first project, *Implementation of Riparian Corridor Management along the Woodson Bridge Subreach of the Sacramento River*, requests funding for: baseline data collection (topography, bathymetry, and geology) at the Woodson Bridge site; implementation of rock removal at Kopta Slough and rock placement on the west bank of the river between the bridge and the City of Corning sewage outfall, computer modelling of channel dynamics, and the development of longterm adaptive management recommendations for the site.

The second project, *Arundo donax control on Burch Creek: Non-native Invasive Species Eradication, Flood Management, and Restoration*, requests funding to eradicate *Arundo donax*, or giant reed, within the Burch, Hall, and Brannin Creek watershed. As you are aware, this proposal is being developed in cooperation with the Tehama County Flood Control and Water Conservation District and the California State University, Chico. Thank you very much for the support expressed by the Board of Supervisors on this proposal.

If you have any questions, please call me at (530) 529-7342 or Stacy Cepello at (530) 529-7352.

Sincerely,

A handwritten signature in black ink, appearing to read "Naser J. Bateni".

Naser J. Bateni, Chief  
Northern District

cc: Mr. George Robson  
Tehama County Planning Department  
444 Oak Street  
Red Bluff, California 96080