INITIAL STUDY
DRAFT MITIGATED NEGATIVE DECLARATION

WILLOW CREEK ROAD 2ND BRIDGE AREA FISH PASSAGE PROJECT

February 18, 2010

State of California
DEPARTMENT OF PARKS AND RECREATION
Russian River District
P.O. Box 123
Duncan Mills, CA 95430-0123

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DRAFT MITIGATED NEGATIVE DECLARATION

PROJECT: Willow Creek Road 2nd Bridge Area Fish Passage
Sonoma Coast State Park

LEAD AGENCY: California Department of Parks and Recreation

AVAILABILITY OF DOCUMENTS: The Initial Study for this Draft Mitigated Negative Declaration is available for review at:

- California Department of Parks & Recreation
  Northern Service Center
  One Capitol Mall - Suite 410
  Sacramento, CA 95814

- California Department of Parks & Recreation
  Russian River District Headquarters
  P.O. Box 123
  Duncan Mills, CA 95430-0123

- California Department of Parks & Recreation
  Sonoma Coast State Park
  3095 Coast Highway 1
  Bodega, CA 94923

- Guerneville Regional Library
  14107 Armstrong Woods Rd.
  Guerneville, CA 95446

  California Department of Parks and Recreation Internet Website
  http://www.parks.ca.gov/?page_id=981

PROJECT DESCRIPTION:
The California Department of Parks and Recreation proposes to replace six channel-constraining culverts with a single-span, precast concrete bridge. The purposes of the project are to support channel formation and maintenance processes, to remove a significant barrier to fish passage, and to improve public access. The project is located on lower Willow Creek Road in Sonoma County approximately two miles southeast of the community of Jenner.

A copy of the Initial Study is attached. Questions or comments regarding this Initial Study/Draft Mitigated Negative Declaration should be submitted in writing no later than March 20, 2010, to: Brendan O'Neil – Senior Environmental Scientist
California Department of Parks & Recreation
P.O. Box 123
Duncans Mills, CA 95430-0123

Pursuant to §21082.1 of the California Environmental Quality Act, the California Department of Parks and Recreation has independently reviewed and analyzed the Initial Study and Draft Mitigated Negative Declaration for the proposed project and finds that these documents reflect the independent judgment of DPR. DPR, as lead agency, also confirms that the project mitigation measures detailed in these documents are feasible and will be implemented as stated in the Draft Mitigated Negative Declaration.

Brendan O'Neil
Senior Environmental Scientist

2/10/10
Date

Liz Burko
District Superintendent

2/10/10
Date

TABLE OF CONTENTS

Chapter **Page**

Appendices

1 INTRODUCTION

1.1 Legislative Guidance

The Initial Study/Draft Mitigated Negative Declaration (IS/MND) has been prepared by the California Department of Parks and Recreation (DPR) to evaluate the potential environmental effects of the proposed **Willow Creek Road 2nd Bridge Area Fish Passage Project** at Sonoma Coast State Park, Sonoma County, California. This document has been prepared in accordance with the California Environmental Quality Act (CEQA), Public Resources Code (PRC) §21000, *et seq*., and the State CEQA Guidelines, California Code of Regulations (CCR) §15000, *et seq*.

An Initial Study is conducted by a lead agency to determine if a project may have a significant effect on the environment (CCR §15063(a)). If there is substantial evidence that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) must be prepared in accordance with CEQA Guidelines §15064(a). However, if the lead agency determines that revisions in the project plans or proposals made by or agreed to by the project proponent mitigate the potentially significant effects to a less-than-significant level, a Mitigated Negative Declaration may be prepared instead of an EIR (CCR §15070(b)). The lead agency prepares a written statement describing the reasons a proposed project would not have a significant effect on the environment and, therefore, why an EIR need not be prepared. This IS/MND conforms to the content requirements under CEQA Guidelines §15071.

1.2 Lead Agency

The lead agency is the public agency with primary approval authority over the proposed project. In accordance with CEQA Guidelines §15051(b)(1), "the lead agency will normally be an agency with general governmental powers, such as a city or county, rather than an agency with a single or limited purpose." The lead agency for the proposed project is DPR. The contact person for the lead agency is:

Brendan O'Neil – Senior Environmental Scientist
California Department of Parks & Recreation, Russian River District
P.O. Box 123
Duncans Mills, CA 95430-0123

All inquiries regarding environmental compliance for this project, including comments on this environmental document, should be addressed to:

Brendan O'Neil, Senior Environmental Scientist
California Department of Parks & Recreation, Russian River District
P.O. Box 123
Duncans Mills, CA 95430
Fax: 707-865-2046
E-mail address: boneil@parks.ca.gov

Submissions must be in writing and postmarked, or received by fax or e-mail, no later than March 20, 2010. The originals of any faxed document must be received by regular mail within ten (10) working days following the deadline for comments, along with proof of successful fax transmission.

1.3 Document Purpose and Organization

The purpose of this document is to evaluate the potential environmental effects of the proposed Willow Creek Road 2nd Bridge Area Fish Passage Project at Sonoma Coast State Park. Minimization and mitigation measures have been incorporated into the project to avoid potentially significant impacts or reduce them to a less-than-significant level.

This document is organized as follows:

- Chapter 1 - Introduction
  Summarizes the background and purpose of the project, describes the organization of this document, and summarizes the findings.

- Chapter 2 - Project Description
  Details the project background, location, purpose, objectives, implementation, adaptive management, and consistency with local plans and policies and includes a discussion of visitation to Willow Creek, regulatory setting and discretionary approvals, and related projects.

- Chapter 3 - Environmental Setting, Impacts, and Mitigation Measures
  Identifies the significance of any potential environmental impacts, explains the environmental setting for each resource area, and evaluates the potential impacts identified in the CEQA Environmental (Initial Study) Checklist. Measures to minimize potential impacts are included, and mitigation measures are incorporated, where appropriate, to reduce potentially significant impacts to a less-than-significant level.

- Chapter 4 - Mandatory Findings of Significance
  Identifies and summarizes the overall significance of any potential impacts on natural and cultural resources, cumulative impacts, and impacts on humans, as identified in the Initial Study.

- Chapter 5 - Summary of Conditions and Mitigation Measures
  Summarizes the minimization and mitigation measures incorporated into the project as a result of the Initial Study.

- Chapter 6 - References
  Identifies sources of information used in the preparation of the IS/MND.

- Chapter 7 - Report Preparation
  Provides a list of those involved in the preparation of this Initial Study and Mitigated Negative Declaration.

- Appendix A – Interim Report: 30% Design and the Preferred Alternative
  Discusses the multiple options for replacing the culverts that were assessed during the 30% design phase of the project and briefly summarizes the site constraints, viability of the structure options, and the preferred alternative.

- Appendix B – Project Plans and Specifications, Sheets 1 through 8
  Includes a plan view, longitudinal profile, and cross sections of the proposed project, along with construction specifications and details.

- Appendix C – Geotechnical Study Report: Willow Creek 2nd Bridge Crossing, Willow Creek Road, Sonoma County, California

- Appendix D – Adaptive Geomorphic Plan for the Willow Creek Valley above the 2nd Bridge Crossing, Sonoma County, California

- Appendix E – Biological Resources Evaluation and Preliminary Wetland Delineation

- Appendix F – Vascular Plants of Willow Creek 2nd Bridge Project Area

- Appendix G – Typical Dewatering and Species Protection Plan

- Appendix H – Acronyms

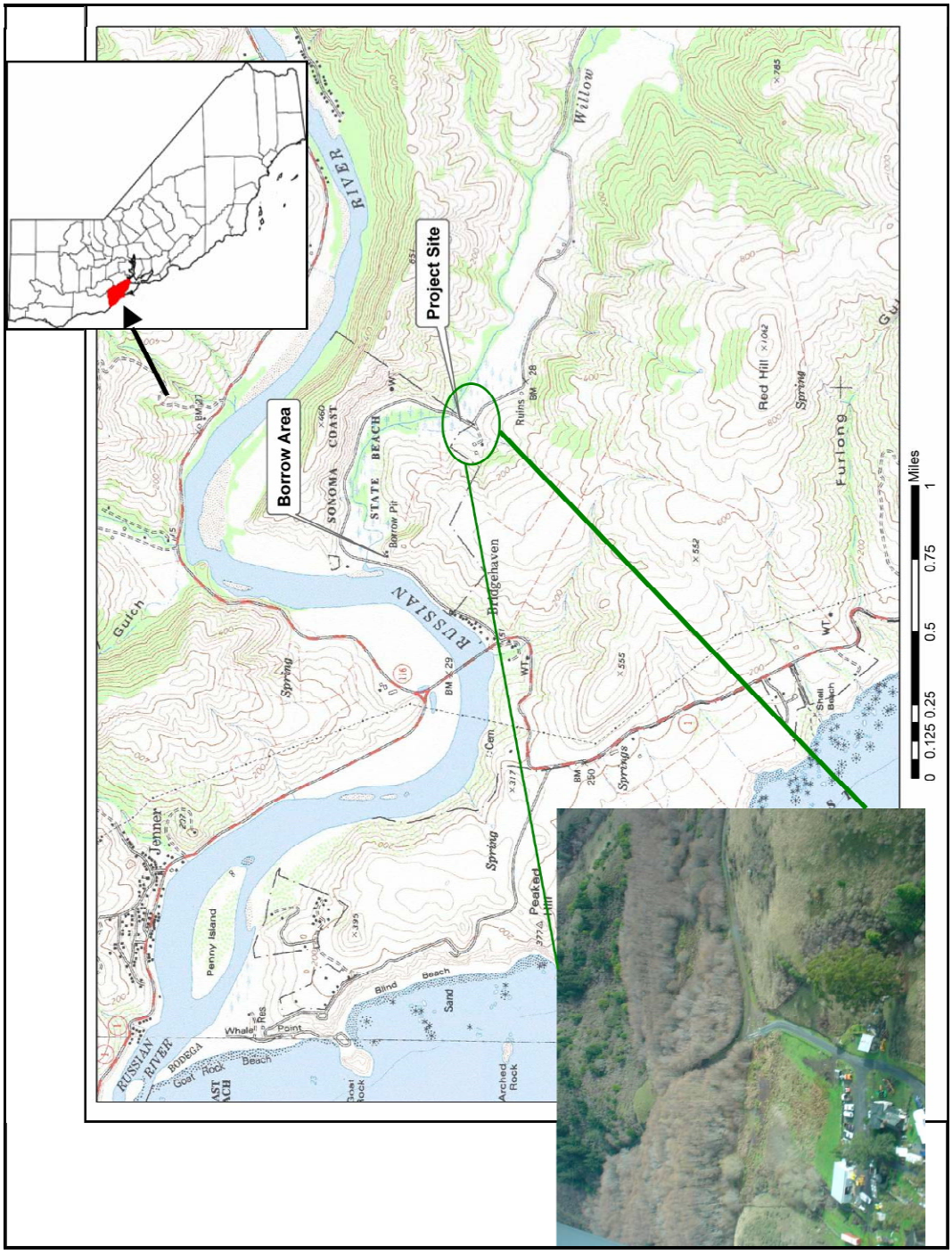
1.4 Summary of Findings

Chapter 3 of this document contains the Environmental (Initial Study) Checklist that identifies the potential impacts by environmental issue and provides a brief discussion of each potential impact resulting from implementation of the proposed project.

Based on the Initial Study and supporting environmental analyses provided in this document, the proposed Willow Creek Road 2nd Bridge Area Fish Passage Project would result in no impacts on aesthetics, agricultural resources, land use and planning, mineral resources, population and housing, public services, recreation, and utilities and service systems. Impacts on air quality, cultural resources, global climate change, hazardous materials, hydrology and water quality, noise, and transportation/traffic would be less than significant, and measures to minimize impacts are provided where possible. Minimization and mitigation measures are included that will reduce impacts on biological resources and geology, soils, and hazards to a less-than-significant level.

In accordance with §15064(f) of the CEQA Guidelines, a Mitigated Negative Declaration shall be prepared if the proposed project would not have a significant effect on the environment after the inclusion of mitigation measures in the project. Based on the available project information and the environmental analyses presented in this document, there is no substantial evidence that, after the incorporation of mitigation measures, the proposed project would have a significant effect on the environment. It is proposed that a Mitigated Negative Declaration be adopted in accordance with the CEQA Guidelines.

Figure 1. Vicinity Map Showing Project Location



Source: USGS

2 PROJECT DESCRIPTION

2.1 Project Background

This Initial Study/Draft Mitigated Negative Declaration (IS/MND) has been prepared by the California Department of Parks and Recreation (DPR) to evaluate the potential environmental effects of the proposed Willow Creek Road 2nd Bridge Area Fish Passage Project at Sonoma Coast State Park, located two miles southeast of the community of Jenner, in Sonoma County, California. The proposed project will replace six existing culverts with a single-span, precast concrete bridge. The purposes of the project are to remove impediments to natural stream channel formation, to remove a significant barrier to anadromous fish passage, and to improve public access.

The Willow Creek channel feasibility study (PCI 2005a) outlined a range of "fixes" for the 2nd bridge floodplain crossing to allow for natural channel-forming processes and to restore fish passage. The original investigation focused on establishing a single-thread channel in lower Willow Creek at the existing bridge location. However, it was dismissed as an option because it was found to be neither self-maintaining nor sustainable. Findings indicated that the lowest part of the valley, the thalweg, had moved to the south and is now located at the six constricting culverts rather than under the existing 2nd bridge. Also, the creek's historic configuration appears to be a series of interconnecting channels rather than a single one. Options considered ranged from replacing the floodplain culverts at the west side of the crossing, to building a causeway across the valley, to removing the bridge and crossing altogether and rerouting the road on the east side of the valley and out of the floodplain.

In 2005, the Willow Creek Technical Advisory Committee (TAC)[1] reached initial consensus that rerouting the road may be the preferred, long-term, ecologically superior alternative. Scoping for this alternative was immediately initiated by DPR, and an on-site route assessment was done in the fall of 2005 that determined road realignment was not an economically, geologically, or ecologically viable option. Rerouting the road would require extensive road cuts into unstable slopes, be twice as long as the existing road, traverse untouched, coastal grassland ridges, and cross intact riparian areas and marshy wetlands. Even if the costs and ecological impacts were mitigated, it was considered unlikely that permits or the public concurrence needed to establish a new road would be obtainable.

The TAC was reconvened in spring 2007, and numerous bridge and culvert options were reviewed in the context of ecological and hydraulic performance, future and existing road service levels, relative costs, and implementation timeframes. A new

[1] The TAC is a multi-disciplinary team that was convened by Stewards of the Coast and Redwoods (Stewards) in 2001. It consists of representatives from the California Department of Fish & Game, NOAA's National Marine Fisheries Service, the North Coast Regional Water Quality Control Board, DPR, Sonoma County Department of Transportation and Public Works, Stewards, Trout Unlimited, LandPaths, and private consultants with expertise in range management, fish passage, biology, ecology, geomorphology, hydrology, and regulatory compliance planning.

consensus was reached to design and install a channel crossing at the valley thalweg (west side of the 2nd bridge roadway) that would provide for channel development, hydraulic connectivity, fish passage, and have a 20- to 50-year lifespan. Choices included a free-span bridge and multiple-arched or box culverts.

This proposed project falls short of the ecologically superior and long-term options afforded by road decommissioning or a valley-spanning causeway. However, it was determined by the TAC that this approach to solving fish passage and channel connectivity was the most reasonable given the costs, right-of-way issues, and implementation needs and constraints. The proposed project does not preclude the later installation of additional, similar structures to create a raised, open causeway-like structure across the valley bottom should the need arise. Although the channel feasibility study (PCI 2005a) stated that multiple culverts would only have a lifespan of 5 to 15 years, further examination of the predicted channel evolution process, existing sediment transport dynamics, and hydraulic conditions at the site indicate the proposed fix will last a minimum of 20 years and is likely to be functional for much longer.

2.2 Project Location

Willow Creek flows from an 8.7-square mile watershed into the Russian River approximately 2 miles upstream of the river's mouth at Jenner in Sonoma County (Figure 1). Located on the western edge of the Coast Range, Willow Creek flows in a northwesterly direction following an inactive fault trace. Most of the Willow Creek watershed is part of the 10,286-acre Sonoma Coast State Park.

Willow Creek Road is a Sonoma County road which traverses the Willow Creek watershed. The road is ten miles in length and extends from State Highway One near Bridgehaven to Coleman Valley Road (approximately 3 miles west of Occidental). From highway one, Willow Creek Road first crosses Willow Creek at 1st Bridge at a distance of 0.75 mile, 2nd Bridge is 1.75 miles, and 3rd Bridge is 2.75 miles for the intersection of Highway One. Two private residences are located approximately 3.5 miles from the intersection of Highway One. The County has installed gates blocking public access to Willow Creek Road. The lower gate is located just above the residences at approximately 4.0 miles from the intersection of Highway One and the second is located just below the next group of residences at 8.0 miles from the intersection of Highway One. The upper two miles of Willow Creek Road passes through a rural residential neighborhood before terminating at the intersection with Coleman Valley Road.

The project area consists of the 2nd Willow Creek Road crossing and the floodplain immediately upstream to the 3rd bridge. The project site is approximately 1.75 miles from the intersection of Highway One and is surrounded by DPR property. The nearest private residences are approximately 1.75 miles to the north. Approximately 500 feet to the west is a DPR maintenance facility, an abandoned historic residence, barn and accessory structures, and two temporary mobile homes. To the north and south is the Willow Creek riparian corridor, and to the east lies open space.

2.3 Need for the Project

The 2nd bridge crossing has become a migration barrier to anadromous[2] salmonids and other aquatic species. Fish population surveys in 1962, 1963, and 1965 documented coho salmon and steelhead trout throughout the mid-lower, mid, and upper sections of Willow Creek (up to the rock falls) in schools of 15 to 20 in each pool (CDFG 1995:8). Subsequent surveys indicated a steady decline in population density, especially of coho salmon.

Concurrent with the population surveys, stream inventories assessing key habitat features were performed. These studies, along with other assessments of historic land-use practices, sediment supply and deposition, large woody debris, and channel morphology provided clues to the disappearance of anadromous salmonids in the Willow Creek watershed. These limiting factors are discussed in detail in Chapter 4 of the *Willow Creek Watershed Management Plan* (PCI 2005b).

The bermed roadway restricts channel connectivity and impedes channel-forming processes at the creek's geomorphically preferred location. High rates of sediment production in the Willow Creek watershed from past land-use practices have led to intensified channel and valley aggradation in lower Willow Creek. Low valley slopes, combined with frequent backwater conditions during high flows in the Russian River, naturally promote sediment deposition upstream of the tidal wetlands at the mouth of Willow Creek.

Historic channel management practices (realignment and frequent dredging) sought to control the natural tendency of the creek to form an anastamosing[3] system within the lower Willow Creek valley. A road was established in the 1930s that crossed the creek in the lower valley at three locations. The channel at the 2nd crossing required regular maintenance to conform to the bridge location established at that time.

Land use in lower Willow Creek transitioned from the historic agriculture and its associated channel and upland management practices to wildland in 1978 after the purchase of the area with public funding and its conversion to a State Park. Dredging of the channel ceased in the mid-1980s when it was deemed a financially and ecologically unsustainable practice. The natural processes immediately reasserted control over the system in the vicinity of the 2nd bridge, filling the man-made channel and inducing channel migration to the west side of the valley.

2.4 Project Objectives

The objectives of the project are to reestablish channel connectivity and fish passage, to allow natural channel development, to provide habitat connectivity, and to maintain

[2] The term "anadromous" is used to describe fish such as steelhead and salmon that return from the sea to the rivers and streams where they were born in order to breed.

[3] An "anastamosing" system is one in which a number of highly interconnected stream channels develop in broad, gentle valleys such as Willow Creek.

public access. The project is consistent with the goals and guidelines of the *Sonoma Coast State Park General Plan* (DPR 2007a). See specific General Plan discussions in Section I: Aesthetics; Section IV: Biological Resources; Section V: Cultural Resources; Section X: Land Use and Planning; and Section XV: Recreation.

2.5 Project Description Details

The proposed project will replace six existing culverts with a single-span, precast concrete bridge. Plan view, profile, and cross sections are found in Appendix A; see page 11 of Appendix A for other photos. Design details include:

- A bridge clear-span length of 43 feet,
- A bridge deck width of 27.5 feet,
- A bridge deck elevation of 20 feet National Geodetic Vertical Datum of 1929 (NGVD),
- Concrete bridge abutments supported by 16-inch diameter pipe piles driven approximately 70 feet deep,
- Bridge approaches graded to meet existing bridge elevation on the western approach and the 18-foot road contour on the eastern approach, and
- Bridge guard rails and a 6-inch concrete curb designed to meet Caltrans' highway design specifications.

Minimal channel construction is included in the project plan. To remove the culverts and to provide for natural stream channel configuration the channel at the bridge location will be excavated to the expected thalweg elevation and graded to conform to existing upstream and downstream incipient channel features. The thalweg under the bridge will be set at an elevation of 12.6 feet. It is expected that subsequent flows will create natural channel features and dimensions while connecting the existing channels currently forming on the south side of the valley.

To reduce the frequency of road flooding in the vicinity of the existing culverts, approximately 790 feet of the existing roadway will be raised and repaved. This includes approximately 120 feet of roadway leading to the DPR maintenance facility. Grading the bridge approaches will include fill at the edges of the roadway to raise the road elevation approximately 3 feet to match the bridge surface elevation. The grading will result in approximately 2,100 cubic yards of cut and 2,500 cubic yards of fill. The net fill required for the project will be approximately 400 cubic yards.

Because the entire area off the road is wetland, some wetland fill will be required. There is an intersection at the corner of Willow Creek Road (adjacent to the culverts) with the road to the maintenance area. Raising both of these approaches to meet the bridge will create a slightly larger road footprint, allowing a reduced angle of the turn onto the maintenance road and creating a small, grassed area. Two 24-inch diameter by 40-foot long culverts currently carry water into the corner of this junction and then west of the road. The corner has a small, degraded wetland that will be filled. Flow to the seasonal wetland west of the road will be maintained by replacing the two culverts with a single

18-inch diameter by 85-foot long culvert that will pass under the raised area at the intersection.

Upstream of the 2nd crossing, channel-forming processes have been hindered. Several measures will be taken to improve aquatic habitat and to improve hydrologic connectivity in this area:

- Hand falling of small trees (< 11"dbh) in dense, immature alder stands downstream of flow avulsion point to facilitate channel development upstream of the 2nd bridge and to improve riparian function through promotion of gallery forest development. The number and spatial frequency of removal has not yet been determined. The area of thinning will be ±30 acres.
- Construction of a large woody debris jam across the historic channel at flow avulsion point (approximately 4000 feet upstream of 2nd Bridge to facilitate flow convergence and channel development across the floodplain for fish passage. Project spoil materials will be used in association with the large woody debris to create topographic complexity within the floodplain.
- Construction of up to 100 small log structures, as needed, to encourage complex channel development throughout 3,000 feet within the lower reach.
- Excavation of a primary channel through two marshy areas where multiple, poorly connected channels presently exist in order to tie into the well-defined channels on the upstream and downstream edges of the marsh. Dimensions of the primary channel will be 2 feet deep, 4 feet wide, with the total length of excavated channel approximately 1,000 feet.
- Reconnection of a perennial spring to the floodplain pond by replacing a failed culvert under Willow Creek Road and excavating a channel that will direct water to the pond, as needed.

Monitor trends in channel development, sedimentation, and avulsion. Collect cross-section data and survey thalweg to identify potential problems with channel migration, sedimentation, and habitat quality. Fish presence/ absence surveys will occur prior to and after construction, along with spawner surveys.

2.6 Project Implementation

Bridge construction and channel enhancement will occur in 2010 upon approval of all applicable permits and receipt of funding. Work will occur after Labor Day in late summer and early fall in order to avoid the peak recreation season in the park, winter weather conditions, and potential impacts on bird nesting, which generally occurs between mid-March and mid-August in the Willow Creek area. Construction is expected to take two to three months depending on sequencing and availability of project resources. Some advance work, such as pile driving, may occur prior to Labor Day to accelerate completion before the rainy season begins; pile driving will not occur in flowing water.

Figure 2. Photos of Proposed Type of Bridge

Single-span precast concrete bridge

Precast concrete bridge abutments

Photos courtesy of Pacific Bridge

Heavy equipment, such as excavators, graders, bulldozers, cranes, pile drivers, and dump trucks, will be used to construct the bridge. Equipment use will be limited to work sites or adjacent disturbed areas. Temporary construction staging areas will be located in the closed portions of the road and at the existing DPR maintenance facility, a turnout approximately 0.25 miles east of the project area on Willow Creek Road.

Best Management Practices (BMPs) have been incorporated into the project design to ensure that the natural and cultural resources in and around the project area are adequately protected during and after construction. The BMPs discussed in this document and used in the implementation of this project were derived from a variety of sources, including DPR, Sonoma County, Caltrans, California Stormwater Quality Association, and California Regional Water Quality Control Board. Temporary BMPs will be used to retain sediment on site throughout the duration of project construction. BMPs will be checked daily, maintained, and modified as needed, and BMPs will be used after construction to stabilize the site and minimize erosion.

2.7 Adaptive Management and Monitoring Plan

The *Adaptive Geomorphic Plan for the Willow Creek Valley above the 2nd Bridge Crossing, Sonoma County, California* (OEI 2008), included herein as Appendix D, was prepared to document and evaluate the fluvial geomorphic conditions of Willow Creek and its floodplain from approximately 200 feet below the 2nd bridge crossing to the 3rd bridge (study reach) and to evaluate future conditions after implementation of the proposed project. The study concluded that there is no need for aggressive channel construction and management of lower Willow Creek. Rather, the management plan contains three low-impact, adaptive management elements—installation of wood structures for channel steering and habitat improvement, selective tree removal, and minor channel excavation—that are recommended to hasten channel development and improve connectivity. These measures are included in the Project Description in Section 2.5 above.

A monitoring plan is also proposed to determine trends in channel development, sedimentation, and avulsion. The plan includes collection of cross-section data and a survey of the deepest part of the channel bottom (the thalweg) to identify potential problems with channel migration, sedimentation, and habitat quality. Fish presence/ absence surveys will occur prior to and after construction, along with spawner surveys.

2.8 Visitation to Willow Creek

Sonoma Coast State Park received approximately 3 million total visitors in 2005. Willow Creek watershed is the inland portion of Sonoma Coast State Park and is located off of the main thoroughfare of Highway 1. This portion of Sonoma Coast State Park receives a small fraction of the 3 million visitors for the entire Sonoma Coast State Park. Willow Creek is open to the public and served by the County road. There are limited dedicated public service facilities within Willow Creek (21 environmental campsites, two day use picnic benches and two trails). The campground and day use

facilities are open from April 1 to October 31. In 2009, combined use for Willow Creek facilities (campground and day use) attracted approximately 12,000 visitors.

The adjacent, recently acquired portion of the upper Willow Creek watershed (3,373 acres acquired in 2005) remains undeveloped, and access is available only through a permit-based program and guided tours conducted by the non-profit organization, LandPaths. The most frequent point of entry (Freezeout Creek) for LandPaths permit holders would not be affected by this project. In 2008, approximately 2,000 permit holders were registered with LandPaths.

2.9 Consistency with Local Plans and Policies

The proposed project is entirely within Sonoma Coast State Park and is consistent with the Sonoma Coast State Park General Plan's goals and guidelines. This project is consistent with DPR's mission and its management directives aimed at preservation and maintenance of natural resources. See further discussion in Section X: Land Use and Planning for specific General Plan guidelines that will be met through project implementation.

2.10 Regulatory Setting and Discretionary Approvals

Work in creeks and rivers in California is regulated by several public agencies, including the U.S. Army Corps of Engineers (Corps) under §404 of the federal Clean Water Act, the Regional Water Quality Control Boards (RWQCB) under §401 of the federal Clean Water Act and the State's Porter-Cologne Act, the California Department of Fish and Game (CDFG) under §1600, *et seq.*, of the Fish and Game Code, and the local city or county where the project will take place. The project will likely require the following:

- Corps Clean Water Act §404 Concurrence,
- North Coast RWQCB Clean Water Act §401 Certification,
- CDFG §1602 Streambed Alteration Agreement,
- Consultation with U.S. Fish and Wildlife Service (USFWS) and NOAA's National Marine Fisheries Service (NMFS) regarding potential impacts on Endangered and Threatened listed species,
- A Coastal Development Permit, and
- Public Resources Code §5024 Review and local Native American Heritage Commission Review.

The Sonoma County Department of Transportation and Public Works (SCDTPW) holds an easement for the roadway; DPR has fee title ownership of the underlying land. SCDTPW has agreed to allow DPR to modify the roadway for the purpose of improving watershed processes and fish passage. A formal agreement will be signed authorizing DPR to proceed with construction following the completion of the CEQA process and receipt of required discretionary approvals.

2.11 Related Projects

The Sonoma Coast State Park General Plan was finalized in 2007 (DPR 2007b). Proposed actions in the Willow Creek Unit underwent extensive public and agency review. There are no related projects proposed at this time that would involve changes to Willow Creek Road. Additional proposed restoration projects are in the scoping stage at this time and may include logging road and skid trail upgrades and decommissioning and the placement of large wood within the stream channel to promote habitat complexity for aquatic organisms.

3 ENVIRONMENTAL SETTING, IMPACTS, AND MITIGATION MEASURES

PROJECT INFORMATION

1.	Project Title:	Willow Creek Road 2nd Bridge Area Fish Passage Project
2.	Lead Agency Name & Address:	California Department of Parks and Recreation
3.	Contact Person & Phone Number:	Brendan O'Neil (707) 865-3129
4.	Project Location:	Lower Willow Creek Road, Sonoma County
5.	Project Sponsor Name & Address:	California Department of Parks and Recreation Russian River Distirct PO Box 123 Duncans Mills, CA 95430
6.	General Plan Designation:	PQP – Public and Quasi Public
7.	Zoning:	PF, CC BR F1 F2 VOH – Public Facility with Coastal, Biotic Resources, Floodway 1, Floodway 2, and Valley Oak Habitat Combining Districts
8.	Description of Project:	The Department of Parks and Recreation proposes to remove six channel-constricting culverts and to replace them with a single-span, precast concrete bridge to reestablish channel connectivity and fish passage, to allow natural channel development, to provide habitat connectivity, and to improve public access. The project is located on lower Willow Creek Road approximately two miles southeast of the community of Jenner in Sonoma County.
9.	Surrounding Land Uses & Setting:	Refer to Chapter 3 of this document (Section X, Land Use Planning)
10.	Approval Required from Other Public Agencies:	Refer to Chapter 2, Section 2.9

1. ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact", as indicated by the checklist on the following pages.

☐ Aesthetics	☐ Agricultural Resources	☐ Air Quality
☐ Biological Resources	☐ Cultural Resources	☐ Geology/Soils/Hazards
☐ Global Climate Change	☐ Hazardous Materials	☐ Hydrology/H_2O Quality
☐ Land Use/Planning	☐ Mineral Resources	☐ Noise
☐ Population/Housing	☐ Public Services	☐ Recreation
☐ Transportation/Traffic	☐ Utilities/Service Systems	☐ Mandatory Findings of Significance
☒ None		

DETERMINATION

On the basis of this initial evaluation:

I find that the proposed project **COULD NOT** have a significant effect on the environment and a **NEGATIVE DECLARATION** will be prepared. ☐

I find that, although the original scope of the proposed project **COULD** have had a significant effect on the environment, there **WILL NOT** be a significant effect because revisions/mitigations to the project have been made by or agreed to by the applicant. A **MITIGATED NEGATIVE DECLARATION** will be prepared. ☒

I find that the proposed project **MAY** have a significant effect on the environment and an **ENVIRONMENTAL IMPACT REPORT** or its functional equivalent will be prepared. ☐

I find that the proposed project **MAY** have a "potentially significant impact" or "potentially significant unless mitigated impact" on the environment. However, at least one impact has been adequately analyzed in an earlier document, pursuant to applicable legal standards, and has been addressed by mitigation measures based on the earlier analysis, as described in the report's attachments. An **ENVIRONMENTAL IMPACT REPORT** is required, but it must analyze only the impacts not sufficiently addressed in previous documents. ☐

I find that, although the proposed project could have had a significant effect on the environment, because all potentially significant effects have been adequately analyzed in an earlier EIR or Negative Declaration, pursuant to applicable standards, and have been avoided or mitigated, pursuant to an earlier EIR, including revisions or mitigation measures that are imposed upon the proposed project, all impacts have been avoided or mitigated to a less-than-significant level and no further action is required. ☐

Brendan O'Neil
Senior Environmental Scientist

2/10/10
Date

EVALUATION OF ENVIRONMENTAL IMPACTS

1. A brief explanation is required for all answers, except "No Impact", that are adequately supported by the information sources cited. A "No Impact" answer is adequately supported if the referenced information sources show that the impact does not apply to the project being evaluated (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on general or project-specific factors (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2. All answers must consider the whole of the project-related effects, both direct and indirect, including off-site, cumulative, construction, and operational impacts.

3. Once the lead agency has determined that a particular physical impact may occur, the checklist answers must indicate whether that impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate when there is sufficient evidence that a substantial or potentially substantial adverse change may occur in any of the physical conditions within the area affected by the project that cannot be mitigated below a level of significance. If there are one or more "Potentially Significant Impact" entries, an Environmental Impact Report (EIR) is required.

4. A "Mitigated Negative Declaration" (Negative Declaration: Less Than Significant with Mitigation Incorporated) applies where the incorporation of mitigation measures, prior to declaration of project approval, has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact with Mitigation." The lead agency must describe the mitigation measures and briefly explain how they reduce the effect to a less than significant level.

5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR (including a General Plan) or Negative Declaration [CCR, Guidelines for the Implementation of CEQA, § 15063(c)(3)(D)]. References to an earlier analysis should:

   a) Identify the earlier analysis and state where it is available for review.

   b) Indicate which effects from the environmental checklist were adequately analyzed in the earlier document, pursuant to applicable legal standards, and whether these effects were adequately addressed by mitigation measures included in that analysis.

   c) Describe the mitigation measures in this document that were incorporated or refined from the earlier document and indicate to what extent they address site-specific conditions for this project.

6. Lead agencies are encouraged to incorporate references to information sources for potential impacts into the checklist or appendix (e.g., general plans, zoning ordinances, biological assessments). Reference to a previously prepared or outside document should include an indication of the page or pages where the statement is substantiated.

7. A source list should be appended to this document. Sources used or individuals contacted should be listed in the source list and cited in the discussion.

8. Explanation(s) of each issue should identify:
   a) the criteria or threshold, if any, used to evaluate the significance of the impact addressed by each question **and**
   b) the mitigation measures, if any, prescribed to reduce the impact below the level of significance.

ENVIRONMENTAL ISSUES

3.1 Aesthetics

ENVIRONMENTAL SETTING

The California Legislature initiated the California Scenic Highway Program in 1963, with the goal of preserving and protecting the state's scenic highway corridors from changes that would reduce their aesthetic value. The State Scenic Highway System consists of eligible and officially designate routes. A highway may be identified as eligible for listing as a state scenic highway if it offers travelers scenic views of the natural landscape, largely undisrupted by development. Eligible routes advance to officially designated status when the local jurisdiction adopts ordinances to establish a scenic corridor protection program and receives approval from the California Department of Transportation. (California Department of Transportation 2009) This project is on a county road.

Willow Creek Road is a narrow, rural route that is marginally maintained by the Sonoma County Department of Transportation and Public Works. The area of the 2nd crossing is a small stretch of road bordered on both sides by wildland trees and shrubs. The proposed project, will replace six culverts with a single-span bridge. No lighting is proposed for the bridge.

The proposed project is consistent with the Sonoma Coast State Park General Plan (DPR 2007) and the Sonoma County General Plan. The Sonoma Coast State Park General Plan identifies preserving scenic quality as a key issue. The plan provides a series of guidelines for managing and maintaining scenic quality (DPR 2007b), which are based on the consideration of three primary elements:

1) Scenic resources within the viewshed,
2) Public viewpoints, and
3) Proposals for new facilities in the landscape.

The Sonoma County General Plan's Open Space Element does not identify the project site as a scenic resource or Willow Creek Road as a scenic roadway. An adjacent parcel, Red Hill, is listed as a scenic resource in the County's Open Space Element. However, the project site is not visible from the scenic viewpoints atop Red Hill.

The project is intended to maintain the existing character of the road, which is located in the valley bottom within a willow and red alder riparian forest that screens views from ridge tops in the upper watershed.

LESS THAN

WOULD THE PROJECT:	POTENTIALLY SIGNIFICANT IMPACT	SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☒	☐
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

AESTHETICS DISCUSSION

a) **Less-than-significant impact.** The project will take place within an existing rural road. The project will not result in a substantial adverse effect, but minor, short-term disturbance to the scenic vista may occur during construction activities due to the presence of construction materials and equipment. The area will be restored to its natural condition upon project completion.

b) **No impact.** The project is on a county road and not within view of a state scenic highway. The project will not damage scenic resources.

c) **Less-than-significant impact.** As stated in a) above, the project will not result in a substantial adverse effect, but minor, short-term disturbance to the existing visual character of the site may occur during construction activities.

d) **No impact.** The project will not create a new source of light.

3.2 Agricultural Resources

ENVIRONMENTAL SETTING

Historically, Willow Creek watershed was used for agricultural purposes. Lowland areas along the creek were converted from thick riparian forest to grasslands for crops and livestock by Russian settlers from nearby Fort Ross in the 1830s. Grazing of both sheep and cattle occurred, and grains and other crops were raised in the watershed during much of the 19th and 20th centuries. With the exception of grazing on remaining private lands, agricultural activities have been largely eliminated from the watershed since its inclusion in the State Parks' system in 1978. No agricultural activities occur in the vicinity of the 2nd crossing (PCI 2005b).

Farmland Mapping and Monitoring Program

Prime Farmland has the best combination of physical and chemical characteristics for crop production. Farmland of Statewide Importance is not as productive as prime soil, although it still has supported crop production for at least the three preceding years. Unique Farmland ranks below Prime and Statewide-important Farmlands, although it is still capable of producing "high economic value crops" such as olives, avocados, or grapes. Finally, Farmland of Local Importance ranks below the other three, yet "may be important to the local economy due to its productivity" (Department of Conservation, Important Farmland Map Categories). The project site is underlain by soils classified by the Natural Resource Conservation Service as Tidal Marsh.

The California Department of Conservation Farmland Mapping and Monitoring Program, Soil Candidate Listing for Prime Farmland and Farmland of Statewide Importance for Sonoma County do not include Tidal Marsh soils. The project site is not listed on the Sonoma County Important Farmland map as Grazing Land (2006).

Williamson Act

The Williamson Act enables local governments to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. In return, landowners receive property tax assessments that are lower than normal because they are based upon farming and open space uses as opposed to full market value. Sonoma County currently has 42,321 acres of prime agricultural land and 230,937 acres of non-prime land (Department of Conservation 2007). The proposed project is not located on or adjacent to Williamson Act agricultural land.

WOULD THE PROJECT*:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment that, due to their location or nature, could result in conversion of Farmland to non-agricultural use?	☐	☐	☐	☒

* In determining whether impacts on agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997), prepared by the California Department of Conservation as an optional model for use in assessing impacts on agricultural and farmland.

AGRICULTURAL RESOURCES DISCUSSION

a) **No impact.** The project is not located on Prime Farmland, Unique Farmland, or Farmland of Statewide Importance. No farmland will be converted in the project.

b) **No impact.** The project does not change land use, which is a county road within a state park. The project is not located within a Williamson Act contract.

c) **No impact**. The project will not result in changes to the existing environment relevant to farm use.

3.3 Air Quality

ENVIRONMENTAL SETTING

The project site is located in the North Coast Air Basin (NCAB), which comprises Del Norte, Humboldt, Trinity, Mendocino, and northern Sonoma Counties, under jurisdiction of the Northern Sonoma County Air Pollution Control District (NSCAPCD) and the United States Environmental Protection Agency (USEPA) Region IX. Sonoma County is located within the southwestern portion of the NCAB.

Climate

Climate has a strong influence on both natural resources and recreational opportunities on the project site. Sonoma County has a Mediterranean climate with moderate temperatures, wet winters, and typically dry summers. The climate along the coast is heavily influenced by the Pacific Ocean, which brings summertime fog, low clouds, winter storms, and seasonally variable winds. Summer temperatures are mild (average 64º F), with frequent low clouds and fog that provide important moisture to vegetation during the dry season. Prevailing summer winds are from the northwest, averaging 10 to 15 miles per hour, with gusts as high as 50 to 60 miles per hour. Winter storms often batter the coastline with strong, moisture-laden, southerly winds. These winter storms, from November through April, account for nearly all the average annual rainfall, which varies between 30 and 38 inches. Winter temperatures are moderate, with averages ranging from highs in the 50s to lows in the 40s. (DPR 2008)

Air Quality Designations

The California Air Resources Board (CARB) makes state-area designations for ten criteria pollutants (an air pollutant for which acceptable levels of exposure can be determined and for which an ambient air quality standard has been set): ozone, suspended particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), carbon monoxide, nitrogen dioxide, sulfur dioxide, sulfates, lead, hydrogen sulfide, and visibility reducing particles (VRPs). At the State level, ozone is designated as non-attainment/transitional; PM_{10} is designated in attainment; $PM_{2.5}$, carbon monoxide, hydrogen sulfide, and VRPs are designated unclassified; and nitrogen dioxide, sulfur dioxide, sulfates, and lead are designated in attainment.

If a pollutant concentration is lower than the standard, the area is classified as “attainment” for that pollutant. If an area exceeds the standard, the area is classified as “non-attainment” for that pollutant. If there are not enough data available to determine whether the standard is exceeded in an area, the area is designated “unclassified.” Non-attainment/transitional is a subcategory of the non-attainment designation; an area is designated non-attainment/ transitional to signify that the area is close to attaining the standard for that pollutant.

In contrast to the State-area designations, the USEPA makes national area designations for five criteria pollutants: ozone (8-hour standard; the national 1-hour standard was revoked in June 2005), particulate matter (PM_{10}), carbon monoxide, nitrogen dioxide, and sulfur dioxide. At the national level, ozone, carbon monoxide, $PM_{2.5}$, and nitrogen dioxide are designated unclassified/attainment; PM_{10} and sulfur dioxide are designated unclassified.

If an area does not meet (or contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant, it is

designated as non-attainment. If an area meets the national primary or secondary ambient air quality standard for the pollutant, it is designated in attainment. An area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant is designated unclassifiable (USEPA 2009)

Table 1 illustrates the criteria pollutant designations at both the State and federal levels.

Table 1. California and Federal Criteria Pollutant Designations

Criteria Pollutant	State	Federal
Ozone	Non-Attainment	Unclassified / Attainment
Suspended Particulates (PM_{10})	Attainment	Unclassified
Fine Particulates ($PM_{2.5}$)	Unclassified	Unclassified / Attainment
Carbon Monoxide	Unclassified	Unclassified / Attainment
Nitrogen Dioxide	Attainment	Unclassified / Attainment
Sulfur Dioxide	Attainment	Unclassified
Sulfates	Attainment	No Federal Standard
Lead (particulate)	Attainment	No Federal Standard
Hydrogen Sulfate	Unclassified	No Federal Standard
Visibility reducing particles	Unclassified	No Federal Standard

State designations were updated July 2007; National designations were current as of September 2006
Source: California Air Resources Board

Sources

During personal and business activities, Californians release thousands of tons of pollutants into the air every day. Although each of us may only produce a small amount of air pollution, the combined pollution from the 33 million Californians adds up to problems. Some air pollutants are formed and released during the combustion (burning) of petroleum-based products and other fuels such as wood. Examples include gasoline and diesel-powered vehicles and fireplaces, respectively. Many tons of pollutants also enter the air through evaporation, such as fuel from gasoline storage and dispensing facilities, car and truck gasoline tanks, and gasoline storage containers.

On hot, sunny days, pollutants emitted by vehicles, industry, and many products (nitrogen oxides and volatile organic compounds) react with each other to form ozone, the main ingredient of smog. During the winter, temperature inversions can trap tiny particles of smoke and exhaust from cars, trucks, fireplaces, and anything else that burns fuel. This keeps the pollution close to the ground—at the level where people are breathing.

Sonoma County experiences a combination of rural-type pollution (dust and smoke) and pollution transport. Such problems stem from the county's agricultural economy, which necessitates land cultivation and agricultural waste burning and from the prevailing wind patterns that transport pollutants from the San Francisco Bay Area air basin to the North Coast air basin. Sparsely populated on the coast, where prevailing winds blow clean air in from the Pacific Ocean, this basin enjoys some of the best air quality in California.

Air Monitoring Stations

The monitoring stations in the state are operated by CARB, by local Air Pollution Control Districts (APCD) or Air Quality Management Districts (AQMD), by private contractors, and by the National Park Service (NPS). These entities operate more than 250 air monitoring stations in California. CARB operates air monitoring stations throughout the State. Most of the local districts operate air monitoring stations within their jurisdictions. In some portions of the State, private contractors operate monitoring stations under contract with businesses that are required by permit conditions to conduct monitoring. NPS also operates a number of air monitoring stations in the National Parks and National Monuments throughout California (CARB 2008b). Six monitoring stations are located in Sonoma County: Cloverdale, Guerneville-1st & Church, Healdsburg-Limmerick Lane, Healdsburg-Matheson, Healdsburg-Municipal Airport, and Santa Rosa. The Cloverdale, Guerneville-1st & Church, Healdsburg-Limmerick Lane, and Healdsburg-Matheson stations monitor $PM_{10.}$ The Healdsburg-Municipal Airport station monitors ozone. The Santa Rosa station monitors CO, $NO_{2,}$ O_3, PM_{10}, $PM_{2.5}$, Toxics, Outdoor Temperature, Wind Direction, Horizontal Wind Speed, and Solar Radiation.

Health Hazards

Ozone and particulate matter are the most common air pollutants in California. Ozone, also known as smog, can irritate the respiratory system, causing coughing, irritation in the throat, or a burning sensation in the airways. It can reduce lung function, resulting in feelings of chest tightness, wheezing, or shortness of breath. Particle pollution, also known as particulate matter, is composed of microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. When exposed to these small particles, people with heart or lung diseases and older adults are more at risk of hospital and emergency room visits or, in some cases, even death from heart or lung disease.

Carbon monoxide can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. Sulfur dioxide causes a wide variety of health and environmental impacts because of the way it reacts with other substances in the air. Impacts include respiratory effects, visibility impairments, acid rain, plant and water damage, and aesthetic damage (building decay). People, animals, and fish are mainly exposed to lead by breathing and ingesting it in food, water, soil, or dust. Lead accumulates in the blood, bones, muscles, and fat. Nitrogen dioxide contributes to ozone; causes respiratory problems; contributes to the formation of acid rain; contributes to nutrient overload, which deteriorates water quality; contributes to atmospheric particles, which causes visibility impairment; reacts to toxic chemicals; and contributes to global warming (USEPA).

Sensitive Receptors

Sensitive receptors include individuals as well as groups relating to specific land uses. Some individuals are considered to be more “sensitive” than others to air pollutants. The reasons for greater sensitivity than average include age, health problems, proximity to the emission source, or duration of exposure to air pollutants. Land uses such as primary and secondary schools, hospitals, and convalescent homes are considered to be sensitive receptors to poor air quality because the very young, the old, and the infirm are more susceptible to respiratory infections and other air quality-related health problems than the general public. Residential uses are considered sensitive receptors because people in residential areas are often at home

for extended periods of time, so they can be exposed to pollutants for extended periods. Recreational areas are considered moderately sensitive to poor air quality because vigorous exercise associated with recreation places a high demand on the human respiratory function.

Sensitive receptors in the vicinity of the proposed project area are limited to recreational users. During construction, the project site will not be open to public use.

WOULD THE PROJECT*:	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
a) Conflict with or obstruct implementation of the applicable air quality plan or regulation?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☒	☐
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?	☐	☐	☒	☐
d) Expose sensitive receptors to substantial pollutant concentrations (e.g., children, the elderly, individuals with compromised respiratory or immune systems)?	☐	☐	☒	☐
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒

* Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make these determinations.

AIR QUALITY DISCUSSION

a) **No impact**. Proposed work would not conflict or obstruct implantation of any of the applicable air quality plan or regulation for the North Coast Air Basin.

b,c) **Less-than-significant impact.** Construction activities would not emit air contaminants at a level that by themselves violate any local, State, or federal ambient air quality standards or contribute to a long-term or permanent increase in any air contaminant. However, project implementation would generate short-term emissions of fugitive dust and involve the use of equipment and materials that would emit ozone precursors. Increased emissions of ozone precursors could contribute to existing non-attainment conditions, which could interfere with achieving the projected attainment standards. Integration of the following minimization measures into the project design will reduce potential impacts to a level of less than significant.

MINIMIZATION MEASURE AIR-1
• All construction areas (dirt/gravel roads and surrounding dirt/gravel area) will be watered at least twice daily during dry, dusty conditions. • All trucks hauling soil, sand, or other loose materials on public roads will be covered or required to maintain at least two feet of freeboard. • All construction-related equipment engines will be maintained in good condition, in proper tune (according to manufacturer's specifications), and in compliance with all State and federal requirements. • Earth or other material that has been transported onto paved roadways by trucks, construction equipment, erosion, or other project-related activity will be promptly removed.

d) **Less-than-significant impact.** As mentioned above, project construction would generate dust and equipment exhaust emissions for the duration of the project. Although sensitive receptors are limited in the area, there is the possibility that during construction, recreational users on adjacent property could be affected. However, members of the public with conditions that make them sensitive to these emissions would have the option of moving to areas further away and avoiding the area altogether or remaining in areas that would be upwind or protected from blowing dust or other emissions. Integration of **Minimization Measure Air-1** above will reduce potential impacts to less than significant.

e) **No impact.** The project is located in a rural area. Any odors (i.e. exhaust) would dissipate before reaching heavily populated areas.

Climate Change is discussed in section VII.

3.4 Biological Resources

ENVIRONMENTAL SETTING

The immediate area of the 2nd crossing has been identified as red alder woodland, while the areas to the west were labeled as the sedge series and to the east and north as the Douglas fir-tan oak series (DPR 2007a: Exhibit 2-6. Plant Communities). A full discussion of biological resources expected to occur at the project site is provided in the Biological Resources Evaluation and Preliminary Wetland Assessment, Willow Creek Road 2nd Bridge Area Fish Passage Project, Sonoma Coast State Park (PCI 2008), Appendix E.

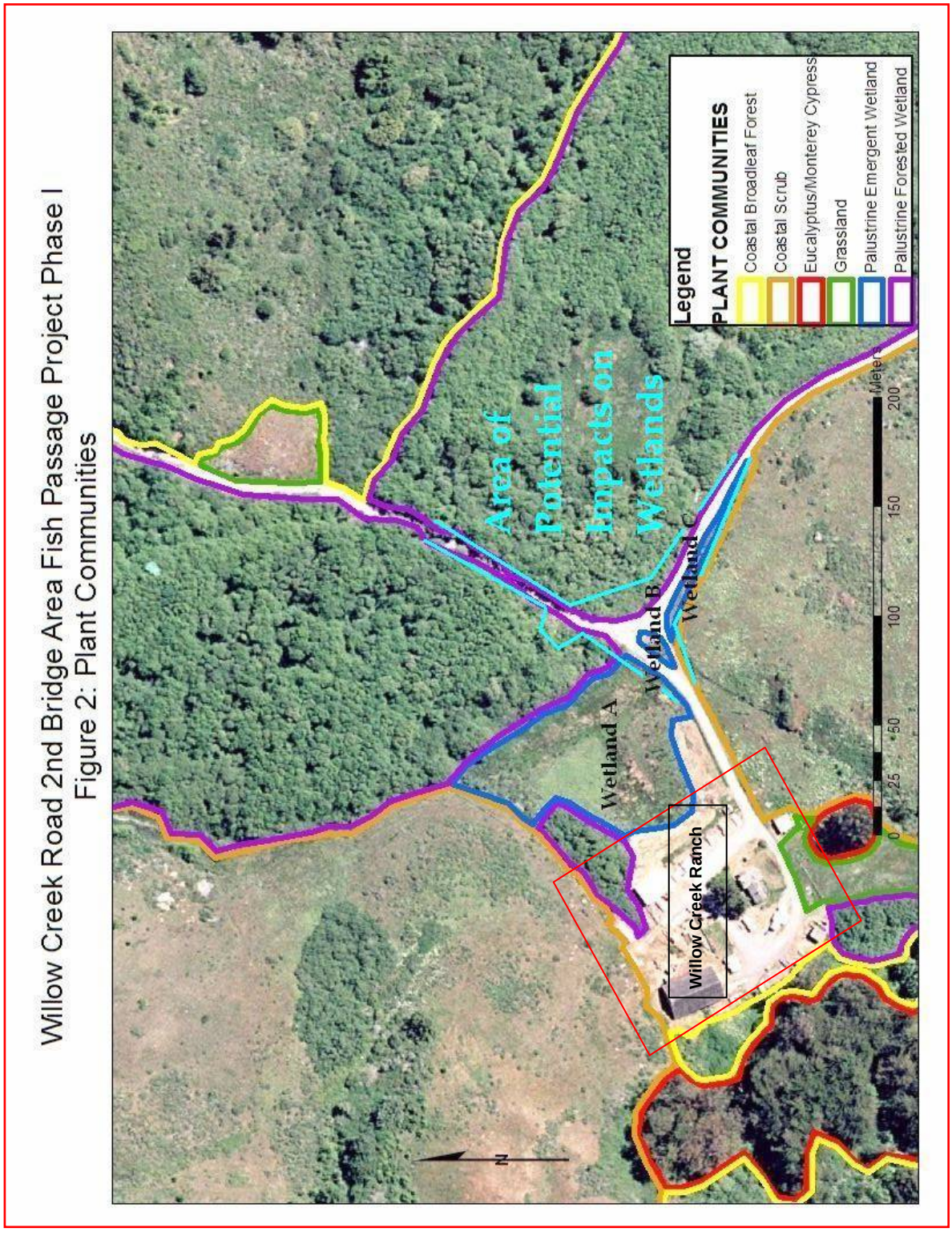
Within the project site and surrounding areas, the Willow Creek floodplain is characterized as palustrine, forested wetland. Tree canopy is dominated by arroyo willow and red alder with diverse riparian understory plants. In portions of the habitat that are very marsh-like, rushes and horsetails dominate the understory. Roadside berms are primarily dominated by weedy, opportunistic species with the occasional native plant.

The riparian corridors upstream and downstream of the 2nd bridge crossing are large palustrine forested wetlands. Three small emergent-dominated wetlands occur adjacent and within the project area (PCI 2008); see Figure 3. The largest of the emergent-dominated wetlands (A) occurs at the southwestern edge of the project site. A second, small, disturbed wetland (B) is an isolated feature between the existing access road to the maintenance yard and an adjacent pullout. The last is a narrow feature that runs in a northwest-southeast direction parallel to Willow Creek Road (Wetland C). All of the features are connected via underground culverts.

Wetland A is dominated by spikerush (*Eleocharis* sp., FACW to OBL), broadleaf cattail (*Typha latifolia*, OBL), smallfruit bulrush (*Scirpus microcarpus*, OBL), slough sedge (*Carex obnupta* OBL), and spreading rush (*Juncus patens*, FAC). Wetland B is highly disturbed and consists primarily of tall flatsedge (*Cyperus eragrostic*, FACW), smallfruit bulrush, and frequently mowed arroyo willow shrubs (*Salix lasiolepis*, FACW). Wetland C is dominated by California blackberry (FACW), slough sedge, rush (*Juncus* sp., FAC to OBL), and spreading rush, and additional cover is provided by pennyroyal (*Mentha pulegium,* OBL), Pacific cinquefoil (*Potentilla anserina*, OBL), curly dock (*Rumex crispus,* FACW-), arroyo willow, and black twinberry (*Lonicera involucrate,* FAC).

Historically, the area of the 2nd crossing provided habitat for both resident and migratory aquatic species, including salmonids. See discussion in Section 2.3 above and in the Willow Creek Watershed Management Plan (PCI 2005b). The densely forested, palustrine wetlands and adjacent emergent-dominated wetlands provide habitat for a rich array of bird, mammal, reptile, and amphibian species. Dusky-footed woodrat nests were observed in the project area during field reconnaissance for the Biological Resources Evaluation (PCI 2008). Other wildlife species that might be expected to occur in the vicinity of the 2nd crossing are multiple reptiles, including western pond turtles; many species of amphibians, including California red-legged frog; diverse small and large mammals, including multiple bat species; raptors, local and migratory song birds, swimming birds, and wading birds. See the Biological Resources Evaluation in Appendix E (PCI 2008) for further details.

Figure 3. Plant Communities and Willow Creek Ranch Location



3.4 Biological Resources (continued)

Plant surveys were conducted in the spring and summer of 2009 to California Native Plant Society (CNPS) protocols (DPR 2009). No state or federally listed species were noted to occur within the project limits. Gilia (*Gilia capitata* ssp. *tomentosa*) CNPS list 1B.1 and western dog violet (*Viola adunca*) the host larval plant for Myrtle's silverspot butterfly (federally endangered) were noted to occur just outside of the project limits. See the Vascular Plants of Willow Creek 2nd Bridge Project Area in Appendix F for the list of vascular plants present in the project vicinity.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Have a substantial adverse effect, either directly or through habitat modification, on any species identified as a sensitive, candidate, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?	☐	☒	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or the U.S. Fish and Wildlife Service?	☐	☐	☒	☐
c) Have a substantial adverse effect on federally protected wetlands, as defined by §404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☒	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors or impede the use of native wildlife nursery sites?	☐	☐	☒	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

BIOLOGICAL RESOURCES DISCUSSION

a) **Less-than-significant with mitigation.** The project site supports potential habitat for California red-legged frogs (federally listed as threatened, California Species of Special Concern), great blue herons (California Species of Special Concern), special-status and common bat species, Myrtle's silverspot butterfly (federally listed as endangered) and

northwestern pond turtles (California Species of Special Concern); it historically supported all three of the area's listed salmonids. It is moderately likely that central coast Evolutionary Significant Unit (ESU) steelhead (federally listed as threatened) and central coast ESU coho (federally and state-listed as endangered) are present when water is flowing in Willow Creek. Additionally, the project site supports breeding habitat for birds protected under the Migratory Bird Treaty Act (e.g., songbirds, etc.). Foothill yellow-legged frogs and California freshwater shrimp are unlikely, but measures will be taken to avoid impacts on these and other aquatic species. Project precautions, listed below, are included to avoid impacts on special-status species.

The project site supports potential habitat for special-status plant species, although none were identified within the project limits during field surveys. Prior to construction, focused spring surveys will occur for the following species:

Sonoma alopecurus (*Alopecurus aequalis var. sonomensis*)
Swamp harebell (*Campanula californica*)
Sonoma white sedge (*Carex albida*)
Bristly sedge (*Carex comosa*)
Deceiving sedge (*Carex saliniformis*)
Gilia (*Gilia capitata* ssp. *tometosa*)
Pale yellow hayfield tarplant (*Hemizonia congesta* ssp. *congesta*)
Baker's goldfields (*Lasthenia californica* ssp. *bakeri*)
Point Reyes checkerbloom (*Sidalcea calycosa* ssp. *rhizomata*)
Saline clover (*Trifolium depauperatum* var. *hydrophilum*)
Western dog violet (*Viola adunca*)

MINIMIZATION MEASURE BIO-1

- If water is present during any part of project activities, and dewatering is deemed necessary, a dewatering and species protection plan will be developed by the project's biologist. The plan will be developed and implemented as described in the Biological Resources Evaluation recommendations (Appendix E; PCI 2008) by a qualified and permitted biologist. Appendix G contains specific details for dewatering techniques and species protection developed for the nearby Jenner Creek bridge replacement project that will be used in the unlikely event that dewatering is required for this project.
- To avoid impacts on aquatic and terrestrial species within the immediate work area, prior to disturbance of the stream channel and removal of vegetation, a qualified biologist will conduct a preconstruction survey to ensure no special-status species are occupying the site. If special-status species are observed within the project site or immediate surroundings, these areas will be avoided until the animal(s) has (have) vacated the area, and/or the animal(s) have been relocated out of the project area by a qualified biologist, upon approval by the regulatory agencies. In addition, the site will be surveyed periodically during construction to ensure that no special-status species are being impacted by construction activities. The biologist will also monitor to ensure water quality standards are being met and sediment and/or debris are not entering downstream aquatic habitats.
- To avoid impacts on special-status and common bat species, prior to the removal of any

trees, a qualified biologist will survey for roosting bats. If occupied roosts are identified, removal of the roost trees will not occur until the roost is unoccupied. In addition, construction will be limited to daylight hours to avoid interference with the foraging abilities of bats.

- To avoid potential losses of breeding birds, construction activities will occur outside of the critical breeding period, typically mid-March to mid-August in the Willow Creek area.
- To avoid potential impacts on special-status plants, a focused botanical survey will be completed during the appropriate blooming period for the above-mentioned species. If special-status plants are found occupying the site, avoidance measures will be in place during construction to minimize disturbance (e.g., temporary construction fencing around existing populations).
- If impacts to special status plants are unavoidable, appropriate mitigation measures will be implemented (e.g., seed collection and revegetation). Replacement to disturbance will occur at a 4:1 ratio.
- To avoid impacts to Myrtle's silverspot butterflies and their host plants, the following measures will be taken. Prior to construction, butterflies surveys will be completed within the project area to determine if adults or larvae are present. If adult or larvae are found to be present, additional protection measures may be necessary, and further consultation with U.S. Fish and Wildlife Service will be required. If not found, the following protection measures will be implemented. Existing populations of larval host plants [western dog violet (*Viola adunca*)] will be avoided, as feasible. Plants will be protected through the installation of temporary fencing around all known plants and these areas avoided. If western dog violets are found to be present within the area of impact, they will be transplanted to appropriate habitat off-site. As feasible, adult nectar plants [e.g., coyote mint (*Monardella villosa*), bull thistle (*Cirsium vulgare*)], will be flagged and avoided during construction.
- The project biologist will conduct a preconstruction training session for construction crew members. The training will include a discussion of the sensitive biological resources within the project area and the potential presence of special-status species, special-status species' habitats, protection measures to ensure species are not impacted by project activities, and project boundaries.

b) **Less-than-significant impact.** Under existing conditions at the project site, Willow Creek Road is located within sensitive riparian habitat on a berm across the floodplain of Willow Creek. The project will improve habitat values in the area. During project implementation and adaptive management, sensitive habitat will be protected by the following:

MINIMIZATION MEASURE BIO-2

- Hand labor will be used to control exotic and unwanted vegetation. The use of chemical agents and mechanical equipment within the stream channel will be avoided.
- During vegetation removal, large trees with extensive canopy will be maintained, as feasible, to preserve the existing cover over the stream channel.
- Proper erosion control and other water quality BMPs will be implemented to avoid sedimentation and disturbance into downstream and adjacent aquatic habitats. Work in aquatic habitats will be scheduled to occur during the dry season, with work up on the elevated road surfaces scheduled toward the end of construction when rainfall becomes more probable. If work in wetted areas is necessary, they will be dewatered as described above. An erosion and sediment control plan will be developed and implemented for the project.
- Temporary wildlife exclusionary and tree protection fencing will be installed around the work area in sensitive wetland and riparian habitats to preclude animals from entering the work site once construction has commenced (following the preconstruction survey) and to protect riparian trees during construction activities.

c) **Less-than-significant with mitigation.** In order to raise the approaches to the new bridge the 4 feet necessary to achieve appropriate high flow capacity, the road edges will need to be widened, which will entail some very minor fill of wetlands (0.035 acres). The hydrology of Wetland A will be maintained by the replacement of the two culverts currently linking the emergent-dominated wetlands with a new, single culvert from the newly created wetland along the road. The new culvert will be placed underneath the new road junction in order to maintain drainage at the southern edge of the road as flow into Wetland A. Wetland A will remain largely undisturbed with the exception of a narrow band along the existing road that will be filled to allow the road to be properly side-sloped. Wetland B, a disconnected area between Willow Creek Road and the maintenance yard road, will be filled to allow for the realignment of the road. Wetland C, a narrow, disconnected swath along Willow Creek Road, will be partially filled to allow for side-sloping.

Wetland C, at the upstream end up the project, would not be impacted by alterations in existing hydrology. However, the work may change the hydrology at Wetlands A and B because road construction will eliminate the existing culverts that connect the three areas. To maintain hydrology in Wetland A, a new culvert will be installed to carry the outflow from Wetland C directly to Wetland A.

MITIGATION MEASURE BIO-3

- Net wetland loss (0.035 acres) will be compensated by wetland restoration elsewhere in the park at a 4:1 ratio through reconnection and enhancement of the old grist mill spring with the Willow Creek floodplain, which provides good quality existing wetland habitat 0.5 mile upstream of the project area.

d) **Less-than-significant impact.** The project as a whole will make movement under the road easier for aquatic species because it will occur through a natural channel rather than clogged culverts. There may be some reduction of movement through the area during

construction, although, in a normal year, movement would not occur in the late summer or early fall due to lack of water. The existing 2nd bridge will continue to allow as much passage past the road as it currently does. Therefore, the reduction in movement capacity for aquatic species is not considered significant. Movement of terrestrial species will not be constrained because of the relatively small project area.

e) **No impact.** The project will not conflict with any local policies or ordinances protecting biological resources.

f) **No impact.** The project is planned in accordance with the *Sonoma Coast State Park General Plan* (DPR 2008b); see further discussion in Section 3.10. Land Use and Planning. There are no habitat conservation plans or natural community conservation plans in place for the project area. The project takes place in the Coastal Zone. The Coastal Commission Strategic Plan (CCC 1997) calls for protecting and restoring "ecologically viable tidepools, kelp beds, streams, wetlands, riparian corridors, and marine and terrestrial environmentally sensitive habitat areas, including the habitats of rare or endangered organisms." Since this project will enhance the ecological health of stream, wetland, and riparian habitats, it is consistent with the strategic vision of the Coastal Commission.

3.5 Cultural Resources

ENVIRONMENTAL SETTING

The Willow Creek watershed has a long and diverse history of human habitation. Sonoma Coast State Park contains an array of prehistoric sites that date back as far as 9,000 years (DPR 2007a). Cultural resources in Willow Creek range from Native American sites to Russian farms associated with nearby Fort Ross to the remains of historic ranching complexes and logging operations from the 19th and 20th centuries.

Willow Creek includes ethnographic territories of two Native American groups, the Kashia Pomo (also known as the Southwestern Pomo) and the Coast Miwok. Willow Creek is considered an area of interface between the two tribes. Consultation with representatives of both Tribes has occurred in conformance with Sonoma Coast State Park General Plan Guideline CUL-1B to consult with local Native American people and groups who have traditional ties to resources within Sonoma Coast State Park to ensure productive, collaborative working relationships during the planning and implementation of specific development projects.

The Kostromitinov Ranch was established in the Willow Creek area in 1833 and operated until 1841 when the substantial decline of seal and otter populations resulted in an unprofitable fur trade economy. It was one of four main ranches in western Sonoma County that supplied fruits, grains, and livestock to Russian settlements in Alaska and up the coast at Fort Ross. The exact location of the Kostromitinov Ranch is unknown. Remnants of the Russian roads in Willow Creek may still exist today.

Euro-Americans arrived in Willow Creek by the mid-19th century. The first recorded commercial logging occurred in the Willow Creek watershed in the 1840s, and timber harvest activities continued throughout the 20th century. Similarly, grazing and other agricultural activities occurred during this time period, but have been discontinued since the inclusion in the State Parks' system. The Willow Creek Ranch is a remnant of this era. The ranch house is located approximately 500 feet to the southwest of the project site (Figure 3). A 1981 survey of the Willow Creek Ranch found that this structure is eligible for the National Register.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Cause a substantial adverse change in the significance of a historical resource, as defined in §15064.5?	☐	☐	☒	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☒	☐
c) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☒	☐

CULTURAL RESOURCES DISCUSSION

a-c) **Less-than-significant impact.** The following minimization measures will be implemented to ensure that no significant adverse impacts on cultural resources occur. The project site was surveyed for cultural resources by the Anthropological Studies Center at Sonoma State University in conjunction with representatives from the Kashia Band of Pomo Indians of Stewarts Point Rancheria and the Federated Indians of Graton Rancheria in 2008 (ASC 2008). The project is limited to a small footprint of previously disturbed soils and alluvium. While multiple sites were recorded elsewhere on the Willow Creek property, no sites of record occur and no cultural resources were noted during surveys within the project site.

MINIMIZATION MEASURE CULT-1

- A preconstruction meeting will be held to acquaint project personnel with the possibility of encountering sensitive cultural resources. Prehistoric resources may include chert or obsidian flakes, projectile points, mortars, and pestles; dark friable soil containing shell and bone dietary debris; heat-affected rock; or human burials. Historic resources may include stone or adobe foundations or walls, structures and remains with square nails, and refuse deposits, often in old wells and privies.
- In the event that previously undocumented cultural resources (including but not limited to dark soil containing shellfish, bone, flaked stone, groundstone, or deposits of historic trash) are encountered during project construction by anyone, the state representative will temporarily halt work at that specific location and direct contractors to other project-related tasks. A DPR-qualified archaeologist will record and evaluate the find and work with the state representative to implement avoidance, preservation, or recovery measures as appropriate prior to any work resuming at that specific location.
- If the DPR-qualified archaeologist determines that the find(s) are significant, a qualified archaeologist, and/or Native American representative (if appropriate) will monitor all subsurface work including trenching, grading, and excavations in that area. If it is determined, the find indicates a sacred or religious site. Formal consultation with appropriate representatives will occur as necessary.
- In the event that human remains are discovered, work will cease immediately in the area of the find and the project manager/site supervisor will notify the appropriate DPR personnel. Any human remains and/or funerary objects will be left in place. The DPR Sector Superintendent (or authorized representative) will notify the County Coroner, in accordance with §7050.5 of the California Health and Safety Code, and the Native American Heritage Commission (NAHC) will be notified within 24 hours of the discovery if the Coroner determines that the remains are Native American. The NAHC will designate the "Most Likely Descendent" (MLD) of the deceased Native American. The MLD will recommend an appropriate disposition of the remains. If a Native American monitor is on site at the time of the discovery and that person has been designated the MLD by the NAHC, the monitor will make the recommendation of the appropriate disposition.

3.6 Geology, Soils, and Hazards

ENVIRONMENTAL SETTING

The proposed project is located within a small valley where Willow Creek flows towards the Russian River. An existing roadway that is essentially flat in the immediate vicinity of the planned improvements traverses through the valley. The area beyond the roadway is covered with dense riparian vegetation. Six culverts allow water to pass under the roadway. Natural drainage consists of sheet flow over the ground surface that concentrates in man-made surface drainage elements, such as culverts, and natural drainage elements, such as swales and creeks (RGH 2008).

Geology

The California Geologic Survey's (CGS) geologic maps (Huffman and Armstrong 1980) indicate the property is underlain by alluvium (Qal) that is flanked by hillsides underlain by conglomerate of the Great Valley Sequence (KJgvc) to the northeast and Franciscan Complex (KJfs) to the south and west. The alluvium is shown to comprise sand, gravel, silt, and clay. The Franciscan Complex is shown to comprise sheared shale and sandstone that contains generally resistant masses of chert, "high grade" metamorphic rock, variable shattered sandstone and greenstone, metagreenstone and generally less resistant serpentinite. Fault mapping by CGS indicates that a fault showing no evidence of Quaternary (within the last 5,000,000 years) displacement extends through the project site.

Seismicity

An unnamed fault that shows no evidence of Quaternary (last 5,000,000 years) displacement lies beneath the project site. No landforms within the project area are suggestive of active faulting, and the site is not within a current Alquist-Priolo Earthquake Fault Zone (RGH 2008). The San Andreas Fault (2.5 miles to the southwest), the Healdsburg - Rodgers Creek Fault (18.5 miles to the northeast), the Maacama Fault (23 miles to the northeast), and the West Napa Fault (39 miles to the east) are historically active. In the 1906 San Francisco earthquake, the North Coast segment of the San Andreas Fault generated an earthquake of magnitude 7.6 on the Richter Scale. Due to the proximity of the San Andreas Fault Zone, the area may be prone to ground-surface rupture, strong seismic shaking, and liquefaction. Along Willow Creek, liquefaction potential of the alluvium is considered moderate to high in the event of seismic activity (RGH 2008).

Based on analysis of historic events and seismic modeling, the Rogers Creek Fault has a 30-year probablity of 27% to 31% of generating a magnitude 6.7 or greater earthquake. The San Andreas Fault has a 30-year probability of 21% to 23% of generating a magnitude 6.7 or greater earthquake. While the Rogers Creek Fault has the higher probability, the San Andreas Fault has the greatest potental to generate damage or cause harm.

Landslides

The CGS maps of landslides indicate large-scale instability of the hillside south of the proposed improvements, including a large landslide that extends to the top of the ridge and one on the slope northeast of the project area. The proposed site is located in the alluvial soils that make

up the valley floor. It is possible that landslide debris could extend below the alluvium and below the proposed improvements. Movement of the landslides described would not only impact the planned improvements, but also the valley floor in general. Therefore, reactivation, although unlikely, would uniformly disrupt the bridge approaches, creek alignment and existing features (RGH 2008).

Soils and Erosion

Mapping by the U.S. Soil Conservation Service has classified the soil underlying the project site as belonging to the Tidal Marsh series. Tidal Marsh soils are nearly level marshlands that are underwater or extremely wet throughout the year. The Tidal Marsh series is shown to comprise variable soil textures, but it is generally fine textured and contains many strata of sandy or organic matter. Permeability in the project area is slow to very slow. Degree of plasticity, shrink-swell, and erosion potential are not described. The risk of corrosion is given as high for uncoated steel and high for concrete (RGH 2008).

There are no known paleontological resources or sites, or unique geologic features located in the project area.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map, issued by the State Geologist for the area, or based on other substantial evidence of a known fault? (Refer to Division of Mines and Geology Special Publication 42.)	☐	☐	☒	☐
ii) Strong seismic ground shaking?	☐	☐	☒	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable, as a result of the project and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1997), creating substantial risks to life or property?	☐	☐	☐	☒

e)	Have soils incapable of adequately supporting the use of septic tanks or alternative waste disposal systems, where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f)	Directly or indirectly destroy a unique paleontological resource or site, or unique geologic feature?	☐	☐	☐	☒

GEOLOGY, SOILS, AND HAZARDS DISCUSSION

a) i) **Less-than-significant impact.** The project is not in an Alquist Priolo Fault Zone. There is a fault underlying the valley that runs between the project area and the 2nd bridge. However, the fault has not moved in the last 5,000,000 years, and the chance of rupture is low (RGH 2008).

ii) **Less-than-significant.** The project site, along with the rest of the San Francisco Bay Area, is likely to experience strong shaking in the next 30 years from a magnitude 6.7 or greater earthquake. The San Andreas Fault is 2.5 miles away (RGH 2008). Thus, the project area would be subject to strong seismic shaking. The following **Minimization Measure – Geo-1** will keep the potential for adverse impacts from this project to a less-than-significant level.

MINIMIZATION MEASURE GEO-1

- Project design will take into account the following geotechnical considerations: weak surface soils to about 2 feet below the existing road, compressible soils to depths of 45 to 48 feet, potentially liquefiable soils, and predicted strong seismic shaking.
- Topsoils containing organic matter will be removed and stockpiled for reuse in revegetation with native species.
- Weak soils will be removed and replaced with engineered fill.
- Fill will be free of organic material, have low expansion potential, and conform to the specifications in the geotechnical report; see Appendix C.
- Seismic design will use Site Class E and all specified seismic design criteria from the geotechnical report.

iii) **Less-than-significant.** In February 2008, RGH performed test borings at the project site and subsequent laboratory testing of the samples retrieved. Using this data, they calculated critical blow count and peak ground acceleration to determine liquefaction potential at the project site. The alluvial soils at the site do have the potential for liquefaction. There are three possible consequences of liquefaction: bearing capacity failure, lateral spreading, and differential settlement (RGH 2008). Because of the depth at which alluvial layers with different liquefaction characteristics were found, bearing capacity failure and lateral spreading are unlikely. However, differential settlement is a potential problem. To avoid potential safety impacts from differential settling, the project will be designed with a deep foundation of driven piles using the specific design recommendations from the geotechnical report. A geotechnical engineering firm will provide construction oversight. The following **Minimization Measure – Geo-2** will keep the potential for adverse impacts from this project to a less-than-significant level.

MINIMIZATION MEASURE GEO-2

- The new bridge will be built on driven piles. The piles will be 16-inch diameter steel pipe. If other pilings are used, the geotechnical consultants will be contacted for additional design specifications.
- Contractor will adhere to all specifications in the geotechnical report and will contact the geotechnical engineer prior to pile driving to obtain driving criteria based upon the hammer to be used.
- Geotechnical engineers will review project plans and specifications to determine consistency with the geotechnical recommendations.
- A preconstruction meeting will occur between the geotechnical engineer, general contractor, subcontractors, civil engineer, and other members of the design team to address design issues, clarify procedures, and construction coordination.
- Critical construction steps, such as site excavation, fill compaction, and foundation installation, will be monitored by the geotechnical consultants.

iv) **No impact.** The hills surrounding the Willow Creek valley have landslide potential. There are mapped landslides in the vicinity of the project area. However, movement of these landslides would affect the valley floor generally. This project would have no impact on the likelihood or the effects of earth movement.

b) **Less-than-significant impact.** The project would include grading activities that have some erosion potential. However, the project area is small, standard construction BMPs will be in place, and the project will be done during the dry season to limit potential erosion. After construction, all disturbed areas, except the new channel bottom under the bridge, will be either planted or reinforced as part of bridge and bridge approach construction. The new channel bottom and up- and downstream areas where vegetation will be removed to promote channel formation are likely to undergo some erosion, which is desirable as part of reestablishing normal geomorphic processes in Willow Creek. If the project results in cut material that cannot be reused as fill for the project, the excess spoils will be taken to nearby Pomo Campground parking lot where the fill will be placed in six inch or less lifts, compacted and stabilized in accordance with the specific BMPs listed below.

Specific BMPs that may be implemented during construction to minimize impacts from erosion and loss of topsoil include (Caltrans 2003; CSQA 2003):

- Scheduling (EC-1, SS-1)
- Preservation of Existing Vegetation (EC-2, SS-2)
- Straw Mulch (EC-6, SS-6)
- Geotextiles and Mats (EC-7, SS-7)
- Velocity Dissipation Devices (EC-10, SS-10)
- Streambank Stabilization (EC-12, SS-12)
- Silt Fence (SE-1, SC-1)
- Fiber Rolls (SE-5, SC-5)
- Street Sweeping and Vacuuming (SE-7, SC-7)

c) **Less-than-significant impact.** The project site is subject to liquefaction, as described a)(iii) above. Mitigation for this circumstance at the project site is included above. However, this project will neither create or enhance seismic hazards relating to liquefaction or landslides, nor will it cause any area to become less stable.

d) **No impact.** The alluvial deposits at the project site have been tested and are not expansive. Hazards from the soil at the site are addressed above.

e) **No impact.** The project will generate no wastewater and need no septic tanks or alternate disposal systems. Construction worker wastes will be collected in porta-potties and trucked off site to appropriate disposal facilities.

f) **No impact.** There are no unique paleontological or geological resources at the project site.

3.7 Global Climate Change

ENVIRONMENTAL SETTING

As humans contribute certain gases, chiefly carbon dioxide, to the atmosphere above the naturally occurring range, the average temperature of the earth is increasing. This, in turn, causes changes in weather patterns that generate a set of conditions referred to as global climate change. Collectively, these gases are referred to as "greenhouse gases" or GHGs.

As mentioned in Section III: Air Quality above, AB 32 requires that statewide GHG emissions in California be reduced to 1990 levels by the year 2020 and requires CARB to adopt rules and regulations to achieve this goal. The following discussion of global climate change in relation to this project addresses three fundamental questions:

- How would the project affect climate change?
- How would the project be affected by climate change?
- If the project contributions to climate change are considered a significant impact on the environment, what constitutes feasible "fair share" mitigation?

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Affect climate change by altering the earth's radiative ability through direct emissions of GHGs; indirect emissions of GHG; alteration of sinks of GHG; or changes in land albedo (reflectivity)?	☐	☐	☒	☐
b) Result in a change in water availability and quantity; an increase in the frequency and severity of extreme weather events; changes in cloud cover and rainfall patterns; increases in frequency of ozone exceedances; or sea level rise?	☐	☐	☐	☒
c) Result in contributions to climate change that are considered a significant impact on the environment?	☐	☐	☐	☒

GLOBAL CLIMATE CHANGE DISCUSSION

a) **Less-than-significant impact.** Projects affect global climate change in four ways: direct emissions of GHGs, indirect emissions of GHGs, changes in the reflectivity of the earth's surface (albedo) that can affect the amount of light and heat absorbed, and changes in carbon sequestration. This project would not substantially affect either albedo or carbon sequestration, but it would generate GHGs.

Direct emissions are those generated during project operations, such as burning fuel in construction vehicles or to get employees to work, and indirect emissions are those generated in the production of things used by the project, such as Portland cement for the pilings and bridge. To avoid additional direct emissions, construction equipment will be stored in the project area or in the adjacent State Parks maintenance yard. Cement will be obtained from the company located as close as possible to the project site.

Construction equipment emission calculation assumptions are shown in Table 2 below. Project implementation will occur over an approximately 3-month period. Equipment generating carbon dioxide (CO_2) may include a crane, an excavator, a loader, trucks, and a pile driver. In order to ensure environmental impacts are anticipated, the estimate of total CO_2 generated includes more equipment than is likely to be needed. During project implementation, the site inspector may substitute equivalent pieces of equipment. The number of days for each piece of equipment is estimated from the percentage of time during construction in which that equipment may be necessary. In some cases, the number of days exceeds the estimated time of construction because more than one of that type of equipment may be necessary. The total CO_2 emission from construction equipment for the project is estimated to be 54 metric tons.

Table 2. Construction Equipment Emissions

Vehicle	Hp	Days of construction	Hours/day	Hp*hr	CO_2 grams/hp* hr	Total metric tons (MT) CO2
Crane	175	5	8	7,000	530	3.7
Excavator	300	20	8	48,000	536	25.7
Loader	100	30	8	8,000	691	5.5
Truck	300	10	8	24,000	536	12.9
Pile Driver	375	3	8	9,000	643	5.8

Construction for the road is calculated separately because past experience with road construction has generated simple road distance-to-CO_2 emission calculations. For this estimate, we used 1,400 tons CO_2/mile of road (Williams-Derry 2007). The project will require approximately 6,367 tons of concrete. Concrete for precast bridge structures is generally about 12 % Portland cement (California DOT 2009; Iowa DOT 2003). The ratio for traditional cement is ±1 ton of CO_2 equivalent per ton of cement. Thus, the 6,367 tons of concrete is estimated to produce 764 metric tons of CO_2. Steel produces about 2 tons of CO_2 per ton of steel (Blue Scope Steel 2005). The project will use fourteen 70-foot steel H piles (weighing 42 lbs. per foot), which works out to 18.7 tons of steel and 37 metric tons of CO_2. Estimates of total project emissions are shown in Table 3 below.

Table 3. Construction Emissions of GHGs

Construction Emissions Source	CO_2 Equivalent (MT)
Construction Equipment	54
Construction Supplies	801
Trips Generated for Construction	<1
Road Construction	210
Total GHGs from Construction	1,065

Thus, the project may generate up to 1,065 metric tons of CO_2. The regulatory community is currently developing thresholds for what constitutes a significant impact. Many proposals focus on efficiency or percent reduction from a baseline. Proposals that give amounts are in terms of emissions per year. Since all emissions from this project happen at construction, the construction emissions are calculated over the life of the project to generate emissions per year. The bridge is likely to last more than 50 years, but the design specification is 20 to 50 years. The construction emissions spread over 20 years generate an emission rate of 53 metric tons of carbon dioxide equivalent (MT CO_2 E) per year. CARB has proposed a significance threshold at 7,000 MT CO_2 E per year, while the Center for Biological Diversity has proposed a significance threshold at 900 MT CO_2 E per year. Thus, by conservative standards, this project would make a less-than-significant contribution to GHGs driving the warming of the earth's atmosphere (radiative forcing).

b) **No impact.** The potential for the project to result in radiative forcing, which warms the atmosphere giving rise to the effects listed in Question b), is assessed in Discussion a) above. Below are evaluations of the project's potential to cause those effects to be more severe and the impact of those effects on the project. There are two impact areas relevant to this project:

Changes in Water Availability and Increases in Extreme Weather Events

Models for climate change are not yet specific enough to make predictions on a local scale, but weather patterns in northern California are likely to generate more intense storms over a shorter rainy season. It is not yet known whether total rainfall will increase slightly, decrease slightly, or stay the same on average. However, more intense storms over a shorter period will likely produce greater peak flows, leading to more frequent flooding. These changes in precipitation timing will probably reduce groundwater infiltration since a larger proportion of rain will fall when the ground is already saturated. Coupled with a longer, drier summer, this will likely lead to increasingly severe water shortages. California is already experiencing a measurable decrease in soil moisture.

Streams will have lower flow or standing water in the summer. For aquatic species, this leads to increased risk of stress and stranding. Channels and deep pools will be important, and this project should help to locally ameliorate changing climate for aquatic species.

During the winter, when more severe storms occur, peak flows will likely be higher. The new bridge is designed to pass more water than the existing culverts and, therefore, should not exacerbate flooding as the hydrology changes. In what are currently normal winters, all water will pass under the bridge. The bridge will likely flood in large storm events but will be designed to withstand short-term flooding. Since the project will locally ameliorate changes in precipitation patterns both during dry and wet season, and will not intensify these effects, no adverse impact is anticipated.

Changes in Sea Level

Sea level is rising, primarily as a result of the warming of the earth that results in thermal expansion of seawater. There is also some contribution from melting land ice (glaciers). By 2100, sea level is likely to rise between 20 – 55 inches. A Joint Policy Committee of the San Francisco Bay Conservation and Development Commission (BCDC), together with the Association of Bay Area Governments (ABAG), the Bay Area Air Quality Management District (BAAQMD), and the Metropolitan Transit Commission (MTC) have agreed that three feet of sea level rise by 2100 is a reasonable and prudent planning prediction.

At high tide, the Russian River is brackish past the mouth of Willow Creek, and the lower creek has tidal influence at least 0.3 mile upstream from the mouth (SCWA 2001). With three feet of sea level rise, brackish water will likely progress further up Willow Creek, gradually extending tidal marsh into the existing freshwater wetlands. This project will not impact the ability of biological systems in the watershed to adapt to changing circumstances.

c) **Less-than-significant impact**. Since the project has a less-than-significant impact on radiative forcing and does not have an impact on the severity of climate change effects, its overall climate change impact is less than significant.

3.8 Hazardous Materials

ENVIRONMENTAL SETTING

The roadway across the valley floor and floodplain at the 2nd bridge crossing acts as a low-head dam, trapping streamflow and sediment and restricting fish passage up- and downstream during spring and winter base-flow conditions. The 24-inch culverts at the west end of the valley crossing are often blocked with debris during annual high flows. The streamflow slows and spreads across the floodplain, overtopping the roadway during most high flows.

Hazardous Materials

The project site is located within an existing roadway and is surrounded by riparian habitat. The site is rural, and there is no evidence of industrial use in the project area. The closest cleanup site listed by the California Department of Toxic Substance Control (CDTSC) is located in Cotati, approximately 28.5 miles away (CDTSC 2008; Google Maps).

Schools and Airports

The closest school is Monte Rio Elementary School, located approximately 4.5 miles northeast of the project site (Google Maps 2008). Sonoma County has one airport, the Charles M. Schultz Airport, which is located over 16 miles to the east of the project area.

Fire Hazards

The California Department of Forestry and Fire Protection (CalFire) has developed methods to assess fire danger throughout California. CalFire bases their zones on estimated fire fuel potential over a 30 to 50-year time horizon based on the probability of a burn and potential vegetation exposure to new construction (CalFire 2007). CalFire has three severity classifications: moderate, high, and very high. The project area is situated within a high fire severity zone that has been designated as a State Responsibility Area (CalFire 2007). Fire protection for the property is available from CalFire's Cazadero station, approximately 5.5 miles from the project area, and the Russian River Fire Protection District, located in Monte Rio, approximately 5 miles from the project area. Additionally, Sonoma Coast State Park is outfitted with fire suppression materials.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and/or accident conditions involving the release of hazardous materials, substances, or waste into the environment?	☐	☐	☒	☐

c)	Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school?	☐	☐	☐	☒
d)	Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code §65962.5, and, as a result, create a significant hazard to the public or environment?	☐	☐	☐	☒
e)	Be located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport? If so, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f)	Be located in the vicinity of a private airstrip? If so, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g)	Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
h)	Expose people or structures to a significant risk of loss, injury, or death from wildland fires, including areas where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☒	☐

HAZARDOUS MATERIALS DISCUSSION

a-b) **Less than significant impact**. Construction activities would require the use of powered equipment that use potentially hazardous materials such as fuels, oils, and solvents. These materials are generally contained within vessels engineered for safe storage. Large quantities of these materials would not be stored at or transported to the construction site. Spills, upsets, or other construction-related accidents could result in a release of fuel or other hazardous substances into the environment. **Minimization Measure – Hazmat-1** will keep the potential for adverse impacts from these incidents to a less-than-significant level.

MINIMIZATION MEASURE – HAZMAT-1

- All equipment will be inspected for leaks immediately prior to the start of construction and regularly inspected thereafter until equipment is removed from the project site.
- A designated staging area will be identified where equipment refueling may occur. A spill kit will be maintained on-site throughout the duration of the project.
- Equipment will be cleaned and repaired (excepting emergency repairs) in the maintenance shop, away from the project site. Any contaminated water, sludge, spill residue, or other hazardous compounds will be disposed of outside park boundaries at a lawfully permitted or authorized destination.

c) No impact. There are no schools in the general vicinity of the project or within one-quarter mile of the proposed project site.

d) **No impact**. The project area is not on a list of hazardous materials sites and is over 24 miles from the nearest listed site (CDTSC 2008).

e-f) **No impact**. The project area is not located within an airport land use plan, within two miles of a public airport, or in the vicinity of a private airstrip.

g) **Less-than-significant impact.** The construction activities associated with the proposed project would block access to Willow Creek Road, however, two alternative routes are available. The following **Minimization Measure – Hazmat-2 Construction Fire Management** will keep the potential for adverse impacts from this project to a less-than-significant level.

MINIMIZATION MEASURE HAZMAT-2
▪ Two alternative routes will be designated by DPR to allow access during construction.

h) **Less-than-significant impact.** The project area contains grasses and shrubs that can become highly combustible during the dry season (June to October). The use of equipment for construction may be in close proximity to vegetation. Improper exhaust systems on equipment and friction between metal and rocks could generate sparks. Due to these uses, there is some risk of accidental wildfire ignition. The following **Minimization Measure – Hazmat-3 Construction Fire Management** will keep the potential for adverse impacts from this project to a less-than-significant level.

MINIMIZATION MEASURE HAZMAT-3
• Prior to the beginning of construction, DPR will develop a Project Fire Safety Plan. The Plan will include emergency calling procedures to dispatch the Monte Rio Fire Protection District. All employees working on site will receive safety trainings regarding these procedures. • Spark arrestors will be required for all motorized equipment. • Construction crews will be required to park vehicles away from flammable material such as dry grasses and brush. • DPR staff will be required to have a State Park radio on site, which allows direct contact to a centralized dispatch, CalFire, or Russian River Fire Protection District.

3.9 Hydrology and Water Quality

ENVIRONMENTAL SETTING

Willow Creek flows from an 8.7-square mile watershed into the Russian River. The watershed area at the 2nd bridge crossing is approximately 8.2 square miles. The stream flows in a northwest trending valley between two steep ridges of the Coast Range, and watershed elevations range from 0 feet at the confluence to 1,481 feet at Koerber Peak.

Streamflow patterns in Willow Creek are typical of small coastal watersheds in temperate climates. Peak flows are flashy and occur during large winter storms, usually in December through March. Between storms, subsurface runoff produces a raised winter base-flow from November through April. During the summer dry season (April through October/November), streamflow fed by springs and groundwater steadily decreases. In late summer, flow often becomes intermittent, and pools become disconnected.

The flows of interest in this project are the channel-forming and maintenance flows and the daily averaged base flows that are sustained during the fish migration period. Table 4 presents the discharges used in this study to assess channel capacity and flooding potential at the project site under existing and proposed project conditions. These discharges were used to evaluate the hydraulic conveyance capacity of the existing (Figure 4) and design conditions at the 2nd bridge crossing.

Table 4. Flood Flow Rates Used for Hydraulic Analysis at the Project Site

Willow Creek Flood Recurrence Interval (years)	Q2	Q5	Q10	Q25	Q50	Q100
Discharge (cfs)	730	1110	1450	1815	2200	2460

Hydraulic analyses of the existing site conditions indicate that the culverts and road are overtopped when flows are in the range of 200-250 cubic feet per second (cfs), which corresponds to a water surface elevation of 16.9 feet on the upstream side of the culverts, assuming the culverts are in a clean condition. Most of the culverts contain a residual amount of sediment, and the inlets are partially occluded with vegetation and debris, causing the culverts to overtop when flow is less than 200 cfs. In general, the road has a tendency to be overtopped at the culverts at least once each year.

Based on the results from the hydraulic analyses, the proposed bridge crossing and approaches will allow all Willow Creek flood flows less than Q100 to be contained within the new channel crossing (Figure 5).

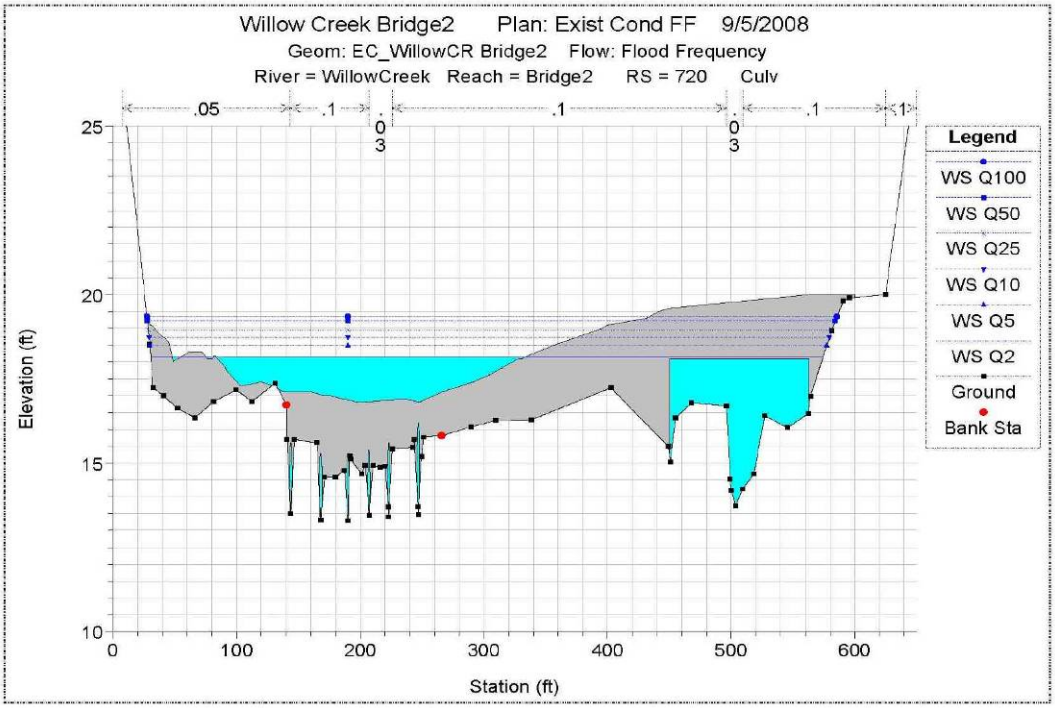


Figure 4. Hydraulic Model Results of Existing Conditions at 2nd Bridge Crossing
View is looking downstream at the road (dark grey is the road fill). *Note that all flood flows overtop the road at the culverts on left side of the image.*

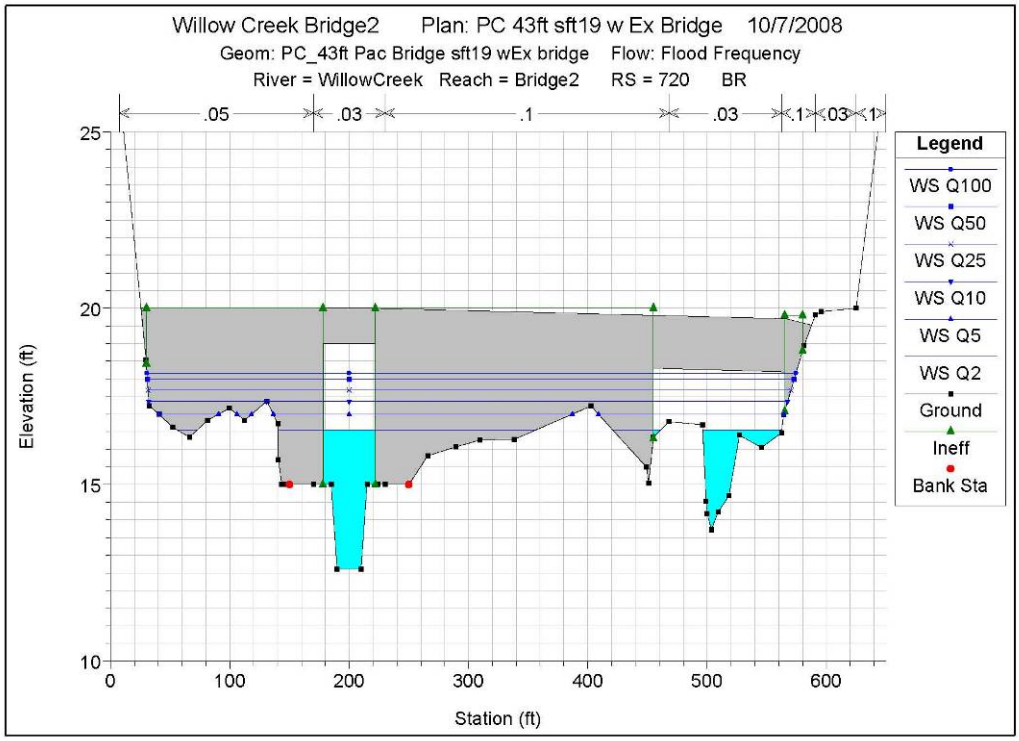


Figure 5. Hydraulic Model Results of Preferred Structure at 2nd Bridge Crossing
View is looking downstream at the road (dark grey is the road fill).

		POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:					
a)	Violate any water quality standards or waste discharge requirements?	☐	☐	☒	☐
b)	Substantially deplete groundwater supplies or interfere substantially with groundwater recharge, such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of preexisting nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒
c)	Substantially alter the existing drainage pattern of the site or area, including through alteration of the course of a stream or river, in a manner which would result in substantial on- or off-site erosion or siltation?	☐	☐	☒	☐
d)	Substantially alter the existing drainage pattern of the site or area, including through alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in on- or off-site flooding?	☐	☐	☐	☒
e)	Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f)	Substantially degrade water quality?	☐	☐	☒	☐
g)	Place housing within a 100-year flood hazard area, as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map, or other flood hazard delineation map?	☐	☐	☐	☒
h)	Place structures that would impede or redirect flood flows within a 100-year flood hazard area?	☐	☐	☒	☐
i)	Expose people or structures to a significant risk of loss, injury, or death from flooding, including flooding resulting from the failure of a levee or dam?	☐	☐	☐	☒
j)	Result in inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒

HYDROLOGY & WATER QUALITY DISCUSSION

a) **Less than significant impact.** All project work will receive Clean Water Act §401 Certification from the North Coast Regional Water Quality Control Board that will include conditions to protect water quality standards.

b) **No impact.** The project will not substantially deplete groundwater supplies or interfere substantially with groundwater recharge.

c) **Less than significant impact.** All project work will receive Clean Water Act §401 Certification from the North Coast Regional Water Quality Control Board that will include conditions to protect water quality standards

d) **No impact.** Most of the existing culverts contain a residual amount of sediment, and the inlets are partially occluded with vegetation and debris, causing the culverts to overtop when flow is less than 200 cfs. Replacing the culvert system with a single-span, precast concrete bridge will allow for natural stream flow and sediment deposition.

e) **No impact.** The project would not substantially alter the existing drainage pattern of the site or area in a manner that would result in substantial on- or off- site erosion or siltation. Replacement of the in-stream culverts with a free-span bridge will reestablish historic drainage patterns at the project site and allow natural channel development and maintenance to occur. Road drainage patterns from the hillside to the wetlands would not be altered.

f) **Less-than significant impact.** The project will have no long-term impacts on water quality. The following **Minimization Measure – Hydro-3** will keep the potential for adverse impacts from this project to a less-than-significant level.

MINIMIZATION MEASURE HYDRO-1
• If the excavation sites must be dewatered, the water will be discharged in a manner that will cause no substantial increase in stream turbidity or discharge of fine sediment to the stream channel. • All appropriate BMPs will be implemented as needed to ensure that there is no discharge of fine sediment, concrete, concrete wash water, or roiled water to the creek. • Building materials and/or construction equipment will not be stockpiled or stored where they could be washed into the water or where they will cover aquatic or riparian vegetation. • Debris, soil, silt, bark, rubbish, creosote-treated wood, raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances resulting from project related activities that could be hazardous to aquatic life will be prevented from contaminating the soil and/or entering the waters of the state. Any of these materials placed within or where they may enter a stream or lake will be removed immediately. • All debris and waste will be picked up daily and properly disposed of at an appropriate site.

Specific BMPs that may be implemented during construction to minimize impacts to the water quality of Willow Creek include (Caltrans 2003; CSQA 2003):

- Water Conservation Practices (NS-1)
- Dewatering Operations (NS-2)
- Paving and Grinding Operations (NS-3)
- Illicit Connection/Discharge (NS-6)
- Vehicle and Equipment Cleaning (NS-8)
- Vehicle and Equipment Fueling (NS-9)
- Vehicle and Equipment Maintenance (NS-10)
- Pile Driving Operations (NS-11)
- Concrete Curing (NS-12)
- Concrete Finishing (NS-13)
- Demolition Adjacent to Water (NS-15)
- Material Delivery and Storage (MW-1)
- Stockpile Management (WM-3)
- Spill Prevention and Control (WM-4)
- Solid Waste Management (WM-5)
- Contaminated Soil Management (WM-7)
- Concrete Waste Management (WM-8)
- Sanitary/Septic Waste Management (WM-9)

g) **No impact.** The project does not involve housing.

h) **Less-than-significant impact.** The new bridge is within the 100-year flood zone but is designed to allow, not impede or redirect flood flows. The existing culvert system will be replaced with a single-span, precast concrete bridge that will have significantly more conveyance capacity than the existing culverts.

i) **No impact.** The project will not expose people or structures to a significant risk of loss, injury, or death from flooding, including flooding from the failure of a levee or dam.

j) **No impact.** The project will not result in inundation by seiche, tsunami, or mudflow.

3.10 Land Use and Planning

ENVIRONMENTAL SETTING

The project will occur on Willow Creek Road, in a rural area of the Sonoma Coast, 2 miles upstream of the river's mouth at Jenner; see Figure 1 for Project Location Map. Located on the western edge of the Coast Range, Willow Creek flows in a northwesterly direction following an inactive fault trace. Most of its watershed is part of the 10,286-acre Sonoma Coast State Park.

The project area is the 2nd Willow Creek Road crossing of the channel where the road berm and buried culverts block passage for resident and migratory aquatic species, including listed salmonids. The road is owned and marginally maintained by the Sonoma County Department of Transportation and Public Works. It leads to state park facilities and the upper watershed, but the road currently is closed to through traffic to Occidental to the east.

The project site is located on Assessor's Parcel Numbers 097-160-003, 097-160-002, 099-070-006, and 099-070-010. The current land use and zoning designations are Public Quasi Public - PQP with Coastal combining zone as well as various combining districts. The following combining districts are applicable to the project site. Their provisions govern the management, activities and facilities at the site (Sonoma County):

- Biotic Resources Combining District
- Floodplain 1 Combining District
- Floodplain 2 Combining District

Land uses on the adjacent parcels (surrounded by Sonoma Coast State Park) are public parklands. Beyond the park boundaries, adjacent uses include scattered residential, agriculture, and timber to the north (David Ranch, Jenner Headlands); timber to the east (Mendocino Redwood Company); timber and agriculture to the east (Poindexter Ranch, Mendocino Redwood Company); and the Pacific Ocean to the west. Land use designations and zoning in the area are consistent with current uses on surrounding lands. These zoning designations are: Public Facilities (PF) on parklands, Land Extensive Agriculture (LEA160/640 with Coastal combining district) on agricultural lands, and Rural Residential (RRD160/640) on scattered residential and timber lands.

Pertinent Planning Documents

Sonoma County General Plan and Local Coastal Plan

The county's General Plan and Local Coastal Plan contain the following combining districts: Biotic Resources on the Willow Creek property, Willow Creek as a Floodplain 1, and Floodplain 2.

In addition to land use and zoning, the Local Coastal Plan (LCP) contains policies and guidelines for implementing the California Coastal Act with respect to public access, recreation, environmental resources, natural resources, transportation, and development (Sonoma County 2001b).

Sonoma Coast State Park General Plan

A Sonoma Coast State Park General Plan and Final Environmental Impact Report (General Plan/EIR) was approved in May 2007. This Plan identifies existing conditions, needs, and issues at the park unit and makes management recommendations for responding to those needs and issues.

The project is consistent with the *Sonoma Coast State Park General Plan* (DPR 2007b), which contains the following vision statement: "The integrity of natural ecosystems may be protected by the control of exotic species, if necessary, and by habitat restoration where appropriate and feasible." This restoration action is designed in accordance with the guiding principle of preservation, support, or reestablishment of physical and biological processes. This action implements the following specific guidelines from the General Plan:

- Guideline FAC-1F: Design culverts placed beneath roads and trails to accommodate 100-year storm and fish passage.
- Guideline FAC-1M: Conduct project-specific geotechnical evaluations prior to preparation of final plans for development on sites that would subject property or persons to significant risks from geologic hazards. Site mitigation, if necessary, shall conform to the recommendations in the geotechnical evaluations.
- Guideline INLAND-2B: Support and implement the Willow Creek Watershed Management Plan in a manner that is consistent with this General Plan.
- Guideline NAT-1D: When implementing habitat restoration projects and landscaping around facilities, use native species that are appropriate to the site and that are obtained from native plant species within Sonoma Coast SP boundaries or from within 5 miles of Sonoma Coast SP. This includes transplanted cuttings and rootstocks or seedlings and saplings grown from collected seed that are genetically compatible. Ensure that all mulches are free of foreign seed.
- Guideline NAT-2H: Remove barriers to fish passage where feasible to provide habitat linkages to existing resources within the Sonoma Coast SP.

Coastal Commission Strategic Plan

The Coastal Commission Strategic Plan (CCC 1997) calls for protecting and restoring streams, wetlands, riparian corridors, and environmentally sensitive terrestrial habitat areas, including habitats of rare or endangered organisms, such as salmonids. The proposed project will enhance the ecological health of stream, wetland, and riparian habitats and is consistent with the strategic vision of the California Coastal Commission.

Other Conservation Plans

The *Willow Creek Watershed Management Plan* (PCI 2005b), the Department of Fish and Game's 2002 Draft Russian River Basin Fisheries Restoration Plan (CDFG 2002), and the unpublished 2008 Draft NOAA National Marine Fisheries Service's Recovery Plan for the Evolutionary Significant Unit of Central California Coast Coho Salmon (NMFS 2008) list the removal of the fish barrier at the 2nd crossing as a high priority project for the restoration of anadromous fisheries.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with the applicable land use plan, policy, or regulation of any agency with jurisdiction over the project (including, but not limited to, a general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

LAND USE AND PLANNING DISCUSSION

a) **No impact.** Willow Creek Road was closed at the top of the watershed between the coast and Occidental by Sonoma County in 2007 due to health and safety issues. Currently, residents of the upper watershed may either go east through Occidental or south along Joy Road to Highway 12. While the construction will temporarily prevent the general public from driving from the coast to the upper watershed, work will occur after peak tourist season, and there will be no long-term effects on public access. Private residents and park employees may use alternative, gated roads to access the upper watershed from either upper Willow Creek Road or from Freezeout Creek.

b) **No impact.** This project is consistent with the Sonoma County General Plan, the Local Coastal Program, the General Plan for Sonoma Coast State Park and other local conservation plans.

c) **No impact.** No habitat conservation plan or natural community conservation plan is currently in place for the area.

3.11 Mineral Resources

ENVIRONMENTAL SETTING

Mineral resource extraction is not permitted under the Resource Management Directives of DPR.

All construction activities associated with the project will take place within the boundaries of Sonoma Coast State Park, Sonoma County.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Result in the loss of availability of a known mineral resource that is or would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

MINERAL RESOURCES DISCUSSION

a) No impact. The project will not result in the loss of availability of known minerals because extraction is not permitted under DPR's Resource Management Directives; no known mineral resources exist within the project area.

b) No impact. No loss of availability of locally important mineral resource recovery sites will occur because none are known to exist within the project area.

3.12 Noise

ENVIRONMENTAL SETTING

The Willow Creek property is located in a very sparsely populated area in Sonoma Coast State Park. Vehicle traffic from Willow Creek Road, a 1.5-lane, rural county road is the primary source of noise in the area. Common noises heard at the proposed project site include birds, wind in the trees, and flowing water from the Willow Creek.

Table 5. Construction Equipment Noise at 50 Feet

Equipment	Noise Level at 50 Feet
Earthmoving	**dB**
Front Loaders	75-79
Backhoes	75-85
Dozers	75-80
Tractors	75-80
Graders	75-85
Pavers	80-89
Pile Driver	82-105
Material handling	
Concrete Mixers	75-85
Crane	75-83
Concrete Crushers	75-85
Stationary	
Pumps	75-76
Generator	75-78
Compressors	75-81
Other	
Saws	75-78
Vibrators	75-76

Source: U.S. EPA

Noise is defined as unwanted sound and is known to have several adverse effects on people, including hearing loss, speech and sleep interference, physiological responses, and annoyance. Based on these known adverse effects from noise, the federal government, the State of California, and many local governments have established criteria to protect public health and safety and to prevent disruption of certain activities.

Noise is commonly described in "Ldn," which expresses average sound level over a 24-hour period in decibels (dB), the standard measure of pressure exerted by sound. Ldn includes a 10dB penalty for sounds between 10 pm and 7 am when background noise is lower and people are most sensitive to noise. Because decibels are logarithmic units of measure, a change of 3dB is hardly noticeable, while a change of 5dB is quite noticeable, and an increase of 10dB is perceived as a doubling of the noise level. A change from 50dB to 60dB increases the percentage of the population that is highly annoyed at the noise source by about 7 percent, while an increase from 50dB to 70dB increases the annoyed population by about 25 percent. Sounds as faint as 10dB are barely audible, while noise over 120dB can be painful or damaging to hearing.

The Sonoma County General Plan provides standards for exterior noise levels. For non-transportation noise sources, such as this project, the daytime (7 am to 10 pm) noise level standard is 50dB. The nighttime standard is 45dB.

The project site will not be accessible to the public during construction. Adjacent land uses include recreational activities, timber, and scattered residential. Project construction is anticipated to use equipment with noise levels similar to those listed in the Table 5.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Generate or expose people to noise levels in excess of standards established in a local general plan or noise ordinance, or in other applicable local, state, or federal standards?	☐	☐	☒	☐
b) Generate or expose people to excessive groundborne vibrations or groundborne noise levels?	☐	☐	☒	☐
c) Create a substantial permanent increase in ambient noise levels in the vicinity of the project (above levels without the project)?	☐	☐	☐	☒
d) Create a substantial temporary or periodic increase in ambient noise levels in the vicinity of the project, in excess of noise levels existing without the project?	☐	☐	☒	☐
e) Be located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport? If so, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) Be in the vicinity of a private airstrip? If so, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

NOISE DISCUSSION

a) Less-than-significant impact. As noted above, for non-transportation noise sources, the County daytime (7 am to 10 pm) noise level standard is 50dB. The construction site will not be open to the public during construction. The nearest residence is less than 1 mile away from the project site and nearby recreation sites exist. Although no impacts on these potential receptors are expected, integration of **Minimization Measure Noise-1** into construction plans will reduce temporarily increased noise to a less-than-significant level. Measures to minimize impacts to wildlife, including bats and breeding birds are included.

MINIMIZATION MEASURE NOISE-1

- Construction activities will be limited to the daylight hours between Monday and Friday; however, weekend work could be implemented to accelerate construction or address emergency or unforeseen circumstances. If weekend work is necessary, no work will occur on Saturday or Sunday before 8 am or after 7 pm.
- Internal combustion engines used for any purpose at the job site will be equipped with a muffler of a type recommended by the manufacturer.
- Equipment and trucks used for construction will utilize the best available noise control techniques (e.g., engine enclosures, acoustically-attenuating shields, or shrouds, intake silencers, ducts, etc.) whenever feasible and necessary.

- To avoid impacts on special-status and common bat species, prior to the removal of any trees, a qualified biologist will survey for roosting bats. If occupied roosts are identified, removal of the roost trees will not occur until the roost is unoccupied. Construction will be limited to daylight hours to avoid interference with the foraging abilities of bats.
- To avoid potential losses of breeding birds, construction activities will occur outside of the critical breeding period, typically mid-March to mid-August in the Willow Creek area.
- Should work occur during the breeding season a qualified biologist will survey the area to ensure that no nesting activity is occurring in the project area. Should nesting activity be observed the area will be avoided until nesting birds have fledged.

b) **Less-than-significant impact.** Construction activity would involve the use of an impact hammer and pile driving or other intensive construction techniques that could generate significant ground vibration or noise. The property will not be open to the public during construction. The nearest residence is less than 1 mile away from the project site and nearby recreation sites exist. Although no impacts to these potential receptors are expected, integration of **Minimization Measure Noise-1** into construction plans will reduce temporarily increased noise to a less-than-significant level.

c) No impact. Upon completion of the proposed project, construction-related noise would cease. Nothing within the scope of the proposed project would result in a substantial permanent increase in ambient noise levels.

d) **Less-than-significant impact.** Construction activities utilizing heavy and motorized equipment would result in a temporary increase in ambient noise levels. This would occur only during the initial construction of proposed facilities. The application of **Minimization Measure Noise-1** will ensure that ambient noise remains at a less-than-significant level.

e-f) **No impact.** There is one Public General Aviation Airport located within Sonoma County, the Sonoma County Airport in northern Santa Rosa. The airport is more than 23 miles from the project site. This project is not located within an airport land use plan, within two miles of a public airport, or in the vicinity of a private airstrip.

3.13 Population and Housing

ENVIRONMENTAL SETTING

Between 2000-2008, the County's population grew at a rate of 4.7%, and the County's population reached 484,470 in 2008 with the largest contribution to growth in the City of Santa Rosa (Sonoma County 2008a). According to the Sonoma County General Plan 2020 housing element, housing development has not kept pace with population growth, creating intensified need for housing (Sonoma County 2008b). However, the project area is designated as public or quasi-public land and is, therefore, not identified as a potential development area in the County General Plan. The Sonoma Coast State Park General Plan (DPR 2007) outlines planned improvements, including expansion of the existing Willow Creek Maintenance Yard. The EIR states that development of the park, including upgrades to roads, parking, existing campgrounds, and the visitor center, will not generate a significant need for housing.

The 2nd bridge crossing currently serves as access to a DPR maintenance facility, four private residences, and Pomo Campground. The potential impact of the project on visitation to Pomo Campground is evaluated in Section XV: Recreation. The project will create improvements in the road that may facilitate winter access to the existing maintenance area and private residences during flood events by changing the base elevation of the road. However, the residences and the maintenance yard can also be accessed by other roads.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

POPULATION AND HOUSING DISCUSSION

a) **No impact.** The project will be conducted within the existing footprint of an existing road. It will not affect the use of the existing road except during extreme storm events. During these events, residents and Park staff that need to move in and out of the area can already do so by existing roads but the main road may be more convenient after project implementation. This small change in road use will not induce any population growth either directly or indirectly.

b) **No impact.** In the long term, the project will not substantially alter use of the road or access to existing houses. No housing will be displaced by the project.

c) **No Impact**. The project will not displace people, even during construction, because residents will be able to use existing alternate access routes exist.

3.14 Public Services

ENVIRONMENTAL SETTING

The 2nd bridge currently serves as access to a state park maintenance facility, residences, and a Pomo Campground. The entire area surrounding the road is state park. No police or fire facilities, schools, or other public facilities are present in the area.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Result in significant environmental impacts from construction associated with the provision of new or physically altered governmental facilities, or the need for new or physically altered governmental facilities, to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:	☐	☐	☐	☒
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

PUBLIC SERVICES DISCUSSION

a) **No impact.** The replacement of the existing culvert system with a precast concrete bridge will not affect public services within the area, and implementation will not result in the need for new or physically altered government facilities. The road will continue to provide reasonable access by emergency and service vehicles. It is anticipated that the road will experience a decrease in overtopping during storm events to some extent, allowing an increase in access for emergency vehicles.

3.15 Recreation

ENVIRONMENTAL SETTING

Willow Creek Road is used for both active and passive recreation. The road is a popular but undesignated bikeway from Bridgehaven in the western part of the watershed to Willow Creek's headwaters above Occidental. It is also used as a hiking path and provides bird watching opportunities and access to two environmental campgrounds as well as various trails. Within Sonoma Coast State Park, ranch roads and trails provide for hiking, horseback riding, and mountain biking. DPR's mission is to "provide for the health, inspiration, and education of the people of California by helping to preserve the state's extraordinary biological diversity, protecting its most valued natural and cultural resources, and creating opportunities for high-quality outdoor recreation" (DPR 2007b).

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities, such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☐	☒

RECREATION DISCUSSION

a) **No impact.** One of the major concerns of the TAC in approving the Willow Creek 2nd bridge area improvements was to maintain the current character of the park. Because Pomo Environmental Campground is up the road from the project site, concern was expressed that major road improvements would increase visitation to the campground, thus overtaxing the facilities and causing physical deterioration. To prevent this, one of the design constraints for the project was to maintain the character of the road and its current carrying capacity. The project was designed to maintain the existing road width. Summer driving conditions will be substantially unaltered. The project will provide a road that is less susceptible to flooding at the project site, but this is unlikely to increase campground use as the improved conditions will only apply during the worst weather of the year when Pomo Environmental Campground is closed (Nov. 1 through March 31).

b) **No impact.** The General Plan for Sonoma Coast State Park requires any development and improvement of bikeways to be done in collaboration with the County and/or Caltrans (DPR 2007a). While implementation of this project will result in a smoother surface for a short distance in the area of the 2nd crossing, it is not the intent of this project to result in the development or improvement of recreational facilities.

3.16 Transportation and Traffic

ENVIRONMENTAL SETTING

The project will occur on Willow Creek Road downstream of Pomo Environmental Campground and adjacent to the road to the park maintenance facility. There are a few homes at the base of the road near Highway 1. In addition to local traffic, Willow Creek Road provides access to the park and four residences.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Cause a substantial increase in traffic, in relation to existing traffic and the capacity of the street system (i.e., a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	☐	☐	☐	☒
b) Exceed, individually or cumulatively, the level of service standards established by the county congestion management agency for designated roads or highways?	☐	☐	☒	☐
c) Cause a change in air traffic patterns, including either an increase in traffic levels or a change in location, that results in substantial safety risks?	☐	☐	☐	☒
d) Contain a design feature (e.g., sharp curves or a dangerous intersection) or incompatible uses (e.g., farm equipment) that would substantially increase hazards?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☒	☐
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

TRANSPORTATION AND TRAFFIC DISCUSSION

a) **No Impact.** Construction activities would not likely result in a significant increase in traffic levels. No long-term increase in traffic will occur as a result of the culvert replacement. Equipment and materials will be delivered to the site, and workers will drive to and from the work area during the week. Increased traffic on Highways 1 and 116 will be insignificant compared to the existing traffic load. Construction-related traffic on lower Willow Creek Road itself would result in insignificant delays to residents because construction vehicles would not need to stop in the residential area.

b) Less than significant Impact. In assessing traffic impacts, current and potential future conditions are described by the level of service (LOS), which represents the speed and travel time, traffic interruptions, predictability of flow, and freedom to maneuver for a particular road. LOS A represents virtually free-flow conditions, with unrestricted ability to maneuver. Levels B, C, D, E, and F represent decreasing flow rates with correspondingly more interference from other vehicles in the traffic stream. Both Highway 1 and Highway 116 typically operate at LOS A, except on the busiest holiday weekends. Willow Creek Road has no LOS designation due to its low usage (less than 400 vehicles per day). The project will maintain the existing character of the road. However, Willow Creek Road would need to be completely closed during working hours in the project area for a period of approximately 3 months. Two alternative routes will be provided for staff, residents, and emergency response vehicles. Peak visitation to Pomo Environmental Campground is during the summer months. Project construction will be scheduled after Labor Day to reduce impacts to a level of insignificance.

MINIMIZATION MEASURE TRAFFIC-1
▪ Project construction will be scheduled after Labor Day. ▪ Signage will be provided to redirect traffic at logical turnaround areas in advance of the construction zone.

c) **No impact.** The project area is not located within an airport land use plan, within two miles of a public airport, or in the vicinity of a private air strip.

d) **No impact.** The road will remain in the same place with no changes to public access. The turn from the new bridge area toward Pomo Environmental Campground will be similar to existing conditions but slightly further south. The entry into the State Parks' maintenance road from Pomo Environmental Campground will be less sharp and, therefore, easier for the large maintenance trucks.

e) **Less-than-significant impact.** Although the road will be closed to through traffic during construction activities, there are two alternative routes that will be available for staff, residents, and emergency vehicles. These routes will generally increase trip time, but in some circumstances may decrease trip time depending upon the departure location.

MINIMIZATION MEASURE TRAFFIC-2
▪ Two alternate routes will be designated by DPR to allow access during construction.

f) **No impact.** The project will not eliminate any parking spaces and will add a few spaces in the grassy area at the corner with the maintenance road.

g) **No impact.** The only form of alternative transportation available on Willow Creek Road is use of bicycles. The project will not change bicycle access except as noted for car access in b) above.

3.17 Utilities and Service Systems

ENVIRONMENTAL SETTING

Currently, the existing roadway across the valley floor and floodplain at the 2nd bridge crossing acts as a low-head dam, trapping stream flow and sediment and restricting fish passage upstream and downstream during spring and winter base-flow conditions. The 24-inch culverts at the west end of the valley crossing are often blocked with debris during annual high flows.

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Exceed wastewater treatment restrictions or standards of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities?			☐ Yes	☒ No
Would the construction of these facilities cause significant environmental effects?	☐	☐	☐	☐
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities?			☐ Yes	☒ No
Would the construction of these facilities cause significant environmental effects?	☐	☐	☐	☐
d) Have sufficient water supplies available to serve the project from existing entitlements and resources or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination, by the wastewater treatment provider that serves or may serve the project, that it has adequate capacity to service the project's anticipated demand, in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes, and regulations as they relate to solid waste?	☐	☐	☐	☒

UTILITIES AND SERVICE SYSTEMS DISCUSSION

a) **No impact.** The project will not result in the discharge of wastewater.

b) **No impact.** The project will not require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities.

c) **No impact.** The project will not require or result in the construction of new stormwater drainage facilities or expansion of existing facilities.

d) **No impact.** The project will not require expanded entitlements.

e) **No impact.** The project will not result in an increase of wastewater discharge.

f) **No impact.** Asphalt, concrete, and metal will be recycled at local facilities. If the project results in cuts that cannot be reused as fill, the excess spoils will be placed at a maximum 3:1 slope on the hillside at a nearby borrow site. The spoils will be covered in erosion control fabric, staked to promote stability, and planted with native vegetation in accordance with the specific BMPs listed in Section VI. Geology, Soils, and Hazards.

g) No impact. The project will comply with all federal, state, and local statutes and regulations as they relate to solid waste.

4 MANDATORY FINDINGS OF SIGNIFICANCE

	POTENTIALLY SIGNIFICANT IMPACT	LESS THAN SIGNIFICANT WITH MITIGATION	LESS THAN SIGNIFICANT IMPACT	NO IMPACT
WOULD THE PROJECT:				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal?	☐	☐	☐	☒
b) Have the potential to eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
c) Have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means the incremental effects of a project are considerable when viewed in connection with the effects of past projects, other current projects, and probably future projects?)	☐	☐	☐	☒
d) Have environmental effects that will cause substantial adverse effects on humans, either directly or indirectly?	☐	☐	☐	☒

MANDATORY FINDINGS OF SIGNIFICANCE DISCUSSION

a) **Less than significant impact.** The project will result in improvement of the local environment by creating fish passage, restoring the natural hydrologic and geomorphic processes of Willow Creek, and improving aquatic and floodplain habitat. It will not restrict the range of any species. While narrow slices of wetland habitat will be eliminated along the edge of the road at the bridge approach, it is an insignificant portion of the total wetland in the area. Further, it will not reduce the number or restrict the range of any rare or endangered plants or animals. Construction related mitigation and minimization measures have been included in the project to reduce impacts to less than significant.

b) **No impact.** The project will occur within the existing footprint of Willow Creek Road. A preconstruction training will acquaint construction crew members with articles to avoid and measures to take in the unlikely event that artifacts are discovered. There are no known examples of California history or prehistory at the project site.

c) **No impact.** The project does not pose any cumulative impacts in conjunction with past, current, and future projects. As outlined in the *Willow Creek Watershed Management Plan* (PCI 2005b), the 2nd Bridge Area Fish Passage Project is part of a multifaceted watershed management plan that has been developed through a cooperative effort with a Technical Advisory Committee and other stakeholders, including the public.

d) **No impact.** Creating fish passage and restoring the hydrologic and geomorphic processes of Willow Creek will neither directly nor indirectly cause substantial adverse effects on humans.

5 SUMMARY OF CONDITIONS AND MITIGATION MEASURES

The following conditions and mitigation measures will be implemented by State Parks as part of the Willow Creek Road 2nd Bridge Area Fish Passage Project at Sonoma Coast State Park:

AESTHETICS

No mitigation measures necessary.

AGRICULTURAL RESOURCES

No mitigation measures necessary.

AIR QUALITY

MINIMIZATION MEASURE AIR-1

- All construction areas (dirt/gravel roads and surrounding dirt/gravel area) will be watered at least twice daily during dry, dusty conditions.
- All trucks hauling soil, sand, or other loose materials on public roads will be covered or required to maintain at least two feet of freeboard.
- All construction-related equipment engines will be maintained in good condition, in proper tune (according to manufacturer's specifications), and in compliance with all State and federal requirements.
- Earth or other material that has been transported onto paved roadways by trucks, construction equipment, erosion, or other project-related activity will be promptly removed.

BIOLOGICAL RESOURCES

MINIMIZATION MEASURE BIO-1

- If water is present during any part of project activities, and dewatering is deemed necessary, a dewatering and species protection plan will be developed by the project's biologist. The plan will be developed and implemented as described in the Biological Resources Evaluation recommendations (PCI 2008) by a qualified and permitted biologist. See Appendix E.
- To avoid impacts on aquatic and terrestrial species within the immediate work area, prior to disturbance of the stream channel and removal of vegetation, a qualified biologist will conduct a preconstruction survey to ensure no special-status species are occupying the site. If special-status species are observed within the project site or immediate surroundings, these areas will be avoided until the animal(s) has (have) vacated the area, and/or the animal(s) have been relocated out of the project area by a qualified biologist, upon approval by the regulatory agencies. In addition, the site will be surveyed periodically during construction to ensure that no special-status species are being impacted by construction activities. The biologist will also monitor to ensure water quality standards are being met and sediment and/or debris are not entering downstream aquatic habitats.
- To avoid impacts on special-status and common bat species, prior to the removal of any trees, a qualified biologist will survey for roosting bats. If occupied roosts are identified, removal of the roost trees will not occur until the roost is unoccupied. In addition, construction will be limited to daylight hours to avoid interference with the foraging abilities of bats.

- To avoid potential losses of breeding birds, construction activities will occur outside of the critical breeding period, typically mid-March to mid-August in the Willow Creek area.
- To avoid potential impacts on special-status plants, a focused botanical survey will be completed during the appropriate blooming period for the above-mentioned species. If special-status plants are found occupying the site, avoidance measures will be in place during construction to minimize disturbance (e.g., temporary construction fencing around existing populations).
- If impacts to special status plants are unavoidable, appropriate mitigation measures will be implemented (e.g., seed collection and revegetation). Replacement to disturbance will occur at a 4:1 ratio.
- To avoid impacts to Myrtle's silverspot butterflies and their host plants, the following measures will be taken. Prior to construction, butterflies surveys will be completed within the project area to determine if adults or larvae are present. If adult or larvae are found to be present, additional protection measures may be necessary, and further consultation with U.S. Fish and Wildlife Service will be required. If not found, the following protection measures will be implemented. Existing populations of larval host plants [western dog violet (*Viola adunca*)] will be avoided, as feasible. Plants will be protected through the installation of temporary fencing around all known plants and these areas avoided. If western dog violets are found to be present within the area of impact, they will be transplanted to appropriate habitat off-site. As feasible, adult nectar plants [e.g., coyote mint (*Monardella villosa*), bull thistle (*Cirsium vulgare*)], will be flagged and avoided during construction.
- The project biologist will conduct a preconstruction training session for construction crew members. The training will include a discussion of the sensitive biological resources within the project area and the potential presence of special-status species, special-status species' habitats, protection measures to ensure species are not impacted by project activities, and project boundaries.

MINIMIZATION MEASURE BIO-2

- Hand labor will be used to control exotic and unwanted vegetation. The use of chemical agents and mechanical equipment within the stream channel will be avoided.
- Proper erosion control and other water quality BMPs will be implemented to avoid sedimentation and disturbance into downstream and adjacent aquatic habitats. Work in aquatic habitats will be scheduled to occur during the dry season, with work up on the elevated road surfaces scheduled toward the end of construction when rainfall becomes more probable. When work in wetted areas is necessary, they will be dewatered as described above. An erosion and sediment control plan will be developed and implemented for the project.
- Temporary wildlife exclusionary and tree protection fencing will be installed around the work area in sensitive wetland and riparian habitats to preclude animals from entering the work site once construction has commenced (following the preconstruction survey) and to protect riparian trees during construction activities.
- During vegetation removal, large trees with extensive canopy will be maintained, as feasible, to preserve the existing cover over the stream channel.

MITIGATION MEASURE BIO-3

- Net wetland loss (0.035 acres) will be compensated by wetland restoration elsewhere in the park at a 4:1 ratio through reconnection and enhancement of the old grist mill spring with the Willow Creek floodplain, which provides good quality existing wetland habitat 0.5 mile upstream of the project area.

CULTURAL RESOURCES

MINIMIZATION MEASURE CULT-1

- A preconstruction meeting will be held to acquaint project personnel with the possibility of encountering sensitive cultural resources. Prehistoric resources may include chert or obsidian flakes, projectile points, mortars, and pestles; dark friable soil containing shell and bone dietary debris; heat-affected rock; or human burials. Historic resources may include stone or adobe foundations or walls, structures and remains with square nails, and refuse deposits, often in old wells and privies.
- In the event that previously undocumented cultural resources (including but not limited to dark soil containing shellfish, bone, flaked stone, groundstone, or deposits of historic trash) are encountered during project construction by anyone, the state representative will temporarily halt at that specific location and direct contractors to other project-related tasks. A DPR-qualified archaeologist will record and evaluate the find and work with state representative to implement avoidance, preservation, or recovery measures as appropriate prior to any work resuming at that specific location.
- If the DPR-qualified archaeologist determines that the find(s) are significant, a qualified historian, archaeologist, and/or Native American representative (if appropriate) will monitor all subsurface work including trenching, grading, and excavations in that area. If it is determined, the find indicates a sacred or religious site. Formal consultation with appropriate representatives will occur as necessary.
- In the event that human remains are discovered, work will cease immediately in the area of the find and the project manager/site supervisor will notify the appropriate DPR personnel. Any human remains and/or funerary objects will be left in place. The DPR Sector Superintendent (or authorized representative) will notify the County Coroner, in accordance with §7050.5 of the California Health and Safety Code, and the Native American Heritage Commission (NAHC) will be notified within 24 hours of the discovery if the Coroner determines that the remains are Native American. The NAHC will designate the "Most Likely Descendent" (MLD) of the deceased Native American. The MLD will recommend an appropriate disposition of the remains. If a Native American monitor is on-site at the time of the discovery and that person has been designated the MLD by the NAHC, the monitor will make the recommendation of the appropriate disposition.

GEOLOGY, SOILS, AND HAZARDS

MINIMIZATION MEASURE GEO-1

- Project design will take into account the following geotechnical considerations: weak surface soils to about 2 feet below the existing road, compressible soils to depths of 45 to 48 feet, potentially liquefiable soils, and predicted strong seismic shaking.
- Topsoils containing organic matter will be removed and stockpiled for reuse in landscaping.
- Weak soils will be removed and replaced with engineered fill.

- Fill will be free of organic material, have low expansion potential, and conform to the specifications in the geotechnical report; see Appendix C.
- Seismic design will use Site Class E and all specified seismic design criteria from the geotechnical report.

MINIMIZATION MEASURE GEO-2

- The new bridge will be built on driven piles. The piles will be either 12-inch square precast concrete or 16-inch diameter steel pipe. If other pilings are used, the geotechnical consultants will be contacted for additional design specifications.
- Contractor will adhere to all specifications in the geotechnical report and will contact the geotechnical engineer prior to pile driving to obtain driving criteria based upon the hammer to be used.
- Geotechnical engineers will review project plans and specifications to determine consistency with the geotechnical recommendations.
- A preconstruction meeting will occur between the geotechnical engineer, general contractor, subcontractors, civil engineer, and other members of the design team to address design issues, clarify procedures, and construction coordination.
- Critical construction steps, such as site excavation, fill compaction, and foundation installation, will be monitored by the geotechnical consultants.

HAZARDOUS MATERIALS

MINIMIZATION MEASURE HAZMAT-1

- All equipment will be inspected for leaks immediately prior to the start of construction, and regularly inspected thereafter until equipment is removed from the project site.
- A designated staging area will be identified where equipment refueling may occur. A spill kit will be maintained on-site throughout the duration of the project.
- Equipment will be cleaned and repaired (excepting emergency repairs) in the maintenance shop, away from the project site. Any contaminated water, sludge, spill residue, or other hazardous compounds will be disposed of outside park boundaries at a lawfully permitted or authorized destination.

MINIMIZATION MEASURE HAZMAT-2

- Two alternative routes will be designated by State Parks to allow access during construction.

MINIMIZATION MEASURE HAZMAT-3

- Prior to the beginning of construction, DPR will develop a Project Fire Safety Plan. The Plan will include emergency calling procedures to dispatch the Monte Rio Fire Protection District. All employees working on site will receive safety trainings regarding these procedures.
- Spark arrestors will be required for all motorized equipment.
- Construction crews will be required to park vehicles away from flammable material such as dry grasses and brush.
- DPR staff will be required to have a State Park radio on site, which allows direct contact to a centralized dispatch, CalFire or Russian River Fire Protection District.

HYDROLOGY AND WATER QUALITY

MINIMIZATION MEASURE HYDRO-1

- If the excavation sites must be dewatered, the water will be discharged in a manner that will cause no substantial increase in stream turbidity or discharge of fine sediment to the stream channel.
- All appropriate BMPs will be implemented as needed to ensure that there is no discharge of fine sediment, concrete, concrete wash water, or roiled water to the creek.
- Building materials and/or construction equipment will not be stockpiled or stored where they could be washed into the water or where they will cover aquatic or riparian vegetation.
- Debris, soil, silt, bark, rubbish, creosote-treated wood, raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances resulting from project related activities that could be hazardous to aquatic life will be prevented from contaminating the soil and/or entering the waters of the state. Any of these materials placed within or where they may enter a stream or lake will be removed immediately.
- All debris and waste will be picked up daily and properly disposed of at an appropriate site.

LAND USE PLANNING

No mitigation measures necessary.

MINERAL RESOURCES

No mitigation measures necessary.

NOISE

MINIMIZATION MEASURE NOISE-1

- Construction activities will generally be limited to the daylight hours between Monday and Friday; however, weekend work could be implemented to accelerate construction or address emergency or unforeseen circumstances. If weekend work is necessary, no work will occur on Saturday or Sunday before 8 am or after 7 pm.
- Internal combustion engines used for any purpose at the job site will be equipped with a muffler of a type recommended by the manufacturer.
- Equipment and trucks used for construction will utilize the best available noise control techniques (e.g., engine enclosures, acoustically-attenuating shields, or shrouds, intake silencers, ducts, etc.) whenever feasible and necessary.
- To avoid impacts on special-status and common bat species, prior to the removal of any trees, a qualified biologist will survey for roosting bats. If occupied roosts are identified, removal of the roost trees will not occur until the roost is unoccupied. Construction will be limited to daylight hours to avoid interference with the foraging abilities of bats.
- To avoid potential losses of breeding birds, construction activities will occur outside of the critical breeding period, typically mid-March to mid-August in the Willow Creek area.
- Should work occur during the breeding season a qualified biologist will survey the area to ensure that no nesting activity is occurring in the project area. Should nesting activity be observed the area will be avoided until nesting birds have fledged.

POPULATION AND HOUSING

No mitigation measures necessary.

PUBLIC SERVICES

No mitigation measures necessary.

RECREATION

No mitigation measures necessary.

TRANSPORTATION/TRAFFIC

MINIMIZATION MEASURE TRAFFIC-1

- Project construction will be scheduled after Labor Day.
- Signage will be provided to redirect traffic at logical turnaround areas in advance of the construction zone.

MINIMIZATION MEASURE TRAFFIC-2

- Two alternative routes will be designated by DPR to allow access during construction.

UTILITIES AND SERVICE

No mitigation measures necessary.

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7 REPORT PREPARATION

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APPENDIX A
30% Design and the Preferred Alternative

PRUNUSKE CHATHAM, INC.

Willow Creek Road Second Bridge Area Fish Passage Project: Phase I

Interim Report – 30% Design and the Preferred Alternative

October 2008

Introduction

Willow Creek, a tributary to the lower Russian River, is considered a high priority watershed for California Department of Fish and Game's coho re-stocking program (Coho Salmon: Recovery Strategy for California [DFG 2004]). Viability of the watershed for the coho recovery program is presently limited due to fish passage restrictions related to the County Road in the vicinity of Second Bridge. In spring 2007 the Willow Creek Technical Advisory Committee (TAC) reviewed a range of culvert replacement options to restore fish passage at the Second Bridge roadway. This discussion occurred after it was determined that re-routing the road and removing the Second Bridge floodplain crossing is not feasible. A consensus was reached to design and install a culvert replacement structure at the valley thalweg (west side of the Second Bridge roadway) that will provide for channel development, hydraulic connectivity, fish passage, and at least a 20-50 year lifespan.

Severe channel aggradation in lower Willow Creek in the vicinity of Second Bridge up to Third Bridge has led to abandonment of the historic channel on the east side of the valley. The flow is now concentrated on the west side of the valley where elevations are lowest (Figure 1). The roadway across the valley floor and floodplain at the Second Bridge crossing acts as a low-head dam, trapping streamflow and sediment and restricting fish passage upstream and downstream during spring and winter base-flow conditions. The 24-inch culverts at the west end of the valley crossing are often blocked with debris during annual high flows. The streamflow slows and spreads across the floodplain; overtopping the roadway during most high flows (Figures 2 and 3). This condition does not provide a clear path for upstream salmonid migration. With a lack of channel continuity in this reach, upstream migration by adults and downstream migration by juveniles is severely restricted.

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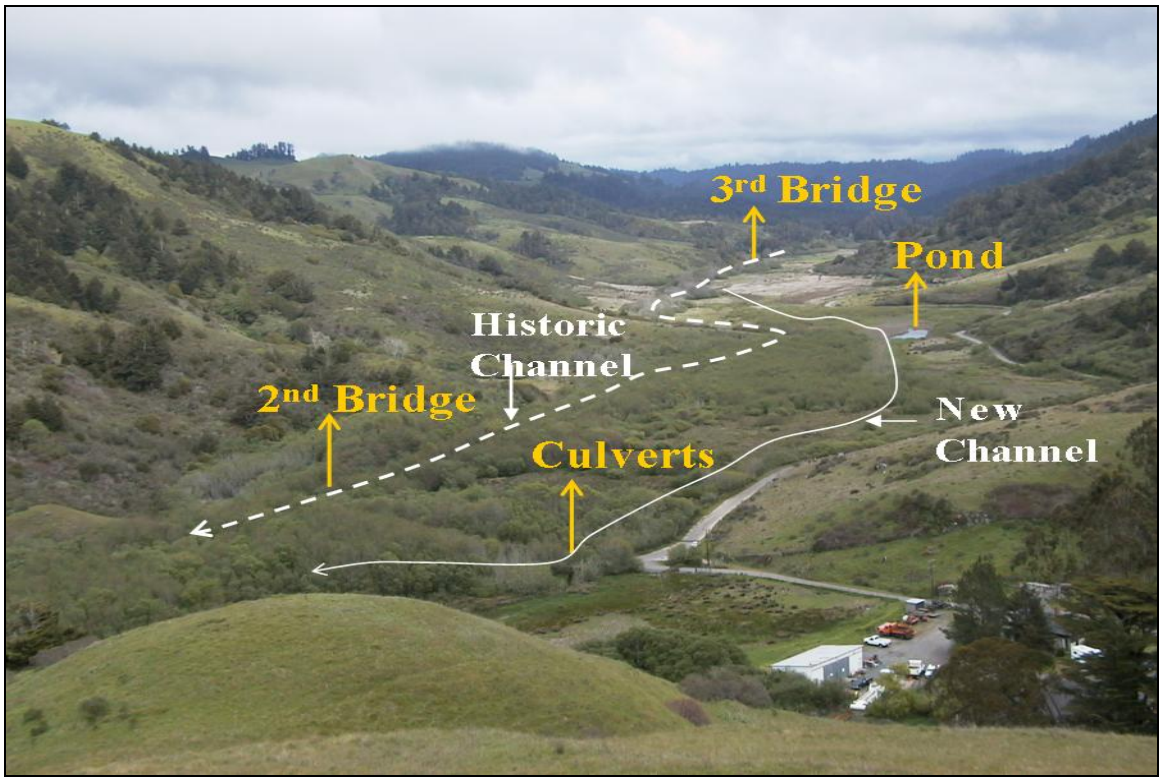

Figure 1. *Lower Willow Creek with features shown that relate to this project (photo looking up the watershed).*

Figure 2*. Aerial view of Second Bridge crossing after high flows on January 28, 2008. Note ponded water at culvert locations and southern approach.*

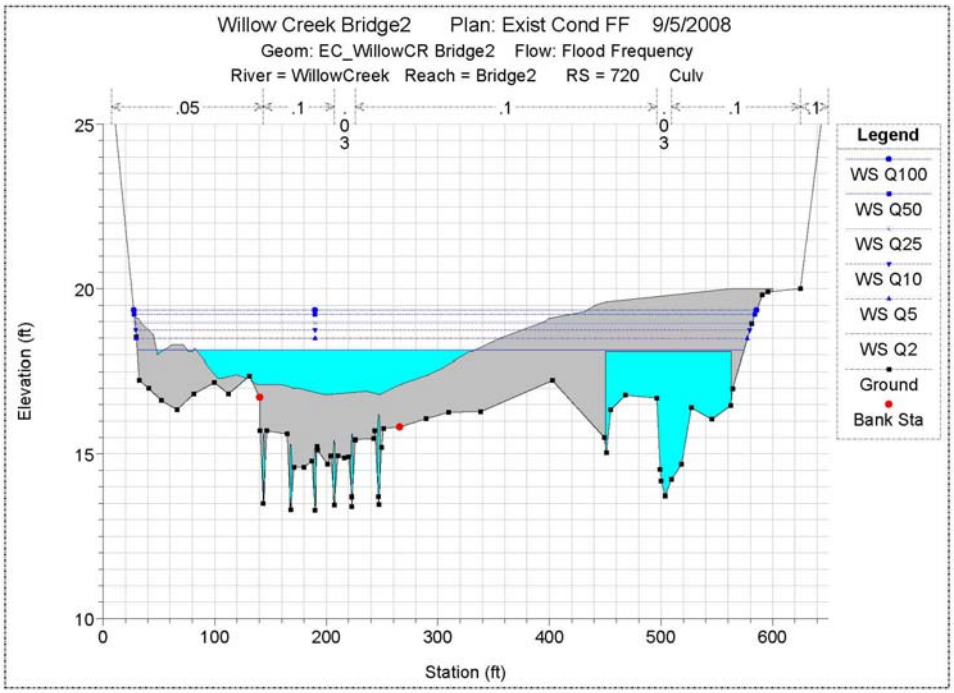

Figure 3. *Hydraulic model results of the existing conditions at the Second Bridge crossing looking downstream at the road (dark grey is the road fill). Note that all flood flows overtop the road at the culverts on left side of the image.*

Multiple options for replacing the culverts were assessed during the 30% design phase of the project including segmented box culverts, pipe arch culverts, arched bottomless culverts, and bridges. This report briefly summarizes the site constraints, the viability of the structure options, and a description of the preferred alternative structure.

Project Site Evaluation and Constraints

The physical features of lower Willow Creek are a result of two landscape forming processes that are described in detail in the report titled Sustainable Channel Development in Lower Willow Creek (PCI 2005). The following are excerpts from this report:

> The first is the approximately 1.5 mile wide San Andreas Fault Zone, comprised of the San Andreas Fault and smaller parallel faults that divide the North American and the Pacific Plates along the coastline (DPR 2004). The active San Andreas Fault sits just offshore at the mouth of the Russian River, with the western side moving northward at a rate of approximately

2 inches per year. Many smaller faults that follow a northwest to southeast orientation split off diagonally from the San Andreas Fault Zone (CDFG 2002). Willow Creek traces an inactive fault contact between the fragmented and sheared Franciscan complex rocks on its south side and a conglomerate member of the Great Valley sequence on its north side (Trihey 1997).

The second large, landscape-shaping Pleistocene event was the Wisconsin stage of the last ice age (15- 20,000 years ago). The ice sheets did not reach into this area; however, during this period, sea level was 350 to 420 feet lower and 10 miles west of its current levels (Imbrie 1979; Parkman 2003). The large coastal rivers would have responded to this sea level lowering by downcutting into the valley floors at an accelerated rate. Tributaries, especially those close to the coast, would also have downcut rapidly in response to the low sea level. As the ice age came to an end and sea levels began to rise, the coastal rivers and tributaries went through a period of rapid deposition. The Russian River filled its valleys with deep deposits of alluvial material comprised of gravel, coarse sand, silt, and clay lenses (PWA 1993). Wells drilled near the mouth of the Russian River penetrate 125 feet of alluvium before reaching the bedrock floor, and at Guerneville the alluvium is 80 feet below sea level (Higgins 1952).

As Willow Creek is only 2.3 miles upstream from the mouth of the Russian River, it would have experienced the greatest degree of downcutting and widening during the lowered sea level conditions. As sea level rose at the end of the last ice age thick deposits of alluvium were deposited in the lower reaches of the Russian River and its tributaries. The lower 3 miles of Willow Creek is a wide, flat alluvial valley formed during depositional conditions such as increased base level and high rates of sediment yield from the watershed.

Geotechnical borings at the project site confirm that the alluvial fill in lower Willow Creek is similar in depth to the alluvium in the Russian River. The borings were drilled to 70 feet without encountering bedrock or coarse material (RGH 2008). Sedimentation of this valley is still occurring (PCI 2005). Stream gradients in the in this section are typically less than 1%. From Third Bridge down to the mouth the average historic channel slope is 0.3%. The channel and valley slopes downstream of second bridge are very low at 0.05%. At the project site the average slope for 500 feet of stream channel centered on the road is 0.3%. These low slopes create slow, subcritical flow conditions through the reach that promote sediment deposition.

Hydrology

The hydrology of the Willow Creek watershed is best described in the Sustainable Channel Development in Lower Willow Creek Report (PCI 2005). Willow Creek flows from an 8.7 square mile watershed into the Russian River. The watershed area at the second bridge crossing is approximately 8.2 square miles.

Streamflow patterns in Willow Creek are typical of small coastal watersheds in temperate climates. Peak flows are flashy and occur during large winter storms, usually in December through March. Between storms, subsurface runoff produces a raised winter base-flow from November through April. The Willow Creek watershed has never been gaged. Several studies have measured individual storm events throughout the watershed, but there has been no regular effort to monitor daily or peak streamflow. The recurrence interval of flood magnitudes has been estimated for Willow Creek in previous studies conducted in 1987 and 1995 using regional stream gaging data. Those data were not used in this analysis because of the high potential error range inherent in the extrapolation methods and assumptions used to produce that data. The flows of interest in this project are the channel forming and maintenance flows and the daily averaged base-flows that are sustained during the fish migration period. Table 1 presents the discharges used in this study to assess channel capacity and flooding potential at the project site under existing and proposed project conditions.

Table 1. *Streamflows used in the hydraulic analysis (HEC-RAS) of proposed project designs.*

Flood Recurrence Interval	Q2	Q5	Q10	Q25	Q50	Q100
Discharge (cfs)	730	1110	1450	1815	2200	2460

Hydraulics

Hydraulic analysis of the existing site conditions indicate that the culverts and road are overtopped when flows are in the range of 200 to 250 cfs, which corresponds to a water surface elevation of 16.9 feet on the upstream side of the culverts, assuming the culverts are in a clean condition. Most of the culverts contain a residual amount of sediment and the inlets are partially occluded with vegetation and debris; causing the culverts to overtop when flow is less than 200 cfs. In general, the road has a tendency to be overtopped at the culverts at least once each year. Preliminary hydraulic analysis of the preferred alternative is presented later in this report.

Geotechnical Considerations

A geotechnical study was conducted as part of the 30% design phase of this project. Refer to the Geotechnical Study Report (RGH 2008) for detailed site analysis and recommendations. The geotechnical analysis indicates that the site soil conditions are complex and limit the feasibility of the structure types available for consideration. Construction materials, consolidation settlement, liquefaction and ground motion during a seismic event, and ground displacement after a seismic event are the primary geotechnical considerations.

Construction materials include considering what soils on site can be used for new fill and spoils that may need to be exported as part of the project. The upper 8 feet of soils on this site consist of clayey gravel that may be reusable as fill. The soft clays and looser sand and gravel below the upper 8 feet are not suitable for engineered fill without supplemental material brought to the site and mixed in. In addition, for all subsurface soils, the moisture content may be excessive and need to be dried back or mixed with drier material.

Approximately 2 feet of material below the existing pavement surface will need to be excavated before new fill can be placed. If any excess excavated material from the project is generated it will have to be disposed of in upland areas or at an approved landfill. The quantity of these materials is determined in final design as part of the grading plan with the preferred structure type.

Consolidation settlement occurs over an initial period of time as the soils settle under the new loads from road fills and structures that are not founded on bedrock. The soils on this site are susceptible to consolidation of up to a few inches. Settlement occurs over time and any maintenance required to adjust the road surface can occur as part of normal wear and tear repairs. Settlement of up to a few inches is not considered significant for either road maintenance or for the hydraulic or channel maintenance performance.

The site is highly susceptible to a seismic event given the underlying geology and proximity to the San Andreas Fault. Both liquefaction and ground motion potential are high and must be considered in the design. Liquefaction prone soils are found throughout the site but in varying thicknesses across the floodplain. The amount of potential movement and settlement is related to the composition and thickness of the sediments. Thus, there is potentially significant differential settlement and lateral movement potential in the project site. This possibility raises concerns of significant uneven ground displacement after an earthquake that would result in impassable road conditions. The design and structure of the culvert replacement should be carefully considered for seismic mitigation.

County Considerations

The current General Plan designates each roadway into one of six functional classifications and establishes design standards for each classification. These standards help streamline the design and right-of-way acquisition process whenever roads are improved. Willow Creek Road is designated as a minor road. Its functional classification is "Local Road" which is to provide access to property and carry local traffic to collector roadways. The standards for a local road are to have 2 travel lanes and a right-of-way width of 50 feet. The pavement width may vary. The current pavement width in the vicinity of the replacement crossing is 20 feet.

The following policies apply to local rural roads:
1) The needed number of travel lanes is usually two but may be one on some remote roadways and some rural bridges.
2) Design local roads for reasonable access by emergency and service vehicles.
3) When practical, locate horizontal and vertical road alignments to correspond to natural topography. Minimize grading.
4) Layout local roads and streets to avoid adverse concentration of stormwater runoff.
5) In agricultural areas, include measures such as road signs, wider shoulders, turnouts or over/under-passes to provide safer highways for the agricultural industry, residents, and visitors.

Due to its location in the coastal zone, the County requested that the culvert replacement structure be composed of concrete, not steel.

Design Criteria

Given the above considerations which can be both constraints and opportunities, the foremost design criteria to follow in the design of a replacement crossing for the culverts are:

- Minimum effective structure span for the channel to allow for natural channel dimensions
- Maximum elevation of the road surface and minimum channel elevation
- Minimum effective flow area for channel formation, maintenance, and fish passage
- Road performance and flooding risk
- Overall project costs including final design, permitting, and construction

The first three criteria in combination generally determine the physical feasibility of a structure type. The minimum effective structure span is considered to be 40 feet. The maximum elevation of the road surface is 25 feet which allows for up to a 4% slope on the road approaches leading up the replacement crossing area. The

minimum channel elevation in the thalweg (lowest elevation in the low flow channel) is a function of the channel slope and downstream elevations. The thalweg elevation approximately 250 feet downstream is 11.8 feet. Using a channel slope of 0.3% and projecting up to the crossing replacement area gives 12.5 feet for the lowest expected channel thalweg elevation. This elevation is not constant along the channel cross section and all natural channels have some elevation complexity such as floodplains. The general floodplain elevation in the vicinity of the replacement crossing is 15.0 feet and is the elevation used in determining the effective channel elevation for flood flow area analysis since the low flow channel makes up only a small percentage of the total cross section area.

The overall project cost criteria is to be least expensive at project completion given that all of the other criteria are met by a particular structure type. The project costs should include final design, permitting, and construction since some structure types may include varying amounts in any of these three categories.

Crossing Structure Type Options and Evaluation
There are multiple structure types that can be considered with varying degrees of risk. The options that are considered suitable for the culverts replacement include segmented embedded box culverts, embedded pipe arches, arched bottomless culverts, and bridges.

Segmented box culverts are side-by-side pre-fabricated concrete boxes that are in segments end-to-end. They are installed by placing them on a bed of conditioned material or suitable subgrade in sections. They typically come pre-fabricated in dimensions that allow for truck transport to the site. The largest single unit span available in pre-cast concrete box culverts is 12 feet. The culvert height can vary between 6 feet and 12 feet for this span length. The box dimension considered for this site is 10 feet by 12 feet (height x span). A series of boxes can be placed side-by-side to make a cumulative effective span and would be considered a culvert system of cells. Embedding the culverts up to 50% of the culvert height relative to the channel elevations allows for a natural channel bed within each set of boxes.

Segmented box culverts will be subjected to potentially significant differential settlement due to liquefaction because the susceptible soils do not extend evenly throughout the area to be improved. In addition, they may not perform well under consolidation settlement because the differential settlement may not only occur end to end of one segment, but side to side. The result of all this is that the road may require constant maintenance due to the movements, and possibly may not be passable after an earthquake.

A thick subgrade and mat slab for the segmented box culverts and a wide border area would be needed to minimize the differential settlement potential. Construction of the mat slab would require significant site prep, groundwater pumping, and concrete set time in the saturated alluvial soils; increasing the construction period, costs, and resource impacts.

Another disadvantage of using side-by-side culverts as a system of cells for a cumulative effective span and channel width is that the intermediate structural parts of the system on the upstream face can trap debris at flood flows, reduce conveyance, and alter the channel morphology. A common occurrence is that the low flow channel becomes discontinuous along the length of the culverts and floodplain functions are not consistent.

Pipe arch culverts are pre-fabricated metal pipes that are "squashed to make them wider than they are tall. They are also installed by placing them on a bed of conditioned material or suitable subgrade. The largest pipe arch dimensions considered for this site is 15 feet by 22 feet (height x span). A series of pipe arches can be placed side-by-side to make a cumulative effective span and would be considered a culvert system of cells. Embedding the culverts up to 40% of the culvert height relative to the channel elevations allows for a natural channel bed within each set of pipes. Pipe arches require a minimum amount of cover over the top as engineered fill depending on the span. For a span of 22 feet a minimum cover of 3 feet is required. Compared to other structure options that either incorporate the road bed or require minimal cover the 3 foot cover considerably increases the road height and associated fill for the approaches.

The geotechnical constraints, construction constraints, and conveyance issues associated with the segmented box culverts apply to the pipe arch culverts. In addition, the County would prefer a concrete structure to maximize lifespan in the coastal environment.

Arched bottomless culverts are either metal or concrete sections mounted on side strip footings or a base slab. The side strip footings allow for a natural channel between them. A base mat slab would need to be embedded below the lowest anticipated channel scour elevation to allow for a natural channel on top of it or the side strip footings need to be mounted on a pile cap. The span of channel for the arch depends on the arch geometry. Concrete arch geometries are best where there is a lot of fill over the top and room to rise above the channel. Metal arches are more suitable for low-rise configurations. All arches typically require a minimum of 2 feet of engineered fill over the top as part of a critical back fill zone that ensures structural integrity. The largest concrete arch span is 60 feet with a height of 12 feet. There are many smaller combinations of these arches with varying height to span ratios.

Based on the geotechnical constraints and the site limitations a concrete arched bottomless culvert would need to be supported by a concrete footing supported by driven piles. The effective flow area of the structure is limited by the arched form, which reduces conveyance during high flows. The 2 feet of engineered fill required will increase road height and associated road fill.

Bridges suitable for this site are either pre-cast or poured-on-site concrete, single-span, pile supported. The other types of bridge options include girder bridges, truss bridges, and suspension bridges. Girder bridges are not considered viable at this location due to the girder thickness that is likely required for a significant span which can occlude flow area. For example, the third bridge on Willow Creek Road is a girder bridge with a span of 58.5 feet and girder thickness of 3 feet. Truss and suspension bridges are not considered for this site due to the large amount of flow-occluding superstructure that would be required for a significant span.

There are two options for bridge footings: spread-footing supported and pile supported. The spread-footing supported bridge should settle relatively evenly under consolidation settlement and could be designed to allow flexibility along the length. However, the bridge may not perform well if differential settlement occurs along the diagonal axis, which is possible at this site because of the variability of the subsurface material. To reduce the impacts of settlement on the structure, a bridge needs to be supported on driven piles.

As span lengths increase so does bridge deck thickness. To minimize road elevations, and thus road fill, an ideal deck thickness is 1 foot. A maximum bridge span with 1 foot deck is 48 feet.

Preferred Crossing Structure Type

Based on the evaluation of the crossing structure types a pre-cast, single-span bridge was chosen as the preferred crossing structure at the Willow Creek culvert replacement site. Construction costs for pre-cast concrete bridges are similar to concrete arched culverts. A bridge is preferred over an arched open-bottom culvert because of its greater channel capacity for a given base width and that it does not require additional fill (up to 2') on top of the structure for the road base.

Pacific Bridge out of Sandy, Oregon designs and constructs pre-cast bridges for culvert replacement projects (see photos below for examples). A standard maximum free span width of this type of bridge is 43 feet with 2.5 foot abutments on either side.

Photos courtesy of Pacific Bridge, 2008

Preliminary design details for the 90% design (construction bid ready) for a bridge of the type shown above, include:

- A bridge opening width of 43 feet,
- A bridge deck width of at least existing pavement width (20 feet),
- A bridge deck at an elevation of 20 feet NGVD,
- The bridge abutments supported by driven pipe piles,
- The bridge approaches graded to meet existing bridge elevation on the eastern approach and the 18 foot road contour on the western approach, and
- The channel thalweg at 12.5 feet.

Hydraulic analysis of these design parameters indicate that the Second Bridge Crossing and approaches will not be submerged during design high-flow events (Figure 4). This analysis does not take into account potential backwater effects from the Russian River.

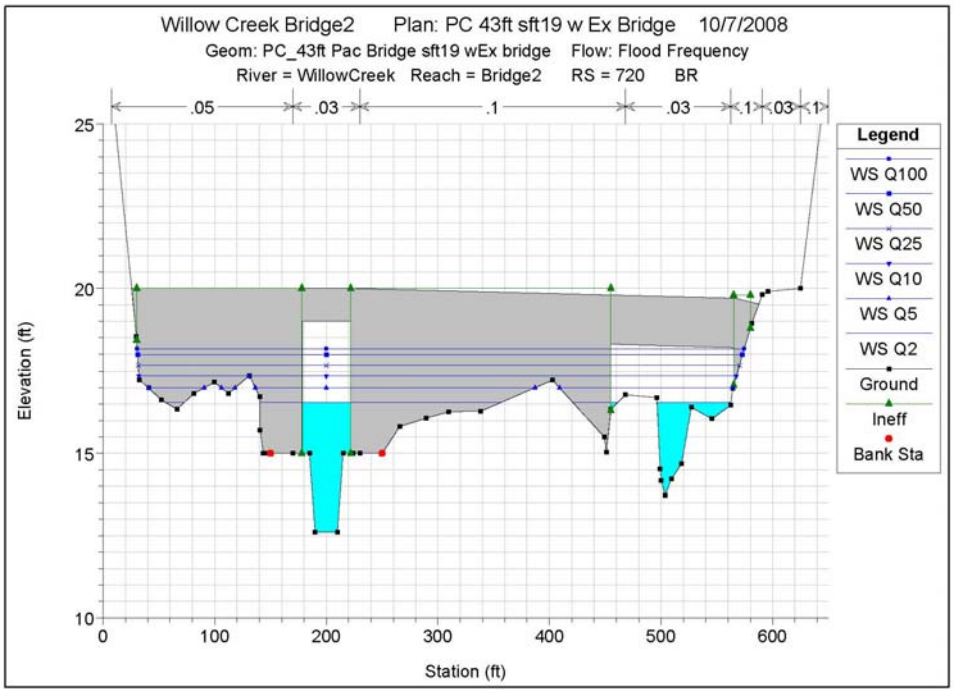

Figure 4*. Hydraulic model results of the preferred structure at the Second Bridge crossing looking downstream at the road (dark grey is the road fill). Note that all flood flows are contained within the channel and floodplain, and they do not overtop the roadway.*

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APPENDIX B
Project Plans and Specifications

WILLOW CREEK ROAD 2ND BRIDGE FISH PASSAGE PROJECT

SPONSORED BY

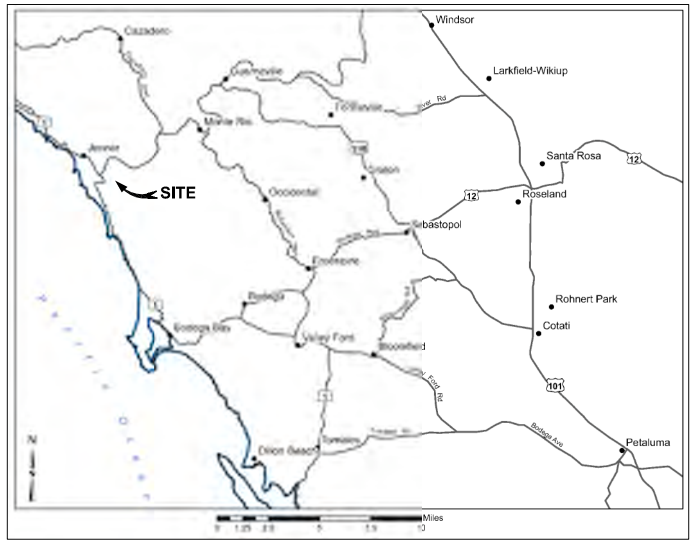
STATE COASTAL CONSERVANCY

IN PARTNERSHIP WITH

STEWARDS OF THE COAST AND REDWOODS

CALIFORNIA STATE PARKS

SONOMA COUNTY DEPARTMENT OF TRANSPORTATION AND PUBLIC WORKS

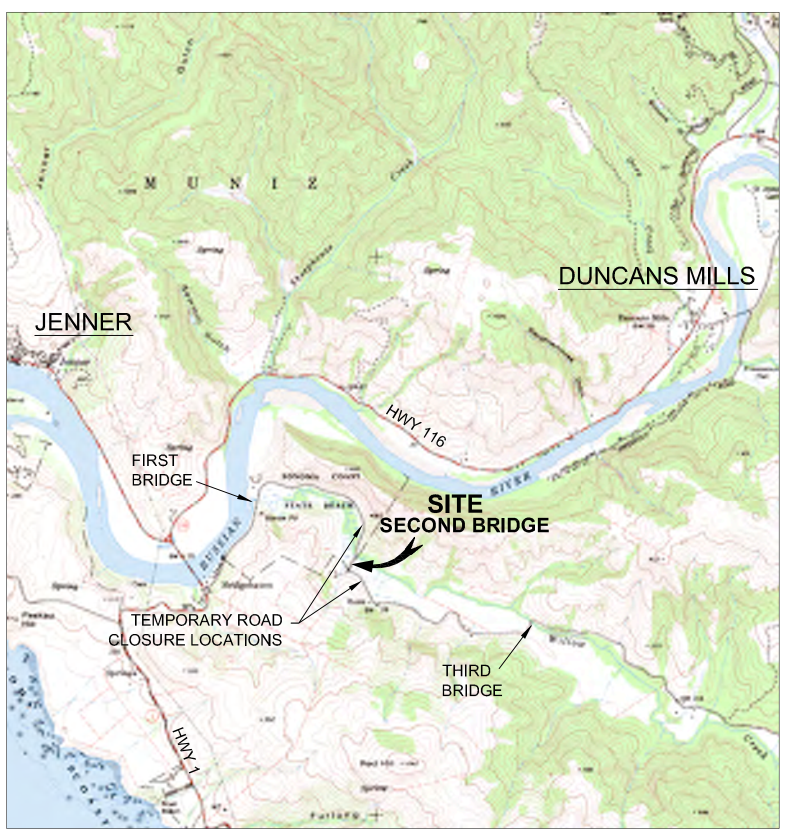


VICINITY MAP

AS SHOWN

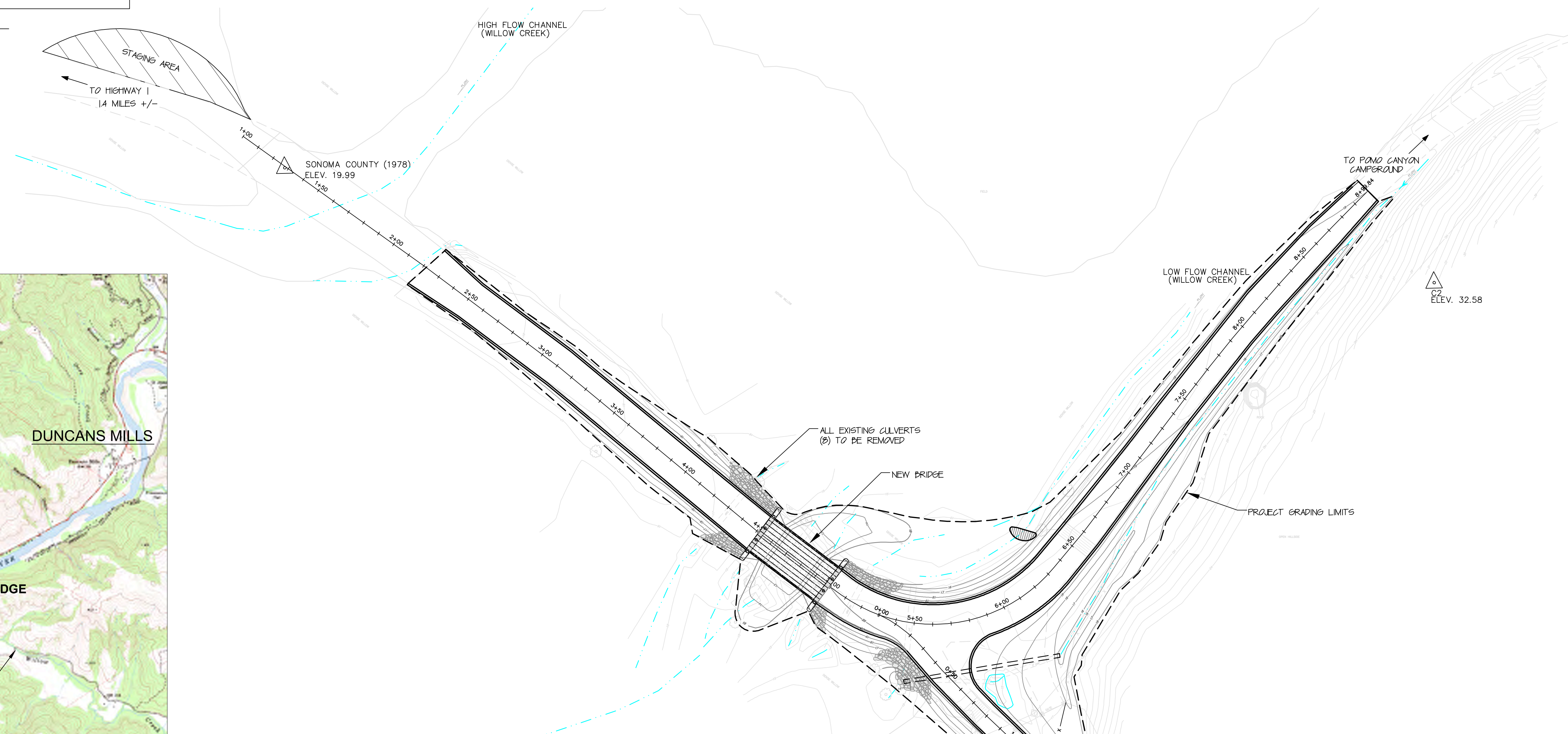
SHEET NO.	TITLE
1	TITLE SHEET, LOCATION MAPS, SHEET INDEX
2	CONSTRUCTION NOTES
3	STA 1+00 - 4+00 PLAN AND PROFILE
4	STA 4+00 - 6+00 PLAN AND PROFILE
5	STA 6+00 - 9+00 PLAN AND PROFILE
6	TYPICAL SECTIONS AND MAINTENANCE ROAD PROFILE
7	CROSS SECTIONS
8	DETAILS

SHEET INDEX



LOCATION MAP

USGS QUADRANGLE 7.5 SERIES
DUNCAN'S MILLS, CA
SCALE: 1" = 2500'



SITE MAP

SCALE = 1" = 30'

NOTE:
THIS DRAWING REDUCED TO APPROXIMATELY 1/2 SCALE

80% SUBMITTAL
NOT FOR CONSTRUCTION

PRUNUSKE CHATHAM, INC.
400 MORRIS STREET, SUITE G
SEBASTOPOL, CA 95472
(707) 824-4600

REGISTERED PROFESSIONAL ENGINEER — JONATHON A. MANN — No. C 63782 — Exp. 9/30/10 — CIVIL — STATE OF CALIFORNIA

DATE: 01/07/09
SCALE: AS SHOWN
DESIGNED BY: LW, DR
DRAFTED BY: LW, AQ
CHECKED BY: JMANN

REVISIONS	DATE	BY

PREPARED FOR:
Stewards of the Coast and Redwoods & California State Parks Duncans Mills, CA

Willow Creek Road 2nd Bridge Area Fish Passage Project Title Sheet

SHEET 1 OF 8

GENERAL CONSTRUCTION NOTES:

A. LEGAL

A1. Construction Contractor shall assume sole and complete responsibility for job site conditions during the course of construction of the project, including safety of all persons and property. This requirement shall be made to apply continuously and not be limited to normal working hours. Construction Contractor shall hold harmless, indemnify and defend the Owner, the Project Designer and their consultants, and each of their officers, employees, and agents.

B. INSPECTION / OVERSIGHT

B1. Project Designer from Prunuske Chatham, Inc., shall inspect construction shown hereon. Contractor to meet with Project Designer and Owner Representative before commencing construction to determine inspection points that require approval before continuing work.

B2. A pre-construction site meeting will be held w/ Contractor, Grading Inspector, Project Designer, Geotechnical Engineer and Owner Representative to discuss construction methods, schedule and inspections.

B3. For site work Project Designer shall inspect and approve: 1. All grade staking prior to construction. 2. After excavation before geotextile fabric placement. 3. After geotextile fabric placement before rock placement. 4. After excavation during compaction of fills and backfills. 5. After rock placement before revegetation/seeding/mulching and erosion blanket. 6. At job completion.

B4. For bridge work Project Designer shall inspect and approve: 1. Foundation Construction. 2. Bridge abutments prior to attachment of bridge deck and backfilling. 3. After placement of bridge deck.

B5. The Project Designer shall approve all rock before placement.

C. GENERAL CONDITIONS

C1. Construction staging areas and temporary access to be coordinated with Owner Representative and Project Designer prior to construction. Staging will occur within project area on north side of creek and as approved by Owner Representative and Project Designer.

C2. Prior to construction, the Contractor is responsible for determining locations of all existing underground utilities through coordination with the property owner, Underground Service Alert, and the various utility companies.

C3. It is expected that the construction area will be dry. In the case that water is present the contractor must provide a water diversion and control plan to be approved by the Project Designer and Owner Representative.

C4. Contractor shall coordinate with the Owner Representative to locate pipes and utilities in field. Locations of pipes encountered during construction shall be documented to the Owner Representative. Cut pipes shall be capped in place and marked in field for recovery and reconditioning by the Owner Representative. Contractor shall coordinate work with recovery of utilities.

C5. All existing vegetation outside of the project limits will be left undisturbed.

C6. Short-term erosion control shall consist of stockpiling soil or other material in areas where it will not be washed into the stream. If rain should occur while the soil is temporarily stockpiled, the stockpiled soil will be covered with plastic. The plastic will be secured in place to insure that soil is protected from rain and wind. Silt fencing or wattles shall be installed on contour around all stockpile locations.

C7. No work shall commence prior to 7am except in an emergency.

D. CONSTRUCTION NOTES

D1. All rock shall be of sound quality, free of cracks, of sufficient durability, and not contain swelling type clay. All rock shall conform to CALTRANS Standard Specifications Section 72-2.02, Materials, for all material qualities, such as but not limited to, durability, absorption, and apparent specific gravity (CALTRANS Standard Specifications, 2006).

D2. Compact fill in 6" lifts with 90% relative compaction, unless otherwise noted.

D3. All rock shall have Mirafi 1100N filter fabric installed between soil and rock. Alternate fabric may be approved by Project Designer in advance of construction.

D4. Begin constructing rock at bottom of slope to insure rock is stable.

D5. All disturbed soil area to be seeded and mulched. (See seed/mulch specification below).

D6. All graded slopes not covered by rock shall be covered with coir erosion control blanket (North American Green C125BN).
Install seed prior to erosion control blanket. Blanket to be pinned w/12" or 18" soil pins 2' on center with triangular spacing.

D7. Contractor shall use temporary dewatering systems to control minor surface flow from ground water seeps through work area. Unless otherwise arranged, Contractor is responsible for the design, operation, and maintenance of any required temporary dewatering system

D8. Contractor to grade stake site.

D9. Contractor shall install straw wattles on graded slopes and disturbed areas where vegetation has been removed or on temporary access roads at the end of the job as needed. Contractor to coordinate with project designer on location of wattles.

D11. Contractor is responsible for identifying and preserving any utilities encountered during construction.

E. ENVIRONMENTALLY SENSITIVE AREAS AND CULTRUAL RESOURCES

This construction site is considered an environmentally sensitive area. The Contractor shall take all precautions and utilize all measures necessary to protect the environmental integrity of the site, including but not limited to the protection of plant, animal, and aquatic life. The following is an integral aspect of this construction project:

E1. All vehicles and equipment on the site must not leak any type of hazardous materials such as oil, hydraulic fluid, or fuel. Vehicles and equipment must be inspected and approved by Owner Representative before use. Fueling shall take place outside of the riparian corridor.

E2. Contractor shall have emergency spill clean up gear (spill containment and absorption materials) and fire equipment available on site at all times. These items are to be reviewed by Owner Representatation before construction begins.

E3. Access to the site must be reviewed with the Owner Representative Project Designer. Exact location of access way, number of trips planned, and type of vehicles used shall be submitted prior to construction start up & approved by Owner Representative and Project Designer. Contractor shall be responsible for repairing, at his own cost above and beyond the scope of work, any damage to property caused by access not approved by the Owner Representative and Project Designer.

E4. Trash, litter, construction debris, cigarette butts, etc., must be stored in designated area approved by the Owner Representative or removed from the site at the end of each working day. Upon completion of work, Contractor is responsible for removing all debris to the satisfaction of the Owner Representative.

E5. Construction personnel shall be briefed about the potential to uncover prehistoric resources, including chert or obsidian flakes, projectile points, mortars and pestles, dark friable soil containing shell and bone dietary, heat-affected rock, or human burials, as well as historic resources such as stone or adobe foundations or walls, structures and remains with square nails, and refuse deposits or bottle dumps. Construction personnel shall be instructed to avoid areas containing potential cultural resources and that collection of cultural resources is forbidden.

E6. Should potential cultural resources be discovered, work will be discontinued until the area can be evaluated by a qualified archaeologist. If human remains are encountered, all work must stop in the immediate vicinity of the discovered remains, and the County Coroner and a qualified archaeologist must be notified immediately so that an evaluation can be performed. If the remains are deemed to be Native American and prehistoric, the Native American Heritage Commission must be contacted by the Coroner so that a "Most Likely Descendant" can be designated.

PERMITTING QUANTITIES:

Total project area = 0.85 acres
Total disturbed area = 0.85 acres (100% total area)
Percent impervious before / after construction = 40% / 40.2%

CONSTRUCTION QUANTITIES:

Total Cut = 2100 c.y.
Total Fill (select fill) = 2500 c.y.
Existing AC to Remove = 120 c.y.
Aggregate Road Base = 400 c.y.
Asphalt = 140 c.y
Rock Fill (1/4 ton) = 25 tons
Rock Fill (No. 1 Backing) = 140 tons
Class 2 Perm Fill = 8 tons
Chinking Rock Fill = 3 tons

SPOIL SPECIFICATIONS:

1. Soil not used for engineered (select) fills will be considered spoils.

2. Spoils to be hauled offsite to facility or location approved by Project Designer.

3. Approximate Spoils = 200 c.y.
(assuming 10% of cut value)

4. Excavated asphalt to be hauled to approved recycling plant.

5. Removed culverts to be hauled to Owner Representative approved location.

NOTE:

Construction quantities shown are approximate.
It is the Contractor's responsibility to determine proper earthwork and rock quantities.

F. SEED, MULCH AND HYDRO MULCH SPECIFICATIONS

TO BE DETERMINED

G. GRADING NOTES

G1. All grading shall be in conformance with the geotechnical report by RGH Consultants, Inc. dated May 9, 2008.

G2. Areas to be graded should be stripped of the upper few inches of soil containing organic matter. Actual stripping depth should be determined by a representative of the geotechnical engineer in the field at the time of stripping. The stripping should be removed from the site, or if suitable, stockpiled for re-use as topsoil in landscaping.

G3. In fill areas, the weak surface soils should be excavated to a depth of approximately two feet below the existing ground surface and should extend at least three feet beyond the edge of pavements. The excavated materials should be removed from the site, or if suitable, stockpiled for re-use as compacted fill.

G4. In general, imported fill should be select. Select fill should be free of organic matter, have a low expansion potential and conform to the following requirements:

		PERCENT PASSING
Liquid Limit - 40% Maximum	SIEVE SIZE	(by dry weight)
Plasticity Index - 15% Maximum	6 in	100
R-value - 20 Minimum	4 in	90-100
	No. 200	10-60

G5. Contractor is responsible for submitting, at least 72 hours (3 days) in advance of its intended use, samples of the proposed import materials for laboratory testing and approval by the geotechnical engineer.

G6. The surface exposed by stripping and removal of weak surface soils should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to near optimum and properly compacted to at least 90 percent of the maximum dry density of the materials as determined by ASTM Test Method D-1557. Approved fill materials should then be spread in thin lifts, moisture conditioned and compacted to at least 90 percent relative compaction unless otherwise specified.

G7. In general and where not specified on the plans, fill slopes should be constructed at slope gradients of 2:1 (horizontal to vertical) or flatter.

G8. Graded areas with slopes 3:1 or steeper shall have North American Green C125 BN erosion control blanket installed.

G9. Unless approved by the Owner Representative, significant trees (diameter greater than 6") shall be protected in place. Any grading or fill shall be placed around the base of a significant tree.

H. ROADWAY SPECIFICATION

H1. All road material and material placement shall conform to Caltrans standard specifications.

H2. All pavement shall have a minimum select fill thickness of 1 foot, a class 2 aggregate base of 0.75 feet, and an asphalt thickness of 0.25 feet.

H3. Prior to placement of aggregate base, the upper 6 inches of the pavement subgrade soils should be scarified, uniformly moisture-conditioned to near optimum, and compacted to a least 95 percent relative compaction to form a firm, non-yielding surface.

H4. Aggregate used for the base course shall comply with the minimum requirements specified in Caltrans Standard Specifications, Section 26 for Class 2 Aggregate Base.

H5. The suitability of on-site soils for use as select fill should be verified during grading and approved by the Geotechnical Engineer prior to use (See G4).

I. BRIDGE SPECIFICATION

I1. A prefabricated concrete bridge with prefabricated abutments shall be designed by others and delivered to site. Bridge detail drawings are in a separate drawing set. Bridge design geometry shall be assumed current. Bridge detail drawings by others shall supersede in the case of a conflict.

I2. Contractor shall install prefabricated concrete bridge and prefabricated abutments according to bridge detail drawings.

I3. Contractor shall coordinate with bridge manufacturer and property owners to unload and stage bridge materials.

I4. A representative of the bridge manufacturer shall be on site during installation. Representative of bridge manufacturer and Project Designer shall approve bridge installation (see note B4, this sheet).

J. TRAFFIC CONTROL

J1. CA State Parks to close road for construction and secure alternative access. Closure is after Labor Day for duration of project.

K. HORIZONTAL AND VERTICAL CONTROL

K1. Topography based on ground survey by PCI in March 2008.+

K2. Vertical datum is NGVD 1929. Based on PCI survey on Sonoma County benchmark located on existing bridge.

K3. Horizontal datum is approximately California State Plane, Zone 2, NAD 83, Feet. Alignment based on correlation of total station survey to data from GPS.

NOTE:
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SCALE: NONE
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DRAFTED BY: LW
CHECKED BY: J MANN

REVISIONS	DATE	BY

PREPARED FOR:
Stewards of the Coast and Redwoods & California State Parks
Duncans Mills, CA

Willow Creek Road 2nd Bridge Fish Passage Project Construction Notes

SHEET 2 OF 8

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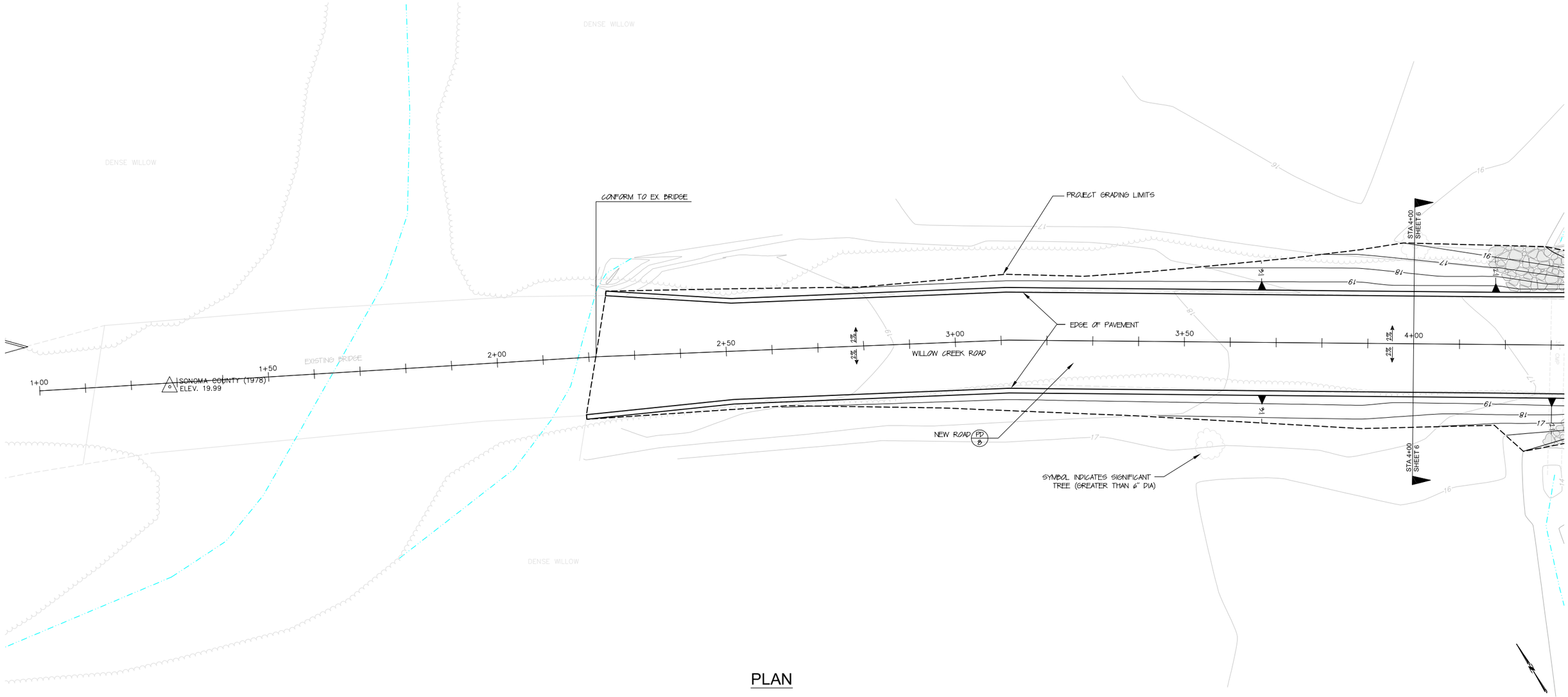
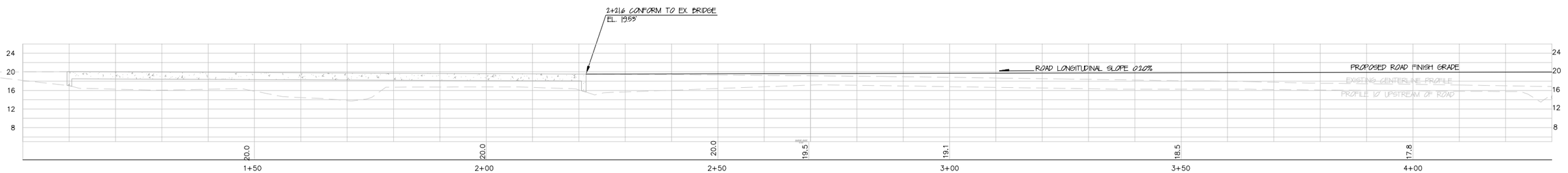


PLAN



PROFILE

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Duncans Mills, CA

Willow Creek Road 2nd Bridge Area Fish Passage Project
Station 1+00 - 4+00 Plan & Profiile

SHEET 3 OF 8

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PROJECT GRADING LIMITS

¼ TON ROCK TO BE BACKFILLED 3' THICK X 3' WIDE BEHIND ALL ABUTMENTS

(CO B) SEE ROCK SLOPE PROTECTION DETAIL

CALTRANS NO. 1 BACKING TO BE PLACED 18" THICK ON SLOPES STEEPER THAN 2:1 ±

LIVE FASCINE DIVERSION BERM (PP B)

NEW ROAD (PP B)

PT = 6+34.59

(CH B) DRAINAGE CHANNEL

EXISTING EDGE OF PAVEMENT

APPROXIMATELY 10:1 SLOPE GRASSED AREA

EXISTING GATE TO BE REMOVED

UTILITY POLE PROTECT IN PLACE

EXISTING DRAINAGE CULVERTS TO BE REMOVED

NEW FENCING BY OTHERS

C1 ELEV. 28.10

EDGE OF PAVEMENT

PC = 5+40.232

PC = 0+00.533

STA 4+00 SHEET 6

STA 0+80 SHEET 6

WILLOW CREEK ROAD

NEW CULVERT 18" DIA X 85' LONG (CO B)

EXISTING FENCE TO BE REMOVED

EXISTING CATTLE GRATE TO BE REMOVED

EXISTING GATE TO BE RELOCATED AT CONFORM

CONFORM STA 4+20

ALL EXISTING CULVERTS TO BE REMOVED

PRESTRESSED PRECAST CONCRETE PLANK BRIDGE DECK ELEVATION AT 20.0

EXCAVATE AND REMOVE BED MATERIAL UNDER NEW BRIDGE TO EL. 12.6

DENSE WILLOW

PLAN

1' THICK x 48' LONG PRESTRESSED PRECAST CONCRETE PLANKS

6" CURB

STA 4+51.41 ELEVATION 20.0

STA 4+99.41 ELEVATION 20.0

EXISTING CULVERTS TO BE REMOVED

PROPOSED ROAD FINISH GRADE

EXISTING CENTERLINE PROFILE

PROFILE TO UPSTREAM OF ROAD

ROAD LONGITUDINAL SLOPE 0.50%

ABUTMENT BLOCKS

CONCRETE PILE CAP

FG CHANNEL ELEVATION 12.6

STA 5+30.66 JUNCTION TO PARK MAINTENANCE ROAD

16" DIA x 70' DEEP STEEL PILE (PRELIM. ESTIMATE)

EXISTING CATTLE GRATE TO BE REMOVED

PROFILE

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DRAFTED BY: LW
CHECKED BY: JMANN

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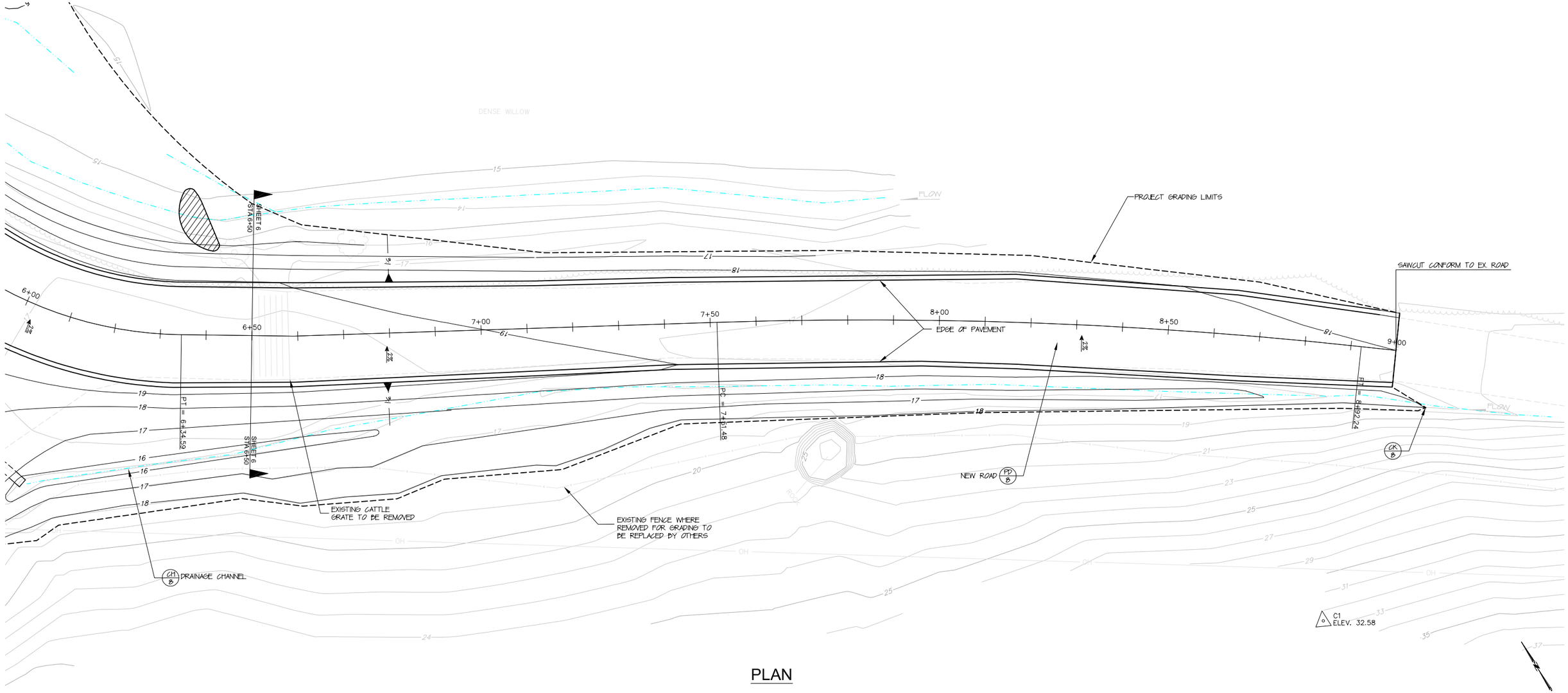
PREPARED FOR:
Stewards of the Coast and Redwoods & California State Parks
Duncans Mills, CA

Willow Creek Road 2nd Bridge Area Fish Passage Project
Station 4+00 - 6+00 Plan & Profiile

SHEET 4 OF 8



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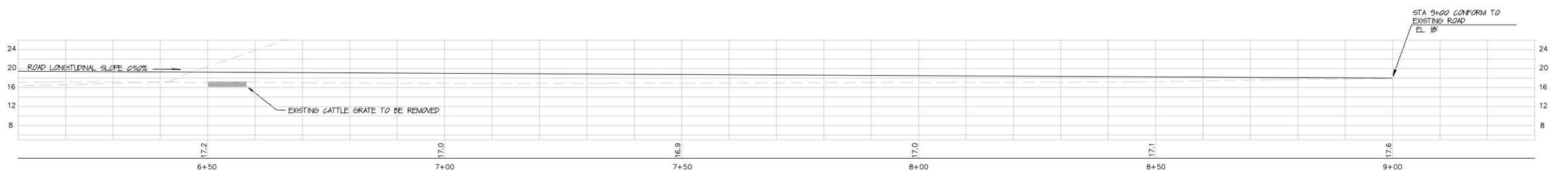

PROFILE

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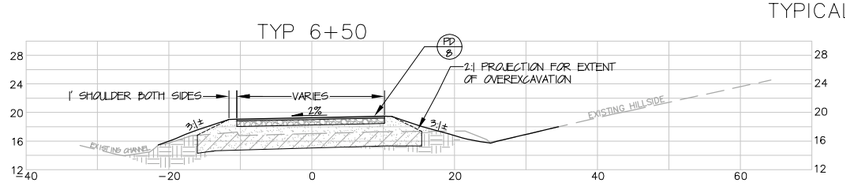
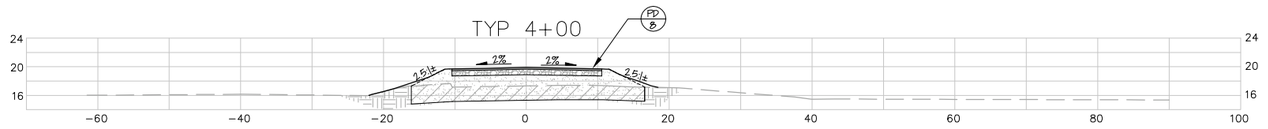
Duncans Mills, CA

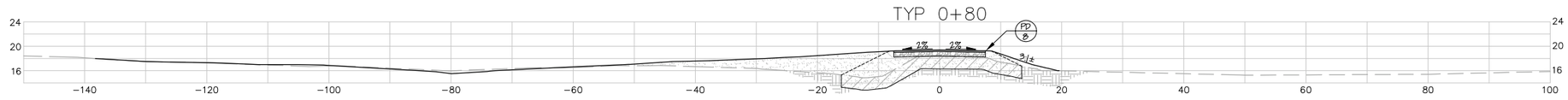
Willow Creek Road 2nd Bridge Area Fish Passage Project
Station 6+00 - 9+00 Plan & Profiile

SHEET
5
OF 8

TYPICAL SECTIONS







ASPHALT - THICKNESS 0.25'

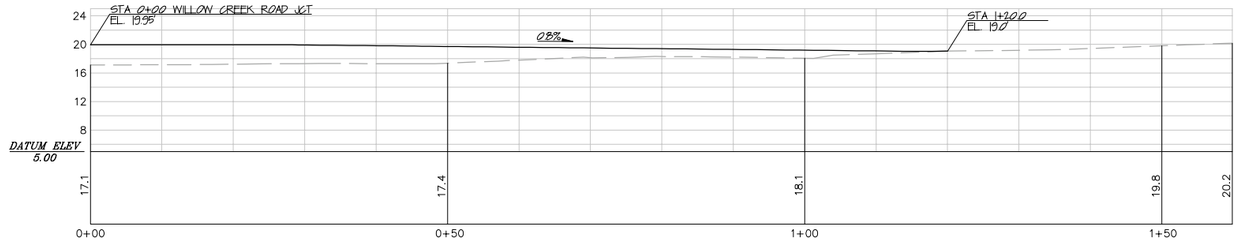
CLASS 2 AGGREGATE - THICKNESS 0.75'

SELECT FILL - MINIMUM THICKNESS 1.0'

OVEREXCAVATION - MINIMUM DEPTH 2.0' FROM EXISTING GROUND SURFACE

EXISTING GROUND

STATE PARK MAINTENANCE ROAD PROFILE



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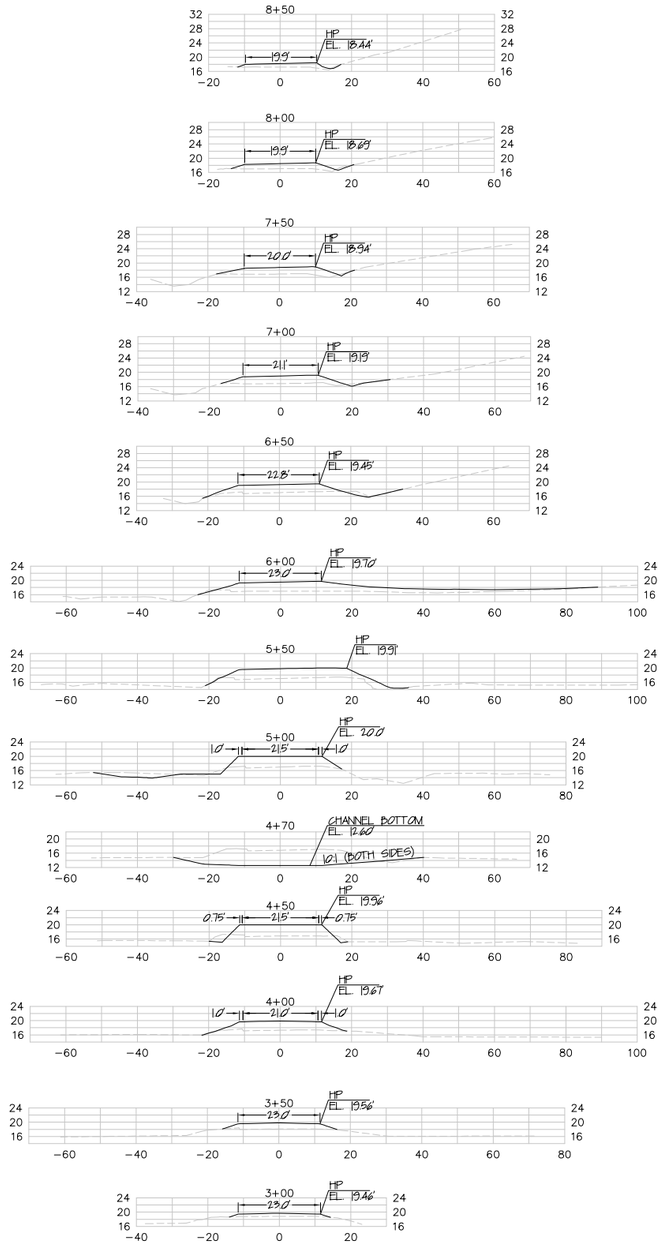
Duncans Mills, CA

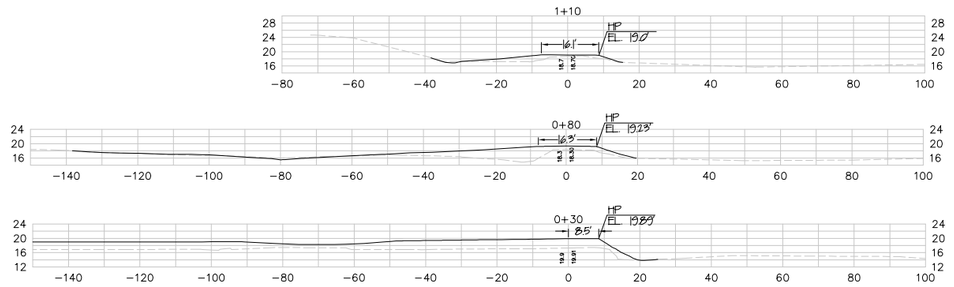
Willow Creek Road 2nd Bridge Fish Passage Project
Typical Sections & Maintenance Road Profile

SHEET 6 OF 8

WILLOW CREEK ROAD ALIGNMENT



WILLOW CREEK SHOP ROAD ALIGNMENT



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CHECKED BY: JMANN

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PREPARED FOR:
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& California State Parks
Duncans Mills, CA

Willow Creek Road 2nd Bridge Fish Passage Project Cross Sections

SHEET
7
OF 8

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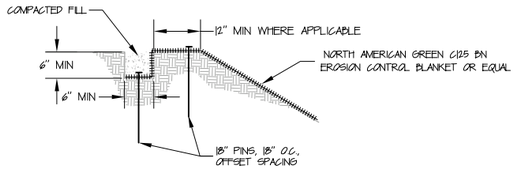
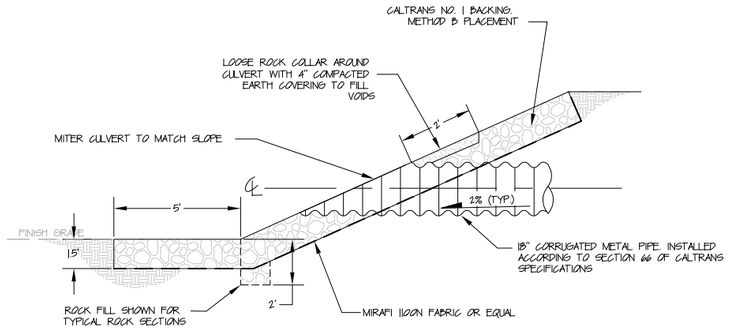
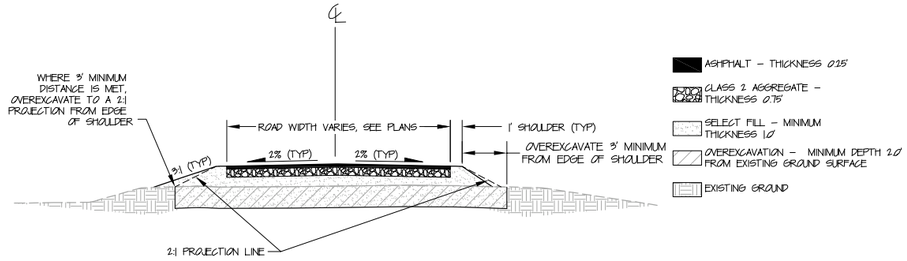


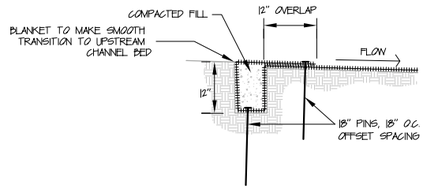
SK - **SLOPE KEY DETAIL**
(TOP OF SLOPE)



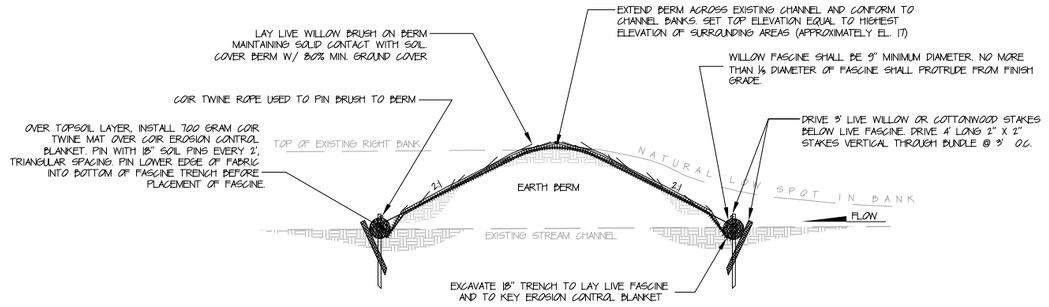
CO - **CULVERT OUTFALL DETAIL - ROCK SLOPE PROTECTION**
NTS



PD - **PAVING DETAILS**
NTS

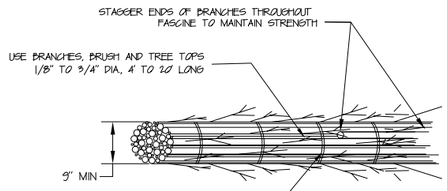


CK - **CHANNEL KEY DETAIL**
NTS



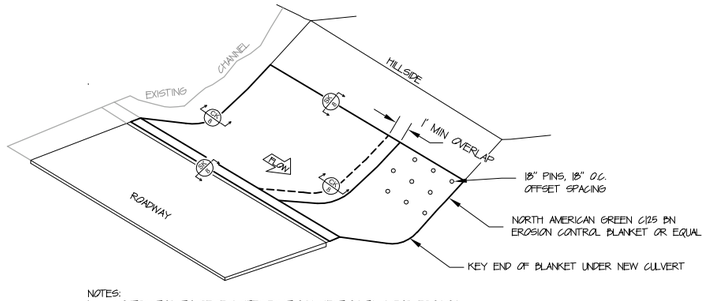
SECTION

DB - **DIVERSION BERM DETAIL**
NTS



LIVE FASCINE

NOTES:
1. OVERLAP FASCINE BY 12" AT ALL JOINTS BETWEEN INDIVIDUAL BUNDLES.
2. OPTIONAL: INSTALL BRANCHES WITH NODES IN THE SAME DIRECTION FOR EASIER BUNDLE CONSTRUCTION.
3. BERM TO BE LEFT IN PLACE AT COMPLETION OF PROJECT.



NOTES:
1. CONTRACTOR TO REVIEW SPECIFICATIONS SECTION 72-4 FOR EROSION CONTROL BLANKET INSTALLATION, CONSTRUCTION SEQUENCING AND MATERIALS.
2. PREPARE SOIL BEFORE BLANKET INSTALLATION INCLUDING COMPACTION, SCARIFICATION, AND SEED APPLICATION.

CH - **DRAINAGE CHANNEL DETAIL**
NTS

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DRAFTED BY: LW
CHECKED BY: JMANN

REVISIONS	DATE	BY

PREPARED FOR:
Stewards of the Coast and Redwoods
Duncans Mills, Ca

Willow Creek Road 2nd Bridge
Fish Passage Project
Detail Sheet

SHEET 8 OF 8

APPENDIX C
Geotechnical Study Report

R G H

CONSULTANTS, INC.

GEOTECHNICAL STUDY REPORT

WILLOW CREEK ROAD 2ND BRIDGE CROSSING
WILLOW CREEK ROAD
SONOMA COUNTY, CALIFORNIA

Project Number:
2601.01.04.1

Prepared For:

Stewards of the Coast and Redwoods
Attn: Michele Luna
P.O. Box 2
Duncans Mills, California 95430

Prepared By:

RGH Consultants, Inc.
Santa Rosa Office
1305 North Dutton Avenue
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Tonya L. Johnson
Staff Engineer

Eric G. Chase
Geotechnical Engineer – 2628

Reviewed by:
Jared J. Pratt
Certified Engineering Geologist – 2453

May 9, 2008

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

INTRODUCTION

This report presents the results of our geotechnical study for the Willow Creek Road 2nd Bridge project to be constructed on Willow Creek Road in Sonoma County, California. Willow Creek Road is a paved County of Sonoma roadway. The planned bridge location is approximately 1 mile east (measured along the road) of the intersection of Willow Creek Road and Highway 1. Six corrugated metal culverts are located below the existing roadway. An existing pile supported bridge is located northeast of the proposed improvements. The site location is shown on Plate 1, Appendix A.

We understand it is planned to construct a new crossing at the location of the corrugated metal culverts. The crossing may consist of segmented box culverts, bottomless arched culverts, or a bridge. Some fill may be required to raise the grade before and after the new crossing.

SCOPE

The purpose of our study, as outlined in our Professional Service Agreement dated February 1, 2008, was to generate geotechnical information for the design and construction of the project. Our scope of services included reviewing selected published geologic data pertinent to the site; evaluating subsurface conditions with test borings and laboratory tests; analyzing the field and laboratory data; and presenting this report with the following geotechnical information:

1. A brief description of soil and groundwater conditions observed during our study;

2. A discussion of seismic hazards that may affect the proposed project; and

3. Conclusions and recommendations regarding:

   a. Primary geotechnical engineering concerns and mitigating measures, as applicable;

   b. Site preparation and grading in the roadway including treatment of weak, porous, compressible and/or expansive surface soils;

   c. Foundation types, design criteria, and estimated settlement behavior;

   d. Lateral forces for bridge abutments and wing walls or culvert design, as applicable;

   e. Preliminary pavement thickness based on our experience with similar soils and projects;

   f. Utility trench backfill;

   g. Geotechnical engineering drainage improvements; and

   h. Supplemental geotechnical engineering services.

STUDY

Site Exploration

We reviewed selected geologic references pertinent to the site and the soil borings performed for the existing bridge located northeast of the new improvements (Moore and Taber, 1975). The geologic literature reviewed is listed in Appendix B.

On March 3 and 5, 2008, we performed a geotechnical reconnaissance of the site and explored the subsurface conditions by drilling four test borings to depths ranging from about 5½ to 71½ feet. The borings were drilled with a truck-mounted rotary wash drill rig at the approximate locations shown on the Exploration Plan, Plate 2. The test boring locations were determined approximately by pacing their distance from features shown on the Exploration Plan and should be considered accurate only to the degree implied by the method used. Our field engineer located and logged the borings and obtained samples of the materials encountered for visual examination, classification and laboratory testing.

Relatively undisturbed samples were obtained from the borings at selected intervals by driving a 2.43-inch inside diameter, split spoon sampler, containing 6-inch long brass liners, using a 140-pound hammer dropping approximately 30 inches. The sampler was driven 12 to 18 inches. The blows required to drive each 6-inch increment were recorded and the blows required to drive the last 12 inches, or portion thereof, were converted to equivalent Standard Penetration Test (SPT) blow counts for correlation with empirical data. Disturbed samples were also obtained at selected depths by driving a 1.375-inch inside diameter (2-inch outside diameter) SPT sampler, without liners or rings, using a 140-pound hammer dropping approximately 30 inches. The sampler was driven 12 to 18 inches, the blows to drive each 6-inch increment were recorded, and the blows required to drive the final 12 inches, or portion thereof, are provided on the test

boring logs. A disturbed "bulk" sample of the anticipated subgrade soils at the bridge approach was also obtained from the test borings and placed in a plastic bucket.

The logs of the test borings showing the materials encountered, groundwater conditions, converted blow counts and sample depths are presented on Plates 3 through 6. The soils are described in accordance with the Unified Soil Classification System, outlined on Plate 7.

The test boring logs show our interpretation of subsurface soil and groundwater conditions on the dates and at the locations indicated. Subsurface conditions may vary at other locations and times. Our interpretation is based on visual inspection of soil samples, laboratory test results, and interpretation of drilling and sampling resistance. The location of the soil boundaries should be considered approximate. The transition between soil types may be gradual.

Laboratory Testing

The samples obtained from the borings were transported to our office and re-examined to verify soil classifications, evaluate characteristics, and assign tests pertinent to our analysis. Selected samples were laboratory tested to determine their water content, dry density, classification (Atterberg Limits, percent of silt and clay), triaxial shear strength, consolidation, and expansion potential (Expansion Index - EI). The test results are presented and/or referenced on the test boring logs. Results of the classification, triaxial shear strength, and consolidation tests are presented on Plates 8 through 15.

SITE CONDITIONS

General

Sonoma County is located within the California Coast Range geomorphic province. This province is a geologically complex and seismically active region characterized by sub-parallel northwest-trending faults, mountain ranges and valleys. The oldest bedrock units are the Jurassic-Cretaceous Franciscan Complex and Great Valley sequence sediments originally deposited in a marine environment. Subsequently, younger rocks such as the Tertiary-age Sonoma Volcanics group, the Plio-Pleistocene-age Clear Lake Volcanics and sedimentary rocks such as the Guinda, Domengine, Petaluma, Wilson Grove, Cache, Huichica and Glen Ellen formations were deposited throughout the province. Extensive folding and thrust faulting during late Cretaceous through early Tertiary geologic time created complex geologic conditions that underlie the highly varied topography of today. In valleys, the bedrock is covered by thick alluvial soils.

Geology and Soils

The California Geological Survey's (CGS), formerly known as the California Division of Mines and Geology (CDMG), geologic maps (Huffman and Armstrong, 1980) indicate the property is underlain by alluvium (Qal) that is flanked by hillsides underlain by conglomerate of the Great Valley Sequence (KJgvc) to the northeast and Franciscan Complex (KJfs) to the south and west. The alluvium is shown to comprise sand, gravel, silt, and clay. The Franciscan Complex is shown to comprise sheared shale and sandstone that contains generally resistant masses of chert, "high grade" metamorphic rock, variable shattered sandstone and greenstone, metagreenstone and

generally less resistant serpentinite. Fault mapping by CGS (Bortugno, 1982) indicates that a fault showing no evidence of Quaternary (within the last 5,000,000 years) displacement extends through the alluvium between the proposed improvements and the existing bridge.

Mapping by the U.S. Soil Conservation Service (Soil Survey Staff, 2008) has classified soil over the portion of this property proposed for improvement as belonging to the Tidal Marsh series. The Tidal Marsh series is shown to comprise variable soil textures. Degree of plasticity and shrink-swell potential are not described. The risk of corrosion is given as high for uncoated steel and high for concrete. Performing corrosivity tests to verify these values was not part of our requested and/or proposed scope of work. Should the need arise, we would be pleased to provide a proposal to evaluate these characteristics.

Landslides

The CGS maps of landslides (Huffman, 1980) indicate large-scale slope instability of the hillside south of the proposed improvements including a large landslide that extends to the top of the ridge. We did observe landslides in that area during our study. In addition, there is a landslide mapped on the slope northeast of the site, easterly of the existing bridge. The proposed site is located in the alluvial soils that make up the valley floor. It is possible that landslide debris could extend below the alluvium and thus below the proposed improvements. Movement of the landslides described herein would not only impact the planned improvements, but the valley floor in general. Therefore, for our analysis of the proposed improvements, we have not included a detailed analysis of the landslides. Reactivation, although unlikely, would uniformly disrupt the bridge approaches, creek alignment and existing features.

Surface

The proposed improvements are located within a small valley where Willow Creek flows towards the Russian River. An existing roadway that is essentially flat in the immediate vicinity of the planned improvements traverses through the valley. The area beyond the roadway is covered with heavy vegetation. Six culverts allow water to pass under the roadway. Natural drainage consists of sheet flow over the ground surface that concentrates in man made surface drainage elements such as culverts and natural drainage elements such as swales and creeks.

Subsurface

Our borings and laboratory tests indicate that the existing roadway below the asphalt concrete and aggregate base section is blanketed by 4 to 8 feet of medium dense to dense clayey gravel that is weak to a depth of approximately 2 feet below existing roadway grade. These surface materials are underlain by layers of clay and silt with interbedded layers of sand to the maximum depth explored (71½ feet). The clay and silt soils are compressible under structure and fill loading to depths ranging from 45 to 48 feet.

These conditions differ from those encountered in the closest boring drilled for the existing bridge to the northeast (Moore and Taber, 1975). That boring encountered loose to medium dense, potentially liquefiable sand and very soft to soft clay over dense sand encountered at a depth of about 37 feet. The differences are likely explained by the existing fault between the two locations (Bortugno, 1982).

Groundwater

Free groundwater was first detected in our borings at depths ranging from 2½ to 5 feet below the ground surface at the time of drilling. Fluctuation in the groundwater level typically occurs because of a variation in rainfall intensity, duration and other factors such as flooding and periodic irrigation.

Flooding

Our review of the Federal Emergency Management Agency (FEMA) Flood Zone Map for Sonoma County, California, Unincorporated Areas (NO. 060375 0640B), dated April 2, 1991, indicates that the site is located within Zone "X," an area determined to be outside the 500-year flood plain. Evaluation of flooding potential is typically the responsibility of the project civil engineer.

DISCUSSION AND CONCLUSIONS

Seismic Hazards

General

We did not observe subsurface conditions within the portion of the property we studied that would suggest the presence of materials that may be susceptible to seismically induced lurching. Therefore, we judge the potential for the occurrence of this phenomenon at the site to be low.

Seismicity

Data presented by the Working Group on California Earthquake Probabilities (2007) estimates the chance of one or more large earthquakes (Magnitude 6.7 or greater) in the San Francisco Bay region within the next 30 years to be approximately 63 percent. Therefore, future seismic shaking should be anticipated at the site. It will be necessary to design and construct the proposed improvements in strict adherence with current standards for earthquake-resistant construction.

Faulting

We did not observe landforms within the area that would indicate the presence of active faults and the site is not within a current Alquist-Priolo Earthquake Fault Zone (Bryant and Hart, 2007). An unnamed fault that shows no evidence of Quaternary (last 5,000,000 years) displacement is shown on the fault map by Bortugno (1982). Therefore, we believe the risk of fault rupture at the site is low. However, the site is within an area affected by strong seismic activity. Several northwest-trending Earthquake Fault Zones exist in close proximity to and within several miles of the site (Bortugno, 1982). The shortest distances from the site to the mapped surface expression of these faults are presented below in Table 1.

TABLE 1
ACTIVE FAULT PROXIMITY

Fault	Direction	Distance-Miles
San Andreas	SW	2½
Healdsburg-Rodgers Creek	NE	18½
West Napa	E	39
Maacama	NE	23

Liquefaction

Liquefaction is a rapid loss of shear strength experienced in saturated, predominantly granular soils below the groundwater level during strong earthquake ground shaking due to an increase in pore water pressure. The occurrence of this phenomenon is dependent on many complex factors including the intensity and duration of ground shaking, particle size distribution and density of the soil.

Granular soils were encountered at the site below the groundwater table. Therefore, we performed an analysis of the blow count data from our borings using the methods of Seed and Idriss (1982), Seed and others (1985), Youd and Idriss (2001), and Boulanger and Idriss (2006). These procedures normalize the blow counts to account for overburden pressure, rod length, hammer energy, and fines (percent of silt and clay) content. Once the blow counts are normalized and adjusted to a clean sand blow count, the critical blow count is then determined. The critical blow count is calculated using the same procedures referenced above and requires a peak ground acceleration and design earthquake magnitude.

Peak ground acceleration (PGA) was determined using the methods in the 2007 California Building Code (CBC) and Chapter 11 of the American Society of Civil Engineers (ASCE) Standard 7-05, titled "Minimum Design Loads for Buildings and Other Structures" (2006). Section 11.8.3 of ASCE Standard 7-05 states that the PGA for liquefaction evaluation can be defined as the design spectral response acceleration at short periods with 5 percent damping (S_{DS}) divided by 2.5. The S_{DS} value is determined using the United States Geological Survey's Earthquake Ground Motion Parameter Java Application (2007). Based on the site's latitude and longitude of 38.435 °N and –123.087 °W, respectively, the S_{DS} value is 1.171g for Site Class E. Therefore, the PGA used for our evaluation is 0.468g.

The San Andreas fault is most likely controlling the ground motions at the Willow Creek Road site. According to Petersen (1996), the San Andreas fault is capable of a M_M 7.6 earthquake. Using this information and the scaling factors presented in Youd and

Idriss (2001), the critical blow count at the site ranges from 21 to 29 blows per foot depending on the depth. The normalized and adjusted blow counts at the site do not exceed this value for soils located below the water table, and thus would have potential to liquefy. Using the methods of Boulanger and Idriss (2006), we were able to screen some of the sand layers out because their Plasticity Index was greater than 7 and their fines content greater than 35 percent. However, two layers of sand approximately 3 and 9 feet thick in Boring B-2 are judged to have a moderate to high potential for liquefaction.

There are three potential consequences of liquefaction: bearing capacity failure, lateral spreading, and differential settlement. Bearing capacity failure is large unpredictable differential settlements that occur when foundations bear in or slightly above (typically within two foundation widths for spread footings) liquefiable materials. The potentially liquefiable soils encountered in Boring B-2 were found as shallow as 11 feet below the existing ground surface. Shallow abutment and culvert foundations are not likely to extend to that depth. Deep foundations, if used, would extend below the potentially liquefiable soils. Therefore, we judge that the potential for bearing capacity failure at the site is low.

Lateral spreading can occur when a potentially liquefiable layer extends to a free face, such as a creek or river bank. Willow Creek is the nearest possible free face and is in the immediate vicinity of the proposed improvements. The potentially liquefiable layer is at least 11 feet deep and was not encountered in both of the deep borings we drilled at the site. Given the depth of the questionable layer and the discontinuous nature of the layers encountered in our borings, we judge that the potential for lateral spreading at the site is low.

Differential, non-bearing capacity related, settlement is caused when the soil densifies under seismic loading. Using the blow count data, potential settlement for the liquefied layers was calculated using the methods of Tokimatsu and Seed (1987). These methods yielded earthquake-induced settlement of the suspect soils in Boring B-2 of about 3 inches. Because potentially liquefiable soils were not encountered in Boring B-3, differential settlement along the improvements could be on the order of 3 inches. In order

to reduce the impacts of this settlement, the improvements will need to be supported on a mat slab or on a deep foundation likely consisting of driven piles.

Densification

Densification is the settlement of loose, granular soils above the groundwater level due to earthquake shaking. Typically, granular soils that would be susceptible to liquefaction, if saturated, are susceptible to densification. As discussed in the "Liquefaction" section, the soils at the site have a moderate to high potential for liquefaction. However, the potentially liquefiable soils are located below the groundwater table. Therefore because of the relatively high groundwater level, we judge that there is a low potential for densification to impact the proposed culverts or bridge at the site.

Geotechnical Issues

General

Based on our study, we judge the proposed culverts or bridge can be built as planned, provided the recommendations presented in this report are incorporated into its design and construction. The primary geotechnical concerns during design and construction of the project are:

1. The presence of weak surface soils that extend to about two feet below the existing roadway grade;

2. The presence of soils that are compressible under fill and structure loads to depths ranging from 45 to 48 feet;

3. The presence of potentially liquefiable soils in Boring B-2; and

4. The strong ground shaking predicted to impact the site during the life of the project.

Weak Surface Soils

Weak, porous surface soils, such as those found to a depth of about two feet below the existing pavement surface, appear hard and strong when dry but will lose strength rapidly and settle under the load of fills, foundations, and pavements as their moisture content increases and approaches saturation. The moisture content of these soils can increase as the result of rainfall, periodic irrigation or when the natural upward migration of water vapor through the soils is impeded by and condenses under fills, foundations, and pavements. The detrimental effects of such movements can be remediated by strengthening the soils during grading. This can be achieved by excavating the weak soils and replacing them as properly compacted (engineered) fill.

Compressible Soils

Compressible soils, such as the silt and clay found at the Willow Creek site, will settle under the load of new fills and structure loads. These soils were encountered starting at about 8 feet below the ground surface and extend to 45 to 48 feet in the area of the proposed culverts or bridge. Layers of sand within the silt and clay were encountered in Boring B-2.

We calculated consolidation settlement under various loading conditions at the site including new fill and shallow foundations. We assumed fill thicknesses could range from negligible to 5 feet, which coincides with settlement ranging from negligible to 3½ to 4¼ inches depending how much sand is in the profile. Essentially for every foot of new fill, we estimate approximately 2/3- to 7/8-inch of settlement. For shallow foundations,

we analyzed strip footings/mats that could represent culvert foundations and/or widths. Our analysis yielded settlement ranging from 1½ to 3½ inches depending on foundation width and bearing pressure. Due to the presence of the sand layers in the area of Boring B-2, differential settlement could be on the order of 1-inch along the roadway alignment. Because of the variability of the soils in our borings and those in previous borings drilled for the adjacent bridge, differential settlement in the direction of creek flow could be on the order of ½-inch.

We understand that one of the culvert systems being considered for the crossing is segmented boxes. These are connected together in the direction of flow and can also be placed side by side. Due to the variability of the soils, differential settlement between adjacent side by side boxes could range from ½ to 1 inch at the transition between the boxes. In order to reduce the impacts of settlement for the segmented box system, the boxes need to be structurally tied together along the direction of water flow and side to side so that the entire system will act as a unit. Alternatively, the segmented boxes need to be founded on a mat slab.

Another alternative being considered is the bottomless culvert that has foundations on either side of the flow of the creek and an arch support connecting them. This type of culvert system is backfilled in accordance with the manufacturer's recommendations to establish finished grade for the roadway. The settlement experienced at the foundations is somewhat dampened at the roadway surface by the backfill materials. If the above-described settlement is tolerable, the bottomless culverts can be supported on spread footings. Alternatively, the culverts can be supported on a driven pile foundation.

A third alternative being considered is a bridge that would have an abutment on both ends, and depending on the length, may have a center bent. Provided the bridge can withstand the above-described settlement, it can be supported on spread footing supported abutments. Alternatively, the bridge can be supported on driven pile foundations.

Potentially Liquefiable Soils

As discussed in the "Liquefaction" section the site has a moderate to high potential for liquefaction. Potentially liquefiable soils were only encountered in two layers in Boring B-2. Estimated differential settlement along the roadway (between the locations of Borings B-2 and B-3) could be on the order of 3 inches. Because of the presence of a fault in the area and because the extent and thickness of the sand layers encountered are undefined, it is possible that similar differential settlement could occur in the direction of the flow of the creek.

The foundation alternatives described above for the compressible soil condition are applicable for the liquefaction condition. Please note that earthquake-induced settlement will likely make the roadway impassable for foundations constructed on spread footings and for the segmented box culverts that are not structurally tied together or founded on a mat slab. Structurally tied boxes and mat slabs will provide better performance during an earthquake. Liquefaction-induced differential settlement of pile supported will be less than ½-inch.

Foundation Support - Depending on the required performance, especially post-earthquake, for the culverts or bridge, foundation support for these structures can be obtained from spread footings or the segmented box culvert bottoms bottomed on engineered fill or firm, natural materials. Alternatively the segmented boxes can be structurally tied together or founded on a mat slab, and the bottomless culverts or bridge can be supported on driven piles that gain support in friction below the compressible soils.

Pavement Support - After remedial grading, satisfactory support for paved approaches to the culverts or bridge can be obtained on the engineered fill.

On-Site Soil Quality

All fill materials must be select, as subsequently described in "Recommendations." We anticipate that, with the exception of organic matter and of rocks or lumps larger than 6 inches in diameter, the excavated material in the upper 5 feet will be suitable for re-use as general and select fill. Depending on the time of year of construction, the on-site soils may be at a moisture content that makes them difficult to compact. These soils may need to be allowed to dry or mixed with imported soil with lower moisture content (drier material).

Select Fill

The select fill can consist of approved on-site soils or import materials with a low expansion potential. The geotechnical engineer must approve the use of on-site soils as select fill during grading.

Settlement

For the segmented box culverts and structures founded on spread footings or mat slabs, we estimate that differential settlement related to the compressible soils (consolidation) will be about 1 inch along the roadway alignment and ½ inch in the direction of creek flow. Consolidation differential settlement of pile supported foundations is estimated to be about ½ inch in all directions. Earthquake-induced differential settlements are estimated to be about 3 inches for non-pile supported structures and less than ½-inch for pile supported structures.

Fill soils placed to construct the approaches will settle as described previously for compressible and potentially liquefiable soils. The differential settlement between the fill and the culverts or bridge is a function of the fill thickness and the foundation type for the

structure. We can provide estimates of this settlement once finished grades and structure foundations have been determined.

Surface Drainage

The site will be impacted by surface runoff. Surface runoff typically sheet flows over the ground surface but can be concentrated by the planned site grading, landscaping, and drainage. It will be necessary to divert surface runoff around slopes and improvements, provide positive drainage away from structures, and install energy dissipaters at discharge points of concentrated runoff.

Excavation Dewatering

Groundwater was encountered within the planned excavation depth. Therefore, in order to accomplish excavations at the site, it may be necessary to dewater excavations. The dewatering system can consist of a perforated plastic pipe (in a grid array) embedded in free draining rock. The system should discharge to a sump area that is pumped continuously during construction. The general contractor is responsible for the design, operation and maintenance of the temporary dewatering system.

RECOMMENDATIONS

Seismic Design

Seismic design parameters presented below are based on Section 1613 titled "Earthquake Loads" of the 2007 California Building Code (CBC). Based on CBC Table 1613.5.2, we have determined a Site Class E should be used for the subject site. Using a

site latitude and longitude of 38.435°N and -123.087°W, respectively, and the United States Geological Survey's Earthquake Ground Motion Parameter Java Application (USGS, 2007) we recommend that the following seismic design criteria be used for structures at the site.

Maximum Considered Earthquake Spectral Response Acceleration:
S_S (0.2 second period) = 1.951g
S_1 (1 second period) = 1.029g

Maximum Considered Earthquake Spectral Response Acceleration for Site Class E:
S_{MS} (0.2 second period) = 1.756g
S_{M1} (1 second period) = 2.469g

Design Spectral Response Acceleration (5% damped) for Site Class E:
S_{DS} (0.2 second period) = 1.171g
S_{D1} (1 second period) = 1.646g

Grading

Site Preparation

Areas to be developed should be cleared of vegetation and debris, including that left by the removal of obsolete structures. Trees and shrubs that will not be part of the proposed development should be removed and their primary root systems grubbed. Cleared and grubbed material should be removed from the site and disposed of in accordance with County Health Department guidelines. We did not observe septic tanks, leach lines or underground fuel tanks during our study. Any such appurtenances found during grading should be capped and sealed and/or excavated and removed from the site, respectively, in accordance with established guidelines and requirements of the County Health Department. Voids created during clearing should be backfilled with engineered fill as recommended herein.

Stripping

Areas to be graded should be stripped of the upper few inches of soil containing organic matter. Soil containing more than two percent by weight of organic matter should be considered organic. Actual stripping depth should be determined by a representative of the geotechnical engineer in the field at the time of stripping. The strippings should be removed from the site, or if suitable, stockpiled for re-use as topsoil in landscaping.

Excavations

Following initial site preparation, excavation should be performed as planned or recommended herein. Excavations extending below the proposed finished grade should be backfilled with suitable materials compacted to the requirements given below.

Within fill areas, the weak surface soils should be excavated to about two feet below the existing ground surface. The excavation of weak soils should also extend at least 12 inches below pavement subgrade (where planned excavations do not completely remove the weak soils). The excavation of weak surface materials should extend at least 3 feet beyond the edge of pavements. The excavated materials should be stockpiled for later use as compacted fill, or removed from the site, as applicable.

At all times, temporary construction excavations should conform to the regulations of the State of California, Department of Industrial Relations, Division of Industrial Safety or other stricter governing regulations. The stability of temporary cut slopes, such as those constructed during the installation of underground utilities, should be the responsibility of the contractor. Depending on the time of year when grading is performed, and the surface conditions exposed, temporary cut slopes may need to be excavated to 1½:1 or flatter. The tops of the temporary cut slopes should be rounded back to 2:1 in weak soil zones.

Fill Quality

All fill materials should be free of perishable matter and rocks or lumps over 6 inches in diameter, meet the requirements herein for select fill, and must be approved by the geotechnical engineer prior to use. We judge the on-site soils are generally suitable for use as general and select fill. The suitability of the on-site soils for use as select fill should be verified during grading. Depending on the time of year of construction, the on-site soils may be at a moisture content that is high enough to make compaction difficult. These soils should either be allowed to dry to moisture contents within 4 percent of optimum or mixed with import soils with lower moisture content.

Select Fill

Select fill should be free of organic matter, have a low expansion potential, and conform in general to the following requirements:

SIEVE SIZE	PERCENT PASSING (By Dry Weight)
6 inch	100
4 inch	90 - 100
No. 200	10 - 60

Liquid Limit - 40 Percent Maximum
Plasticity Index - 15 Percent Maximum
R-value – 20 Minimum

In general, imported fill, if needed, should be select. Material not conforming to these requirements may be suitable for use as import fill; however, it shall be the contractor's responsibility to demonstrate that the proposed material will perform in an equivalent manner. The geotechnical engineer should approve imported materials prior to use as compacted fill. The grading contractor is responsible for submitting, at least 72

hours (3 days) in advance of its intended use, samples of the proposed import materials for laboratory testing and approval by the soils engineer.

Fill Placement

The surface exposed by stripping and removal of weak surface soils should be scarified to a depth of at least 6 inches, uniformly moisture-conditioned to near optimum and compacted to at least 90 percent of the maximum dry density of the materials as determined by ASTM Test Method D-1557. Approved fill material should then be spread in thin lifts, uniformly moisture-conditioned to near optimum and properly compacted. All structural fills, including those placed to establish site surface drainage, should be compacted to at least 90 percent relative compaction. Only approved select materials should be used for fill.

Permanent Fill Slopes

In general, fill slopes should be designed and constructed at slope gradients of 2:1 (horizontal to vertical) or flatter, unless otherwise approved by the geotechnical engineer in specified areas. Where steeper slopes are required, retaining walls should be used. Fill slopes steeper than 2:1 will require the use of geogrid to increase stability. Providing recommendations for grid type and spacing was not part of our requested and/or proposed scope of work. Should the need to use geogrid arise, additional laboratory testing and stability analyses will be required. Fill slopes should be constructed by overfilling and cutting the slope to final grade. "Track walking" of a slope to achieve slope compaction is not an acceptable procedure for slope construction. The geotechnical engineer is not responsible for measuring the angles of these slopes. Denuded slopes should be planted with fast-growing, deep-rooted groundcover to reduce sloughing or erosion. The cut and fill slope inclinations recommended herein address only the stability of the slopes. It

should not be inferred that they address the feasibility of landscaping and weed control. Where these are concerns, the slopes should be flattened accordingly.

Wet Weather Grading

Generally, grading is performed more economically during the summer months when on-site soils are usually dry of optimum moisture content. Delays should be anticipated in site grading performed during the rainy season or early spring due to excessive moisture in on-site soils. Special and relatively expensive construction procedures, including dewatering of excavations and importing granular soils, should be anticipated if grading must be completed during the winter and early spring or if localized areas of soft saturated soils are found during grading in the summer and fall.

Open excavations also tend to be more unstable during wet weather as groundwater seeps towards the exposed cut slope. Severe sloughing and occasional slope failures should be anticipated. The occurrence of these events will require extensive clean up and the installation of slope protection measures, thus delaying projects. The general contractor is responsible for the performance, maintenance and repair of temporary cut slopes.

Foundation Support

Depending on the amount of acceptable settlement and the required performance of Willow Creek Road, the culverts or bridge can be supported on spread footings, a mat slab, or driven concrete or steel friction piles. Specific recommendations for each alternative are given in the following sections of the report.

Spread Footings

Spread footings should be at least 24 inches wide and should bottom on firm, natural soils or engineered fill, as applicable, at least 24 inches below lowest adjacent grade. Additional embedment or width may be needed to satisfy code and/or structural requirements.

The bottoms of all footing excavations should be thoroughly cleaned out or wetted and compacted using hand-operated tamping equipment prior to placing steel and concrete. This will remove the soils disturbed during footing excavations, or restore their adequate bearing capacity, and reduce post-construction settlements. Footing excavations should not be allowed to dry before placing concrete. If shrinkage cracks appear in soils exposed in the footing excavations, the soil should be thoroughly moistened to close all cracks prior to concrete placement. The moisture condition of the foundation excavations should be checked by the geotechnical engineer no more than 24 hours prior to placing concrete.

Bearing Pressures - Footings installed in accordance with these recommendations may be designed using allowable bearing pressures of 1200, 1800 and 2400 pounds per square foot (psf), for dead loads, dead plus code live loads, and total loads (including wind and seismic), respectively.

Lateral Pressures - The portion of spread footing foundations extending into firm, natural soil or select engineered fill may impose a passive equivalent fluid pressure and a friction factor of 350 pcf and 0.35, respectively, to resist sliding. Passive pressure should be neglected within the upper 6 inches, unless the soils are confined by concrete slabs or pavements.

Mat Slabs

Mat slabs should bottom on firm, natural soil or engineered fill. We understand that mat slabs will generally be a uniform thickness with thickened areas along the edges and at the column locations. The bottoms of excavations for thickened portions should be treated like footings and be thoroughly cleaned out or wetted and compacted using hand-operated tamping equipment prior to placing reinforcing steel and concrete. This will remove the soils disturbed during excavations. The slab excavation should not be allowed to dry before placing concrete. If shrinkage cracks appear in soils exposed in the excavation, the soil should be thoroughly moistened to close all cracks prior to concrete placement. The moisture condition of the excavation should be checked by the geotechnical engineer no more than 24 hours prior to placing concrete.

The slabs should be designed to accommodate the differential settlement described in the "Settlement" section of this report. Due to the presence of compressible and potentially liquefiable soils, we recommend using allowable bearing pressures of 1200, 1800, and 2400 pounds per square foot (psf) for dead load, dead plus live load, and total loads (including wind and seismic forces), respectively. Based on the variability of the mat slab subgrade soils and correlations in Bowles (1990), we recommend a modulus of subgrade reaction (k) of 100 pounds per cubic inch (pci) be used for design. The mat slab may impose a passive equivalent fluid pressure and a friction factor of 400 pcf and 0.40, respectively, to resist sliding.

Driven Piles

In order to reduce the impacts of total and differential settlement (both consolidation and earthquake-induced), the proposed culverts or bridge can be supported on a driven pile foundation system. There are a wide variety of pile types that could be used for the project. We typically see 12-inch square pre-cast concrete piles or 16-inch diameter steel pipe piling used for this type of project. Recommendations for both pile types are presented herein. If

the project design team elects to use a different type or dimension of pile, we should be contacted for additional evaluation and recommendations.

Vertical Capacity - The ultimate vertical capacity of the pile depends on the skin friction developed in the underlying sand and clay soils minus the effect of soil downdrag. As the clay and silt soils, that extend from 8 to approximately 45 feet deep, compress under fill and/or structural loads they, and the soils above them, impart a negative skin friction, referred to as downdrag, on the pile. For the Willow Creek site, the soils imparting a downdrag force include all the soils above a depth of approximately 45 feet. For design purposes, these soils will impart an approximate downdrag force onto the piles of 15 kips. The piles should extend into competent soils below a depth of 45 feet. Twelve-inch diameter concrete piles and 16-inch diameter steel pipe piles extending to a depth of 70 feet below existing grade will have ultimate capacities of 47 and 50 kips, respectively. These values are an estimate of actual forces that are likely to develop and are intended for use in a working stress analysis. The values do not contain a factor of safety or load factor. The actual pile lengths and tip elevations should be established from results of an indicator pile driving program, discussed in a subsequent section. If piles other than those described herein are to be used, we should be consulted to provide revised criteria.

Under static loading conditions, we estimate total settlement of a single pile designed in accordance with these recommendations will be less than ½-inch. This value pertains to soil compression only and does not include elastic compression of the pile.

Lateral Capacity - We understand that lateral loads for determining load deflections (p-y) curves are not currently available. Once the project structural engineer has developed these loads, we should be consulted to provide the required p-y curves.

Pile Installation - The piles should be installed with a diesel hammer having a rated energy of at least 40,198 foot-pounds. This energy corresponds to a Delmag D16-32. The contractor should select a hammer and driving system that is capable of driving piles to the

desired capacity without overstressing the piles in either tension or compression. Prior to the start of pile installation at the site, the contractor should submit the following information regarding the hammer and driving system to the geotechnical engineer:

- hammer type and rated energy
- helmet weight, including striker plate
- hammer cushion material, cross-section area, and thickness
- pile cushion material and thickness, if used

This information will be used to provide driving criteria based on wave equation analysis using the proposed pile and hammer combination. The contractor should be advised that modifications to the proposed equipment, including the use of a different hammer, may be required if the analysis indicates that the proposed equipment is not sufficient to obtain the desired ultimate pile capacity, or is likely to damage the pile during driving.

Our subsurface exploration at the site did not encounter subsurface conditions that would be expected to obstruct pile driving. If obstructions are encountered, we recommend the pile locations be pre-drilled.

Abutment and Wing Walls

Abutment and wing walls constructed at the site must be designed to resist lateral earth pressures plus additional lateral pressures that may be caused by surcharge loads applied at the ground surface behind the walls.

Walls free to rotate (yielding greater than 0.1 percent of the wall height at the top of the backfill) should be designed for active lateral earth pressures. If walls are restrained by rigid elements to prevent rotation, they should be designed for "at rest" lateral earth pressures.

Walls should be designed to resist the following earth equivalent fluid pressures (triangular distribution):

Active Pressure (level backfill) ..... 40 pcf
At Rest Pressure ..... 70 pcf

These pressures do not consider additional loads resulting from adjacent foundations or other loads. If these additional surcharge loadings are anticipated, we can assist in evaluating their effects. Where wall backfill is subject to vehicular traffic, the walls should be designed to resist an additional surcharge pressure equivalent to two feet of additional backfill.

Walls will yield slightly during backfilling. Therefore, walls should be backfilled prior to building on, or adjacent to, the walls. Backfill against walls should be compacted to at least 90 and not more than 95 percent relative compaction. Over-compaction or the use of large compaction equipment should be avoided because increased compactive effort can result in lateral pressures higher than those recommended above.

Foundation Support

Abutment or wing walls should be supported on spread footings, mat slabs or driven piles, designed in accordance with the recommendations presented in this report. Wall foundations should be designed by the project civil or structural engineer to resist the lateral forces set forth in this section.

Wall Drainage and Backfill

Abutment and wing walls should be backdrained as shown on Plate 16, Appendix A. The backdrains should consist of 4-inch diameter, rigid perforated pipe embedded in Class 2 permeable material. The pipe should be PVC Schedule 40 or ABS with SDR 35 or better, and the pipe should be sloped to drain to outlets by gravity. The top of the pipe

should be at least 8 inches below lowest adjacent grade. The Class 2 permeable material should extend to within 1½ feet of the surface. The upper 1½ feet should be backfilled with compacted soil to exclude surface water. Expansive soils should not be used for wall backfill. Where expansive soils are present in the excavation made to install the abutment and wing walls, the excavation should be sloped back 1:1 from the back of the footing or pile cap. The ground surface behind walls should be sloped to drain. Where migration of moisture through the abutment and wing walls would be detrimental, retaining walls should be waterproofed.

Utility Trenches

The shoring and safety of trench excavations is solely the responsibility of the contractor. Attention is drawn to the State of California Safety Orders dealing with "Excavations and Trenches."

Unless otherwise specified by the County of Sonoma, on-site, inorganic soil may be used as general utility trench backfill. Where utility trenches support pavements, slabs and foundations, trench backfill should consist of aggregate baserock. The baserock should comply with the minimum requirements in Caltrans Standard Specifications, Section 26 for Class 2 Aggregate Base. Trench backfill should be moisture-conditioned as necessary, and placed in horizontal layers not exceeding 8 inches in thickness, before compaction. Each layer should be compacted to at least 90 percent relative compaction as determined by ASTM Test Method D-1557. The top 6 inches of trench backfill below vehicle pavement subgrades should be moisture-conditioned as necessary and compacted to at least 95 percent relative compaction. Jetting or ponding of trench backfill to aid in achieving the recommended degree of compaction should not be attempted.

Pavements

Based on our study, we believe the near-surface soils will have a moderate supporting capacity, after proper compaction, when used as a pavement subgrade. However, we understand that the approaches to the crossing may be raised, which will require fill. Therefore, provided grading is performed as recommended herein, the uppermost 12-inches of pavement subgrade soils will be either on-site or imported select fill with a minimum R-value of 20. Based on this R-value we recommend the pavement sections listed in Table 2 be used.

TABLE 2
PAVEMENT SECTIONS

TI	THICKNESS (feet)		
	ASPHALT CONCRETE	CLASS 2 AGGREGATE BASE	MINIMUM ENGINEERED FILL THICKNESS*
9.0	0.45	1.30	1.0
8.0	0.40	1.15	1.0
7.0	0.30	1.05	1.0
6.0	0.25	0.85	1.0
5.0	0.20	0.70	1.0

* R-value $\geq$ 20

Pavement thicknesses were computed using Method 301 F of the Caltrans Highway Design Manual and are based on a pavement life of 20 years. These recommendations are intended to provide support represented by the indicated Traffic Indices (TI). They are not intended to provide pavement sections for heavy concentrated construction storage or wheel loads such as forklifts, parked truck-trailers and concrete trucks.

In areas where heavy construction storage and wheel loads are anticipated, the pavements should be designed to support these loads. Support could be provided by increasing pavement sections or by providing reinforced concrete slabs. Alternatively,

paving can be deferred until heavy construction storage and wheel loads are no longer present.

Prior to placement of aggregate base, the upper 6 inches of the pavement subgrade soils should be scarified, uniformly moisture-conditioned to near optimum, and compacted to at least 95 percent relative compaction to form a firm, non-yielding surface. Aggregate base materials should be spread in thin layers, uniformly moisture-conditioned, and compacted to at least 95 percent relative compaction to form a firm, non-yielding surface. The materials and methods used should conform to the requirements of the County of Sonoma and the current edition of the Caltrans Standard Specifications, except that compaction requirements should be based on ASTM Test Method D-1557. Aggregate used for the base course should comply with the minimum requirements specified in Caltrans Standard Specifications, Section 26 for Class 2 Aggregate Base.

Wet Weather Paving

In general, the pavements should be constructed during the dry season to avoid the saturation of the subgrade and base materials, which often occurs during the wet winter months. If pavements are constructed during the winter, a cost increase relative to drier weather construction should be anticipated. Unstable areas may have to be overexcavated to remove soft soils. The excavations will probably require backfilling with imported crushed (ballast) rock. The geotechnical engineer should be consulted for recommendations at the time of construction.

Geotechnical Drainage

Surface water should be diverted away from slopes, foundations and edges of pavements. Surface drainage gradients away from foundations should conform to the

2007 CBC and/or the local jurisdiction Water seepage or the spread of extensive root systems into the soil subgrade of footings, slabs or pavements could cause differential movements and consequent distress in these structural elements. Landscaping should be planned with consideration for these potential problems.

Maintenance

Periodic land maintenance will be required. Surface and subsurface drainage facilities should be checked frequently, and cleaned and maintained as necessary or at least annually. A dense growth of deep-rooted ground cover must be maintained on all slopes to reduce sloughing and erosion. Sloughing and erosion that occurs must be repaired promptly before it can enlarge.

Supplemental Services

RGH Consultants, Inc. (RGH) recommends that we be retained to review the project plans and specifications to determine if they are consistent with our recommendations. In addition, we should be retained to observe construction, particularly site excavations, compaction of fills and backfills, foundation and subdrain installations, and perform field and laboratory testing. As part of these services, we recommend that prior to construction a meeting be held at the site that includes, but is not limited to, the owner or owner's representative, the general contractor, the grading contractor, the foundation contractor, the underground contractor, any specialty contractors, the project civil engineer, other members of the project design team and RGH. This meeting should serve as a time to discuss and answer questions regarding the recommendations presented herein and to establish the coordination procedure between the contractors and RGH.

If, during construction, we observe subsurface conditions different from those encountered during the explorations, we should be allowed to amend our recommendations accordingly. If different conditions are observed by others, or appear to be present beneath excavations, RGH should be advised at once so that these conditions may be evaluated and our recommendations reviewed and updated, if warranted. The validity of recommendations made in this report is contingent upon our being notified and retained to review the changed conditions.

If more than 18 months have elapsed between the submission of this report and the start of work at the site, or if conditions have changed because of natural causes or construction operations at, or adjacent to, the site, the recommendations made in this report may no longer be valid or appropriate. In such case, we recommend that we be retained to review this report and verify the applicability of the conclusions and recommendations or modify the same considering the time lapsed or changed conditions. The validity of recommendations made in this report is contingent upon such review.

These supplemental services are performed on an as-requested basis and are in addition to this geotechnical study. We cannot accept responsibility for items that we are not notified to observe or for changed conditions we are not allowed to review.

LIMITATIONS

This report has been prepared by RGH for the exclusive use of the Stewards of the Coast and Redwoods and their consultants as an aid in the design and construction of the proposed improved crossing of Willow Creek described in this report.

The validity of the recommendations contained in this report depends upon an adequate testing and monitoring program during the construction phase. Unless the construction monitoring and testing program is provided by our firm, we will not be held

responsible for compliance with design recommendations presented in this report and other addendum submitted as part of this report.

Our services consist of professional opinions and conclusions developed in accordance with generally accepted geotechnical engineering principles and practices. We provide no other warranty, either expressed or implied. Our conclusions and recommendations are based on the information provided to us regarding the proposed construction, the results of our field exploration, laboratory testing program, and professional judgment. Verification of our conclusions and recommendations is subject to our review of the project plans and specifications, and our observation of construction.

The test borings represent subsurface conditions at the locations and on the dates indicated. It is not warranted that they are representative of such conditions elsewhere or at other times. Site conditions and cultural features described in the text of this report are those existing at the time of our field exploration on March 3 and 5, 2008, and may not necessarily be the same or comparable at other times.

The scope of our services did not include an environmental assessment or a study of the presence or absence of toxic mold and/or hazardous, toxic or corrosive materials in the soil, surface water, groundwater or air (on, below or around this site), nor did it include an evaluation or study for the presence or absence of wetlands. These studies should be conducted under separate cover, scope and fee and should be provided by a qualified expert in those fields.

APPENDIX D
Adaptive Geomorphic Plan

ADAPTIVE GEOMORPHIC PLAN FOR THE WILLOW CREEK VALLEY ABOVE THE 2nd BRIDGE CROSSING, SONOMA COUNTY, CALIFORNIA

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Russian River District
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December 2008

Table of Contents

Table of Figures

Appendices

Objectives

The primary objective of this study was to document and evaluate fluvial geomorphic condition of Willow Creek and its floodplain from about 200 ft below the 2nd Bridge Crossing to the 3rd Bridge (the study reach), and evaluate future conditions with the proposed new bridge at the 2nd Crossing. This task was accomplished by field investigation supplemented by existing information and prior reports. The development of a properly functioning channel above the 2nd Crossing is a major goal for management of the watershed and the proposed new bridge crossing should not be in conflict with this goal over a period of about 20 to 50 years. Fish passage and habitat conditions are a critical component of properly functioning conditions, and were considered accordingly in the analysis. Floodplain flow patterns were examined and adaptive management and monitoring options for channel development were recommended.

Introduction

The bulk of the Willow Creek watershed (a tributary to the Russian River) is owned by the California Department of Parks and Recreation (DPR). Willow Creek watershed has a history of land use that includes logging and grazing as early as 1860. The stream channel has responded to elevated sediment loads. Aggradation above the 2nd Crossing manifested by channel avulsion has migrated up valley as far as the 3rd Bridge. Historical dredging of a straight channel along the north side of the valley occurred in the 1950's. Portions of the channel and floodplain are now unstable and channel connectivity is intermittent. Since 2001 the DPR and its partners have made restoration of the degraded riparian ecosystem of lower Willow Creek a high priority.

Willow Creek is considered a high priority watershed for restoration of coho salmon habitat. Due to unsatisfactory conditions at the 2nd Crossing, a consensus was reached to design and install a road crossing that would provide for fish passage, hydraulic connectivity, and have a 20-50 year lifespan. This adaptive geomorphic plan considers options for restoring channel function and stream connectivity in the floodplain above the 2nd Crossing.

Approach and Methods

Prior to conducting field work or new analyses, existing data, geomorphic studies and aerial photography supplied by DPR were reviewed. Cross sections and longitudinal profiles of the Willow Creek floodplain, supplied by Prunuske Chatham Inc., were also reviewed. Hence, prior studies provided a framework and foundation of knowledge within which current conditions were analyzed.

Field mapping verified and documented geomorphic processes in the study reach. The rapid growth of woody vegetation and patterns of channel avulsions were processes surveyed in the field. Active channels were mapped and areas of poor channel

connectivity delineated. Digital photographs were taken to document field work. A geomorphic interpretive map of the floodplain was developed using field data and observations documenting distinct geomorphic process zones and influences (Figure 1).

Options for adaptive management and monitoring for channel development were compiled in a table and submitted to DPR for review. Using results from background review and fieldwork, monitoring objectives were established regarding development of channel connectivity, channel scour and sedimentation, migration of channels, fish habitat and passage, and channel avulsion and aggradation. Applicable methods and monitoring metrics were established, considering frequency and timing of monitoring as well as estimated costs.

Upon receipt of input from DPR on the adaptive management table, the present adaptive management plan was prepared. It includes a monitoring plan with guidance on procedures, data analyses and interpretation, and required level of effort and cost. Additionally, adaptive management criteria and procedures including objectives and indicators of trends and conditions are considered.

History of Willow Creek Valley

Review of Previous Studies

This section summarizes observations and accounts from previous studies of Willow Creek, focused on the reach above the 2nd Bridge.

The confluence of Willow Creek and the Russian River is located between Jenner and Duncan's Mills in Sonoma County. It drains approximately 8.7 square miles of steeply sloping coastal watershed. Douglas fir, oak and redwood dominate the forested slopes while willow, alder and redwood are found in the riparian corridor. The channel runs along an inactive fault. The watershed is underlain by highly erodible and deeply weathered siltstones and sandstones of the Franciscan complex and younger conglomerates. These geologic materials are prone to landsliding. The watershed has a long history of human use that have cumulatively disturbed the natural channel. Channel straightening and confinement for agriculture, livestock grazing, and logging have altered sediment supply, sediment transport, and flooding in the lower Willow Creek watershed that has been the focus of many previous reports.

The Willow Creek watershed was first logged in the 1860's. Later that decade a sawmill was built in the lower meadow of the watershed. A narrow gauge railroad was constructed in the stream channel that ran to the headwaters of Willow Creek to facilitate the use of "steam donkey" engines for log extraction. In addition to logging, the watershed was grazed prior to the 1900's. In the late 1800's and early 1900's channelization of the creek expanded agricultural fields on the floodplain upstream of the

2nd Bridge. The straightened channel was aligned along the northern end of the valley and confined flows to prevent meandering across the valley floor above the 2nd Bridge.

In the 1950's through early 1970's extensive areas of the watershed were logged, creating networks of skid trails and landings that were often located on steeply sloped hillsides and in streamside areas. In the 1970's there was a noticeable decline in riparian canopy in the upper watershed attributed to log jams from the recent logging and large amounts of "slash" in the upper watershed. The riparian cover in the lower watershed consisted of a thin strip of willows and undercut banks. Efforts were made to clear the stream in the upper watershed of log jams and by 1982 the riparian canopy had improved and was composed of second growth alder and bay trees. The riparian cover in the lower watershed still consisted of a thin strip of willow and alders with blackberries adjacent to the creek.

Sedimentation problems began to be reported in the 1960's in the Lower Reaches of Willow Creek downstream of the 2nd Bridge (stretching from 2000 ft upstream of the 1st bridge to 1000 ft downstream of the 2nd bridge). This section of the creek was subsequently cleared of woody debris, sediment and vegetation to maintain conveyance capacity of flow through the 2nd Bridge. During the 1980's this reach was frequently excavated to maintain channel flow capacity. In 1983, spoils from channel excavation downstream of the 2nd Bridge were placed adjacent to the southwestern banks upstream of the 2nd Bridge to create a 1,750 foot long artificial levee.

As a component of an Enhancement and Sediment Management Plan (Swanson, 1987) prepared by DPR, excavation of the lower channel stopped in the mid-1980's. DPR identified sedimentation as a problem along the reach of channel with the levee extending from the 2nd Bridge 2,500 ft upstream. After determining that the artificial levee was eroding and acting as a sediment source it was removed by DPR in 1987. It was thought that raising the height of and widening the 2nd Bridge would allow natural channel migration. Due to the prohibitive cost of altering the bridge, extra culverts were installed to facilitate fish passage instead. After removal of the levee upstream of the 2nd Bridge and cessation of the practice of excavating sediment downstream of the 2nd Bridge, major aggradation began to occur from 1,000 feet downstream of the 2nd Bridge extending upstream to the 3rd Bridge. The channel aggradation that occurred after channel maintenance stopped killed the alder trees on the banks. Inspection of the alder tree stumps in the channel in 1987 suggested 3 ft of aggradation since 1980 (Swanson, 1987).

Aggradation of the channel in the Lower Reaches of Willow Creek has been attributed to many factors including elevated sediment supply, channel alteration, infrastructure limitations on flow conveyance at the 2nd Bridge Crossing, and effects of the 1986 flood. Erosion rates in the watershed have decreased since the 1960's to 1980's, which was a period characterized by high sediment yields from skid trail and gully erosion resulting from timber harvest activity. The large storms of the 1980's triggered extensive landslides which contributed large volumes of sediment to Willow Creek (CDFG 2000). In the time period 1969 to 2000, 104 shallow landslides (debris slides and debris flows)

and 43 deep seated landslides (rock slides) have been identified in the Willow Creek watershed. It is estimated that over this time period the sediment input from these landslides was 158 tons/sq mi/yr (MRC 2001). Sediment inputs due to legacy harvest practices, primarily erosion associated with skid trails, and large storms of the 1981-1982 were estimated to be 89 tons/sq mi/yr (MRC 2001). Grassland gullies have been estimated to contribute 30% of the total sediment yield from the watershed (Trihey and Assoc, Inc., 1997). Although the sediment supply has decreased since the 1980's, it is thought insufficient to passively restore the channel (Stewards of Slavianka Report 2001). Anthropogenic influences have created sediment production rates in the watershed that exceed the transport capacity of the lower channel affecting the character and timing of channel response to historic disturbance described above.

In the 1986 flood, the Russian River backwater extended 1500 feet upstream of the 2nd Bridge. Ponded water upstream of the 2nd Bridge caused deposition of sediment upstream of the 2nd Bridge (Swanson 1987). The aerial photo record indicates that Willow Creek avulsed out of the confined, artificially straightened channel on the northern side of the valley onto the floodplain to the south (Figure 3). From 1978 to 1997, 5 feet of aggradation filled the channel above the 2nd Bridge (Swanson, 1987). The Swanson report described the channel upstream of the 2nd Bridge in 1987 as flowing within a straight, shallow channel approximately 3-4 feet deep and 30-40 feet wide bounded on the western side by a dredge spoil levee atop the stream bank. From 1987 to 1997 the channel cross section capacity at the 2nd Bridge was reduced by one half with the elevation of the aggraded channel higher than the adjacent floodplain in many places (Trihey and Assoc, Inc. 1997). Channel avulsion caused by aggradation resulted in flooding on the county road (Trihey and Assoc, Inc. 1997). During the winter storms of 1995, Willow Creek base flows were reported no longer in the channel, but wandering across the meadow above the 2nd Bridge until the flow was artificially directed to the old channel at the 2nd Bridge by the embankment across the valley which the road is built on (CDFG 2000).

By 2001 aggradation effects had resulted in elimination of an identifiable channel above the 2nd Bridge (Stewards of Slavianka, 2001). According to Stewards of Slavianka (2001), sediment deposits in Willow Creek were not able to mobilize in flood flows due to the road embankment across the valley at the 2nd Bridge and the low valley gradient (0.43%). In this interpretation of the situation, sediment delivered from the watershed is not able to flush through the reach in the floodplain near the 2nd Bridge and consequently builds up behind the 2nd Bridge. Progressive upstream sediment deposition has been observed, as evidenced by 3 feet of local aggradation upstream of the 3rd Bridge between 1986 and 1996. Previous investigators have asserted that a restored channel through this reach may not be self sustaining due to the high sediment loads (Stewards of Slavianka report, 2001).

Agriculture was abandoned in the early 1980's and willows and wetland plants sprouted on the floodplain above the 2nd Bridge and rapidly overtook the annual grasses (Figure 6). In 1990 grazing was discontinued on DPR property in the lower Willow Creek

watershed. Aerial photography from 1980 to 2006 documents colonization of the floodplain pastures by willow and alder (Figure 6). The process of colonization was likely aided by deposition of sediment on the valley floor by channel avulsion. These fresh sediment deposits were rapidly colonized by willow and alder. These stands of woody riparian vegetation were (and continue to be) very dense. Combined with the relatively level topography of the valley floor, this dense vegetation increases flow resistance and significantly reduces water velocity during periods of peak flow. This limits the stream's ability to mobilize sediment deposited on the valley floor. The dense root networks of the willow and alder stands further limits channel development. Hence, dense riparian stands exacerbate the problem of aggradation above the 2nd Bridge. Dense woody vegetation stabilizes deposited sediment and reduces water velocity, inhibiting sediment transport and channel development.

Historic Observations of Sediment Size and Bed Mobility

High sediment loads and easily mobilized streambed deposits have been documented along the mainstem of Willow Creek by Trihey and Associates Inc (1997). At the confluence with Pomo Creek (2,500 ft upstream of the 3rd Bridge) point bars on Willow Creek were observed with fresh sediment deposits. The surface layer of sediment included a very high percentage of sand and sub-rounded pebbles finer than 25 mm (Trihey and Associates, 1997). In 1994 the Department of Fish and Game measured the substrate at potential spawning sites and found the fines <0.85mm averaged 18-20% of all samples, a level believed to be detrimental to spawning habitat.

In 2001 the Mendocino Redwood Company studied bed mobility in stream reaches on lands in their ownership starting about 2 miles upstream of the 2nd Bridge on Willow Creek. The Lower Reaches of the mainstem in their study were described as depositional channels entrenched in the streamside terraces. Terraces varied from 5-8 feet deep and terrace deposits were composed of consolidated sand, silt and clay sized particles. Despite their low gradients, these channels had a relatively high transport capacity due to the confined channel keeping water energy directed in the entrenched channel. The channel bed was described as being composed primarily of gravel sized particles. Channel width to depth ratios averaged 17.4 and bed mobility was considered moderate to low. Observed D_{50} (median sediment grain size) for these reaches ranged from 34-52 mm. The predicted D_{50} at the threshold of sediment entrainment at bankfull discharges ranged from 43-51 mm. Average bankfull depths were 1.3-1.95 ft and average bankfull widths were 24.2-34 ft. Floodprone depths in these Lower Reaches ranged from 3.6 ft to 5.6 ft and floodprone widths ranged from 19.5 ft to 45 ft. Observed slopes ranged from 0.5% to 1.0% and channel roughness in order of influence was associated with bedforms, banks and roots, and large woody debris. These observations indicate that the channel of Willow Creek above the study reach has abundant sediment supply stored in the channel and terraces that will continue to be transported to the study reach despite reductions in upstream erosion processes.

Willow Creek Channel Field Survey and Observations

Survey Objectives and Approach

OEI mapped and surveyed portions of the floodplain and channel network of Willow Creek between the 2nd Bridge and 3rd Bridge on April 23 and 28, 2008. Dense vegetation and marshy terrain was an impediment to survey work. The approach to surveying was influenced by availability of prior survey data, including cross-sections provided by Prunuske Chatham Inc. The primary objective of the survey was to map the existing channels and observe geomorphic characteristics of Willow Creek. Observations of channel form, channel substrate, sediment deposition and vegetation type as it pertains to flow resistance were recorded. A Trimble XT GPS unit was used to locate point positions to within 10 to 15 meters; accuracy of some GPS points was limited by riparian forest canopy and insufficient satellite availability during portions of the survey. At these points aerial photo images were used to determine locations. Digital photos were taken at most points.

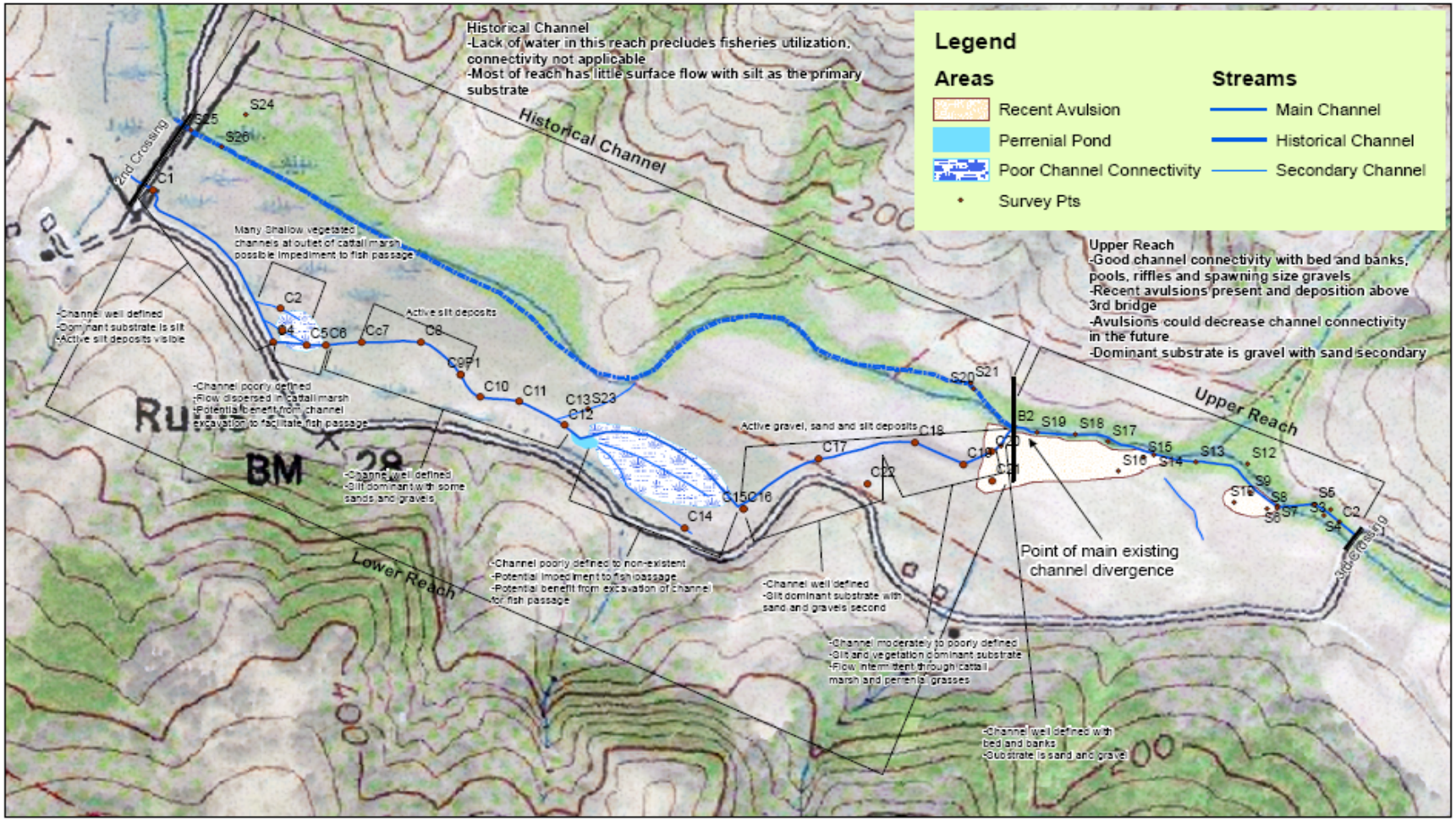
Classification

Typical channel characteristics were noted at discrete locations. Channel descriptors observed included channel form, dominant and secondary channel substrate (channel bed material), the presence and texture of active (mobile) sediment deposit, dominant vegetation type and general comments (see field forms, Appendix A). Channel form was classified into one of three classes: no channel, indistinct channel with weak flow convergence and poorly defined bed and banks, and well defined channel. Substrate classes included vegetated, exposed soil or clay, silts and sand, gravel, and bedrock. Active deposit classes included silt and clay (< 0.063 mm), fine sand (<0.25 mm), sand (<2 mm), gravel with pockets of sands, and gravel. Vegetation classes included marsh and grassland, young trees and shrubs with dense undergrowth, and mature tree with semi-open undergrowth.

General Channel Observations

For the purposes of description of geomorphic conditions, the reach of Willow Creek between the 2nd Bridge and the 3rd Bridge can be divided into an Upper Reach, a Lower Reach and an historic channel segment that has been filled by sediment transport processes and abandoned by avulsion processes (Figure 3). The Upper Reach is the portion of channel where the bulk of surface flow follows the historical channel (map point S1 to B2, Figure 1). The Lower Reach is the segment of channel below the point where the main flow is routed to the floodplain and, ultimately, the culverts at the 2nd Bridge Crossing (map point B2 to C1). The historical channel extends from the point where surface flow leaves the historical channel to the 2nd Bridge (map point B2 to S25).

Figure 1: Channel Map, Lower Willow Creek Study Area, 2008



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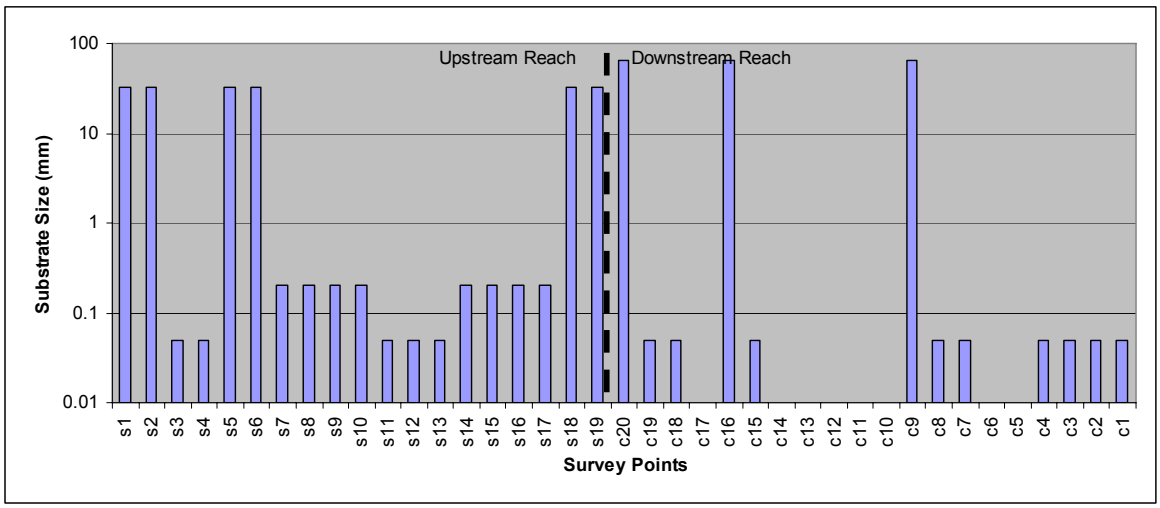
Upper Reach

The Upper Reach extends from the 3rd Bridge about 1,200 ft downstream (map point S1 to B2), where the main flow of the channel is routed by avulsion processes to the historical floodplain. The channel is very well defined (Photo S25 and S19). The dominant substrate and active deposits comprise gravel, sand and fine sand. Pools with a depth of 2 ft or greater are common. Banks range in height from 5 ft at the 3rd Bridge to < 1 ft at the downstream end of the Upper Reach. The dominant vegetation type is mature trees with semi-open undergrowth.

There is a gradation in sediment size from the 3rd Bridge to the downstream end of the Upper Reach (Figure 2). From near the 3rd Bridge to about 500 ft downstream the dominant substrate and active deposits are gravel and sand. Active aggradation at the 3rd Bridge was observed (Photo S1-C). From 500 ft downstream of the 3rd Bridge to the point where the main flow leaves the historical channel the dominant substrate is fine sand and sand and the active deposits are fine sand, sand and gravel (Figure 2). There is a prominent decrease in the diameter of sediment on the bed of the channel from the 3rd Bridge to the bottom of the Upper Reach.

Figure 2: Upper Reach and Lower Reach Substrate Size.
Upstream (s1) to downstream (c1) and excluding the historical channel downstream of main existing channel divergence.



Lower Reach

The Lower Reach extends from the point where the main body of surface flow leaves the historical channel (the bottom of the Upper Reach) and spreads through the historical floodplain to the culverts at the 2nd Bridge Crossing (Figure 1: point B2 to C1). The channel of the Lower Reach takes a variety of forms and is broken by sections of perennial grass and marsh where no distinct channel exists.

From the top of the Lower Reach extending about 150 ft downstream (Figure 1: between survey point C20 and C19) the channel is well defined by bed and banks. The channel is about 0.5 ft deep and 3 ft wide. The dominant substrate is sand and gravel. Lobes of sand and gravel, deposited through avulsion of the historical channel, extend into the perennial grass of the floodplain (Photo C21). Deposits are up to 1.5 ft deep and 250 ft long. The dominant vegetation is a mix of young willows and alders about 2 – 5 years old and perennial grassland. Young alders and willows appear to rapidly colonize in the freshly deposited sediments.

From 150 ft (between map point C20 and C19 in Figure 1) to about 750 ft downstream (from the top of the Lower Reach to a point between survey point C17 and C18 in Figure 1) the channel is moderately to poorly defined. The dominant substrate is silt and vegetation. Active sediment deposits include silt and fine sand. Active deposits are found as thin layers on the banks and within the wetted channel. Vegetation is young alder and willow mixed with perennial grass. Flow is intermittently dispersed through cattail marsh and perennial grasses. The water depth in the channel thalweg was consistently 0.5 ft or greater.

From 750 ft (between survey point C17 and C18 in Figure 1) downstream to about 1,300 ft (survey point C15 in Figure 1) from the top of the Lower Reach the channel is well defined by bed and banks. The dominant substrate is silt with some sand and gravel. Active deposits are silt with lesser deposits of sand and gravel. Active deposits are found as thin layers on the banks and within the wetted channel. The vegetation is mature alder and willow with relatively open understory. Undercut banks and pools with a depth of 3 ft or greater were observed in this section. Steelhead, approximately 1 – 2 years old, were observed in the deeper pools.

From 1,300 ft (survey point C15 in Figure 1) downstream to the upper end of a perennial pond, the channel is poorly defined or non-existent. Flow is dispersed into the cattail marsh above the perennial pond. Some flow is routed through an intermittent channel along the northern boundary of the cattail marsh; however, this intermittent channel is lost in the cattail marsh before entering the perennial pond. The dominant channel substrate class is vegetated. Cattail marsh or young willow are the dominant vegetation. Active deposits were not observed. This section of channel may be an impediment to fish migration.

From the outlet of the perennial pond (survey point C12 in Figure 1) to a point about 1,250 ft downstream (survey point C6 in Figure 1) the channel is well defined by bed and banks (Photo C8 and C6-B). The dominant substrate is silt and vegetation with some sand and gravel. Active deposits are silt with lesser deposits of sand and gravel. Active deposits are found as thin films on the banks and within the wetted channel. The vegetation is primarily mature alder and willow with some areas of young alder and willow and sections of perennial grass and marsh. Exposed roots and undercut banks indicate recent scour. Areas of perennial grass and marsh are

concentrated in the 500 ft section below the outlet of the perennial pond. Sections of poor channel development and dispersed flow probably exist in the areas of marsh below the outlet of the perennial pond.

From 1,250 ft below the outlet of the perennial pond (survey point C6 in Figure 1) to about 1,400 ft (survey point C4 in Figure 1) the channel is poorly defined and flow is dispersed in cattail marsh and perennial grass (Photo C3). Active deposits were not observed. Multiple shallow vegetated channels develop in the outlet of the cattail marsh and perennial grassland (near points C4, C3 and C2 in Figure 1). This section may be an impediment to fish migration.

From 1,400 ft downstream of the perennial pond (survey point C4 in Figure 1) to the culverts at the 2nd Bridge Crossing (survey point C1 in Figure 1) the channel is well defined by bed and banks. The channel is located within 30 ft of the road along the south edge of the floodplain. The dominant substrate and active deposits are silt. Active deposits are found as thin films on the banks and within the wetted channel. The vegetation is primarily mature alder and willow.

Historical Channel

The inactive historical channel extends from the point where the main body of surface flow is routed to the floodplain (survey point B2 in Figure 1) to the 2nd Bridge Crossing (survey point S25 in Figure 1). The historical channel has filled in with sediment and there is little surface flow. The primary substrate is silt. Active deposits are generally found as thin films on the banks and within the wetted channel. Mature alder is the dominant vegetation.

From the top of the inactive historical channel (survey point B2) to about 1,800 ft downstream (200 ft northeast of survey point S23 in Figure 1) the historical channel apparently carries a small fraction of the total surface flow. The dominant substrate is silt and fine sand. Active deposits are found as thin films on the banks and within the wetted channel. This section of channel is densely vegetated with young alder and willow.

Surface flow is routed towards the Lower Reach of the now active channel at the outside bend of the historical channel where a grassy ridge extends from the north and constrains the valley (near survey point S23 in Figure 1). Downstream of this area the historical channel is difficult to follow until about 250 ft upstream of the 2nd Bridge. Linear patches of standing water that identify the historical channel were observed, but no surface flow was evident. Mature alder is the dominant vegetation. The dominant substrate class is vegetation and active deposits are not abundant. Active deposits are found as thin films on the banks and within the wetted channel

From 250 ft upstream of the 2nd Bridge (survey point S26 in Figure 1) to the 2nd Bridge (survey point S25) the historical channel becomes defined by bed and banks (Photo S26). The dominant substrate is silt and sand and gravel. Active deposits consist of gravel and sand. Active deposits are relatively stable.

At the time of the survey (mid-April 2008) little surface flow was routed under the 2nd Bridge through the historical channel (Photo S25). It is expected that during flood events water backs up behind the road at the 2nd Bridge Crossing and concentrated flow is routed under the 2nd Bridge. The concentration of flow maintains the channel form of the historical channel in the immediate vicinity of the 2nd Bridge.

Field Observations of Avulsions

Areas of recent avulsion are delineated on Figure 1 and Figure 3. Deposits of sand and gravel are deposited on the floodplain to the south of the channel. Deposits are typically less than 0.5 to 1 ft thick. Fresh deposits extend up to 250 ft from the channel into the floodplain. These fresh deposits are typically surrounded by young willows and alders. The observed deposits are thought to have resulted from overbank flow in winter 2007/08. Older deposits are expected to be vegetated or covered by fresh deposits.

Downstream of the delineated recent avulsion areas there are few active deposits of coarser sediment of sand size or greater. Sand and gravel is typically deposited in the Upper Reach or avulsion areas; further down valley the deposits are mostly fine sand and silt (Figure 2). It is expected that the lous of ongoing aggradation will continue to migrate upstream to the 3rd Bridge and potentially beyond. Flow and sediment is expected be routed into the floodplain to the south of the channel by avulsion processes.

Avulsion Processes

Sedimentation has been an ongoing process in Willow Creek over the last 60 or more years. Prior to the mid 1980's the straightened channel was periodically cleared and dredged to maintain flood capacity. Once dredging and continued channel maintenance ceased in the mid-1980's the channel quickly filled with sediment, and peak flows readily overtopped its banks.

Available aerial photos were overlayed in GIS to map areas of sedimentation and avulsion (Figures 1 and 3). Aerial photos document that the avulsion process began in the mid-1980's and has shifted upstream toward the 3rd Bridge. The first major avulsion documented occurred in the flooding of 1986. The sediment deposits associated with this avulsion, as delineated in Figure 3, spread out across the lower

floodplain upstream of the 2nd Crossing. The next major avulsion documented occurred in 1999, about 2,000 ft upstream from the 1986 avulsion.

The current position of the most active avulsion is shown in Figure 3. The existing point of divergence, where the main body of flow leaves the historical channel and enters the floodplain to the south, is located about 500 ft upstream of the 1999 avulsion (Figure 3). Sediment deposits atop the south bank, on the floodplain, were noted as far as 1,500 ft upstream of the existing point of divergence, indicative of potential channel avulsion in response to development of new debris jams and/or sediment deposits.

The aerial photos and observed deposits indicate that the avulsion process is moving upstream at an average rate of 100 to 150 ft per year (determined as the linear length of stream between 1986 and current avulsion divided by 22 years). It is expected that the avulsion process will continue to migrate upstream at rates similar to that documented in the recent past. As noted previously, stored sediment upstream of the 3rd Bridge and active fluvial and hillslope erosion processes will continue to provide a significant quantities of sediment to lower Willow Creek. Trihey and Associates (1997) estimated rates of coarse sediment production available for delivery to lower Willow Creek to be between 1,930 and 2,130 yds^3 /yr.

The bulk of sediment sand sized and greater is deposited within the channel or atop the banks in the area of recent avulsion. Little of the sand or gravel sized sediment is transported downstream of the area of recent avulsion.

The avulsion process is driven by both high sediment loads and the topography of the lower Willow Creek valley. As noted earlier, the valley gradient is very low, averaging 0.43% (Stewards of Slavianka 2001). Figure 4 and 5 portray cross sections surveyed by Prunuske and Chatham Inc. in 2004. The cross sections show that the floodplain south of the historical channel commonly has an elevation equal to or below the thalweg of the historical channel. Avulsion processes have diverted the active channel into the floodplain at the locations of Cross Sections 7 and 8. Cross Section 8 is about 300 ft downstream of the existing point of diversion.

Upstream of the existing point of diversion, surveyed cross sections do not show the elevation of the floodplain to be below the bottom of the active channel. Future aggradation in the Upper Reach may raise the channel elevation making it higher than the floodplain, setting the stage for further channel avulsion. Cross Section 8 shows the bottom of the active channel to be about 5 ft below the banks and the floodplain. Banks 5 ft tall are consistent with field observations of the upper reach. It is expected that the channel in the Upper Reach will continue to aggrade and avulse into the floodplain to the south. The channel in the Lower Reach, while poorly defined and lacking in continuity in many locations, is not expected to be affected by further significant channel avulsions.

Figure 3: Detail of Stream Avulsions in Willow Creek Floodplain

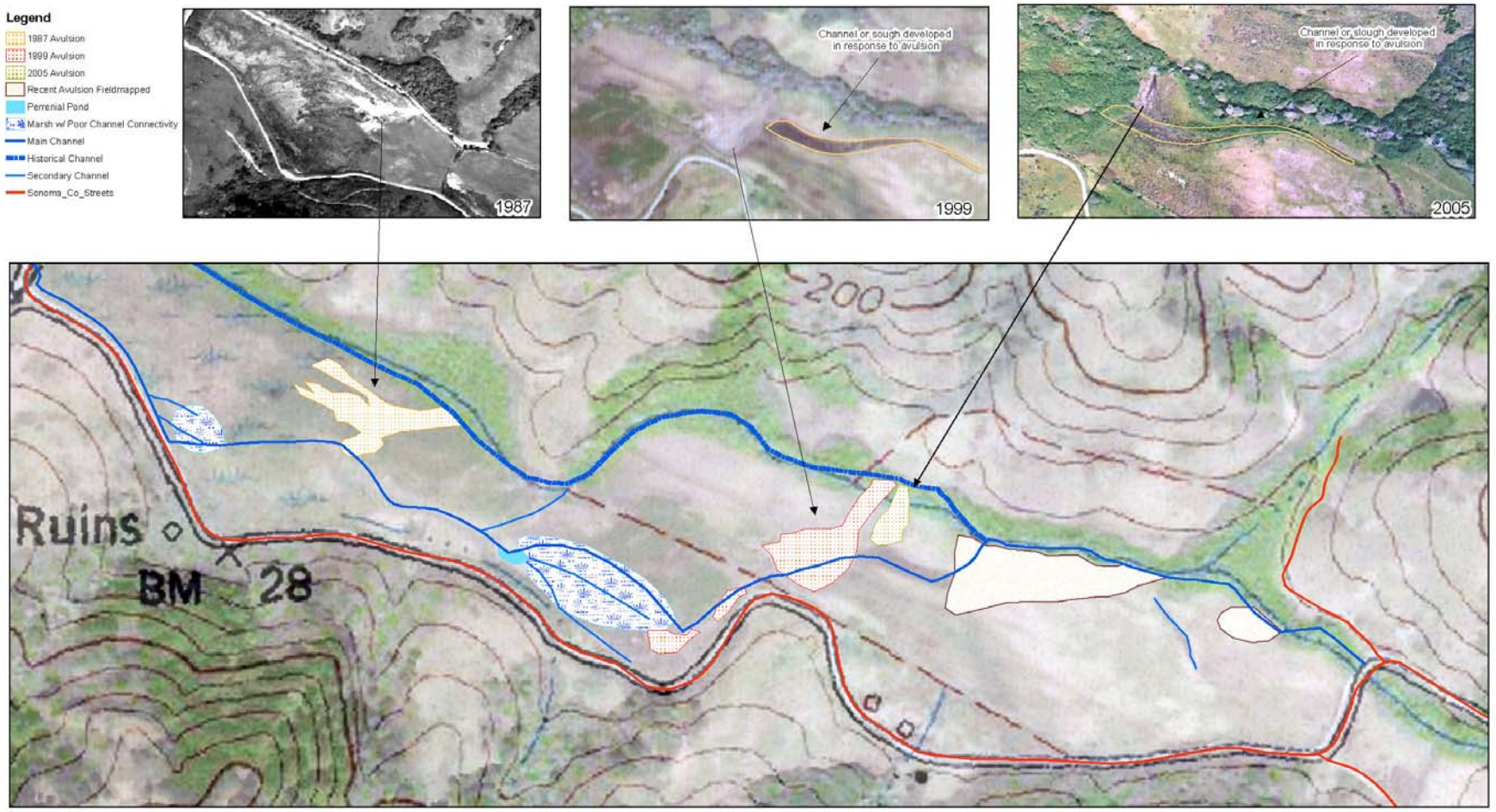


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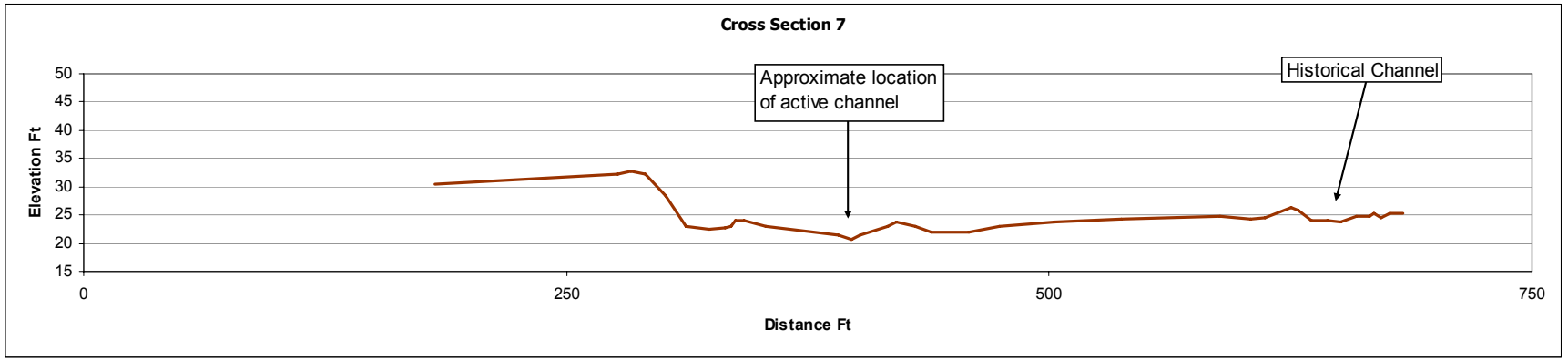
Figure 4: Cross Sections 7 and 8.
Cross Sections plotted from data collected by Prunuske and Chatham, 2004. Topography is shown with the view downstream. Vertical exaggeration is approximately 5:1.



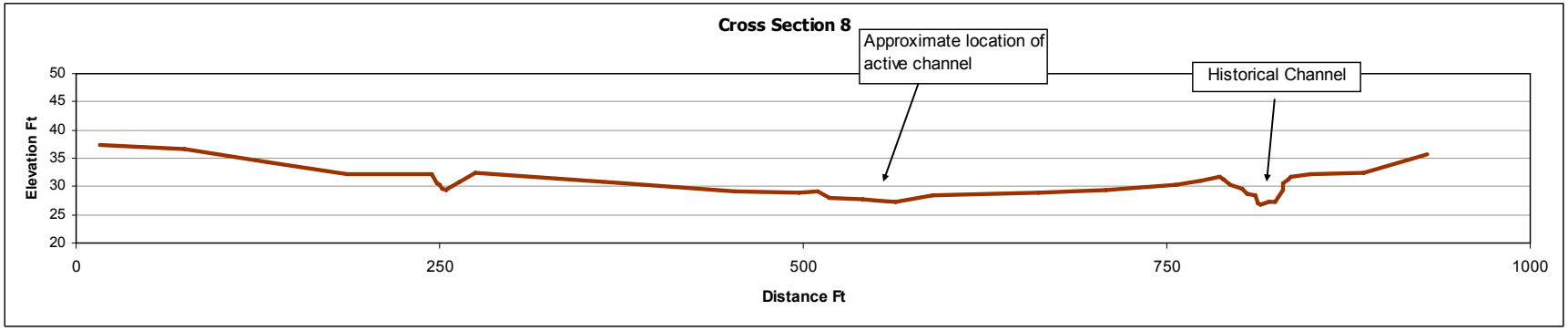
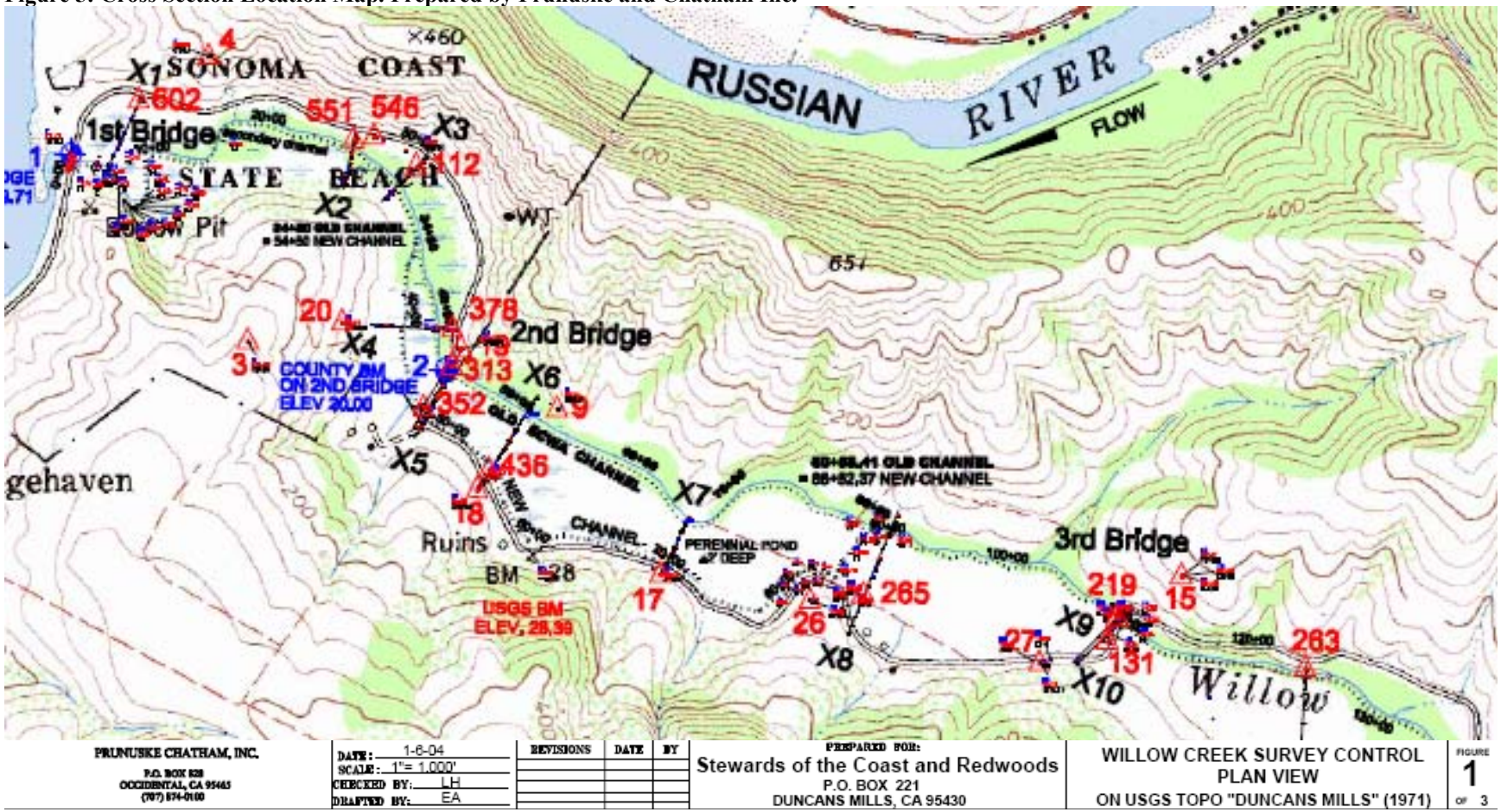


Figure 5: Cross Section Location Map. Prepared by Prunuske and Chatham Inc.



Aquatic Habitat Assessment

The Aquatic Habitat Assessment was conducted by Mike Podlech (report attached, Appendix B). Podlech's fieldwork and report were conducted semi-independently of the OEI work. The observations and conclusions are consistent with OEI's observations. The Aquatic Habitat Assessment noted that the Upper Reach had the greatest complexity of habitat including pools, defined banks, adequate flow, and the greatest abundance of gravel, much of it in the size range appropriate for spawning, in the study reach. Podlech also noted the absence of water in the historical channel downstream of the existing point of divergence. The Lower Reach (the newly formed channel downstream of the existing point of divergence) was the most difficult to characterize in the field, but observations made in the Aquatic Habitat Assessment generally conform with those made by OEI. Channel substrate was noted as being composed of silt, fine sand, and vegetation. Channels generally were recorded as poorly defined in marshy areas and connectivity was considered adequate in stands of riparian trees but suboptimal for rearing habitat. Findings were incorporated in the adaptive management plan

Aerial Photo Analysis of Historic Vegetation Patterns

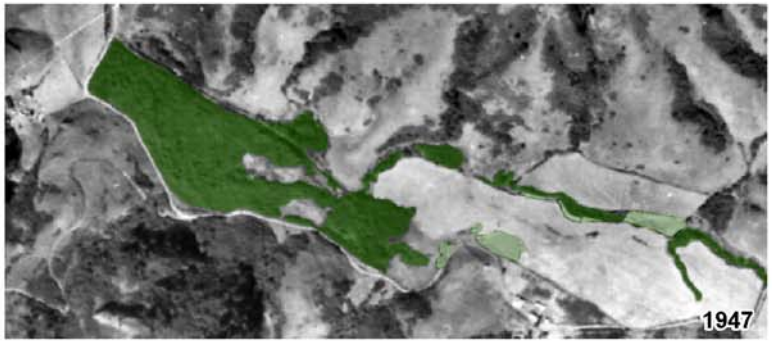
Figure 6 was developed by geo-referencing scanned aerial photos and overlaying them in GIS, enabling one to compare vegetation patterns in the Willow Creek floodplain from 1947 to 2005. In the late 1940s the eastern part of the valley had been cleared for agriculture but the western portion was still covered in mature riparian trees. By the 1950s the entire valley had been cleared of trees except for a few small areas along the dredged channel in the north of the valley. Agriculture was abandoned in the early 1980's and willows and wetland plants colonized the floodplain in the fresh sediments associated with channel avulsion above the 2nd Bridge in the floods of the 1980s. Wetland plants and riparian trees began replacing the grasses that had dominated the floodplain from the 1950's through 1970's.

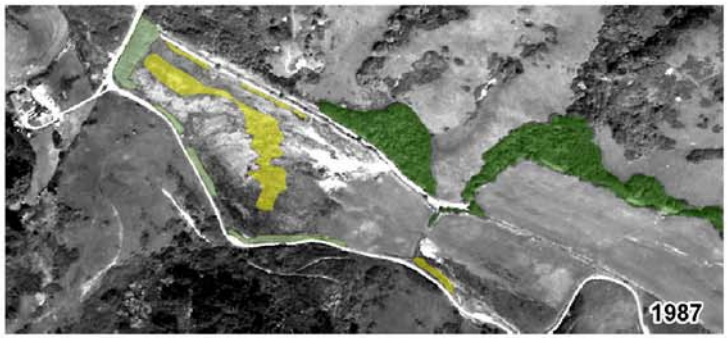
In 1990 grazing was discontinued on State Park property in the lower Willow Creek watershed. Dense riparian willow and alder stands in the valley floor above the 2nd Bridge continued to mature. The 1999 aerial photo shows patches of young riparian trees on newly deposited sediments associated with the avulsion to the east of the 1980s avulsion (Figure 6). Intermediate age stands of riparian trees can be seen in 1999 spreading across the western portion of the floodplain inhabiting the older avulsion deposits of the 1980s and the stand of trees adjacent to the 2nd Crossing has reached maturity. In 2005 the aerial photo shows much of the western half of the floodplain densely populated by intermediate age riparian stands that first established on avulsion deposits then spread across the valley. From observations made in the field it is evident that the avulsion process is moving upstream as the channel continues to aggrade and overtop its banks. The result will most likely be that with each new avulsion, willows and alders will colonize the newly deposited sediments and the pattern of dense stands of riparian trees will migrate up the valley

(eastward). Emergent wetlands have also begun to establish in low-lying area as the channel meanders through the southern portion of the valley, contributing to wet soils conditions. As the riparian trees mature and then die, inputs of large woody debris may increase, which would likely increase local scour and stream complexity, improving fish habitat.

Field observations noted that a lack of channel connectivity was a significant problem in the areas of wetland plants probably owing to ponding of water in low-lying topography. Channels were moderately or well defined in stands of young and mature riparian trees. This may correlate with areas of gently sloping topography with enough gradient to create a defined channel and possibly, enough soil drainage to permit riparian vegetation to thrive.

Figure 6: Patterns of Floodplain Vegetation





California Department of Parks and Recreation, May 2008

Legend

- Young Establishing Riparian Trees
- Intermediate Age Riparian Trees
- Mature Riparian Trees

Young Establishing Riparian Trees- Riparian trees colonizing avulsion deposits

Intermediate Age Riparian Trees- Continuous tree cover seen on air photo but structure of canopy doesn't resemble mature trees

Mature Riparian Trees- Area colonized by trees in previous air photos as well tree canopy structure show definition and structure of older trees

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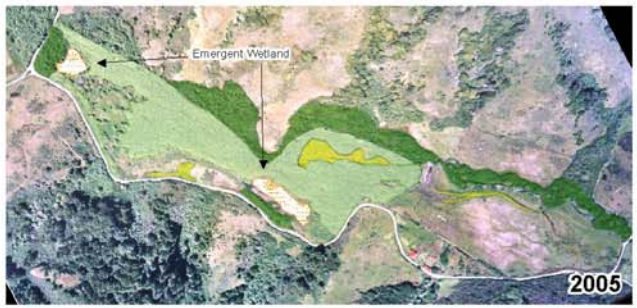

Key Findings Regarding Geomorphic Conditions

The preceding descriptions and interpretations of geomorphic conditions support the following key findings of this assessment.

1. The floodplain and channel of lower Willow Creek in the study area are in a period of dynamic response to historic channel, floodplain and watershed management.
    a. Conversion of the floodplain riparian forest to pasture c. 1950
    b. Dredging of an artificial channel on the north side of the floodplain c. 1950
    c. Elevated rates of erosion in the watershed associated with timber harvest c. 1960-1980
    d. Sedimentation and abandonment of the artificial channel by channel avulsion
    e. Colonization of the floodplain by riparian (willows and alders) and wetland plant communities
    f. Up-valley "migration" of channel avulsion and riparian/wetland vegetation

2. The "Lower Reach" of the study area is dominated by riparian plant communities, channel conditions are relatively stable with lower sedimentation rates. A defined primary channel traverses the Lower Reach, but is interspersed with areas of perennial and seasonal ponds and marshy areas with multiple channel threads and poorly defined channels.

3. The "Lower Reach" of the study area has been subject to channel avulsions that diverted the majority of stream flow from the historic channel to it its current location on the south side of the valley

4. Stable channel conditions in the Lower Reach of the study area are controlled to a large degree by dense stands of woody riparian vegetation. The roots of these plants limit the potential for further channel adjustment. The stems of these woody plants create very high flow resistance that slows water velocity in the channel and on the floodplain in general. These effects are dominant, and overwhelm influence of the 2nd Crossing on floodplain processes.

5. During periods of high stream flow, stream flow in Willow Creek transports bed load sediment and further aggrades the channel as flows encounter portions of the channel undergoing sedimentation. Channel avulsions are widespread in the Upper Reach, and are intensifying.

6. The zone of active sedimentation and channel aggradation continues to migrate up valley and is threatening to overtop the road crossing south of the 3rd Bridge. Flows over the bridge and road were evident during the high flow event of winter 2007/08.

7. Channel restoration and enhancement activities in the Lower Reach are feasible with respect to overall channel stability. Future sedimentation and channel avulsions will occur in the "Upper Reach". Channel restoration and enhancement activity is unlikely to succeed in the Upper Reach until the cycle of sedimentation, channel aggradation, and avulsion runs its course.

8. Bridge construction at the 2nd Crossing will improve flow conditions in the immediate vicinity of the crossing. A primary channel is more likely to establish, and flow divergence to adjacent marshy areas will likely decrease.

Adaptive Management and Monitoring Plan

Management Plan

OEI does not find a strong need for active management of lower Willow Creek, however limited vegetation management and channel restoration may improve channel development and connectivity.

The proposed vegetation management and channel restoration can be implemented before or after the proposed bridge at the 2nd Crossing is constructed. Construction is not expected to deleteriously affect proposed management.

Vegetation Management

Field surveys observed that in the Lower Reach channel connectivity can be correlated with vegetation. Reaches with a dominant vegetation type of perennial grass/marsh plants tended to have poor channel connectivity, while reaches with young or mature trees tended to have moderate to high channel development. Reaches with a mix of young trees and perennial grass and marsh plants tended to have intermittent channel connectivity.

Channel development is not believed to be a function of vegetation type, but rather channel development and vegetation are related to local valley gradient. Perennial grass and marsh plants flourish in low-lying areas of perennially wet soils where water ponds. Trees are less likely to establish themselves in saturated soils. Over time, low areas may slowly fill with sediment further encouraging development of a well defined channel.

Some experimentation with removal of trees in the reach between point C17 and C19 may be useful in aiding channel development. The reach between C17 and C19 is vegetated with young willows and alders along with perennial grass and marsh plants. Removal of some trees in areas of dense growth may be useful to provide a path for higher velocity flow. However the channel position could change in this area given the near proximity to the recent avulsion and potential for sedimentation. An adaptive management experiment of this type at this location would be relatively low risk in terms of potential harm to fish habitat.

Removal of trees for channel development is not recommended downstream of point C17. Areas of poor channel connectivity (downstream of point C17) are located in areas vegetated with perennial grass and marsh plants. Where the dominant vegetation is young or mature trees the channel is typically well defined and does not require further development.

Tree Planting

Historical literature suggests that lower Willow Creek was vegetated with late seral redwood forest during prehistoric post glacial times (Stewards of Slavianka, 2005). An eventual return to these conditions may be desired and could benefit fish habitat in lower Willow Creek. Redwood stands provide deep shade, a source of long lasting large woody debris and associated stream complexity, especially once maturity is reached.

Establishment of redwoods within the willow and alder dominated riparian forests would be difficult due to dense canopy and wet soils. Establishment of redwoods within grassland floodplains could potentially have higher success.

Conifer plantings in the grassland floodplain south of the Upper Reach could provide future stabilized forest area and improved fish habitat. It is expected that Willow Creek will continue to avulse and migrate into the south side of the valley. Willows and alders quickly establish themselves in the fresh sediments associated with each avulsion, and grow rapidly. Establishment of conifers in advance of avulsion and development of the willow/alder riparian community may promote more rapid ecosystem recovery. Established redwoods would eventually provide durable large woody debris as well as seed source. The area for potentially successful conifer planting would include the grassland floodplain south of the Upper Reach and east of point C17. Conifer plantings would take many generations to mature but could help stabilize and improve fish habitat in the lower Willow Creek stream channel network in the long term

Channel Restoration

Major excavation and earth movement is not recommended in lower Willow Creek. Some local excavation, grading and local channel restoration may enhance channel connectivity and improve habitat conditions for salmonids. Due to the high rates of sedimentation and potential for channel migration, channel restoration upstream of point C17 is not recommended.

The construction of a fish-passage channel has been discussed in past studies and considered impractical due to cost and high potential for channel infill (PCI, 2005b). We generally agree with these findings, however substrate data indicate that sedimentation rates in the Lower Reach are relatively low. The dominant substrate below point C17 is silt; the bulk of coarse grained sediment is deposited within the Upper Reach. Therefore, potential for channel infilling below point C17 is low as well.

There are two sections of poor channel connectivity along the Lower Reach (Figure 1). Restoration projects designed to provide channel connectivity may be useful in these areas. The downstream section of poor channel connectivity between points C3 and C6 could potentially benefit from the excavation of a small fish-passage channel 1 to 2 feet

deep and 3 to 5 ft wide. It is expected that the development of the proposed bridge at the 2nd Crossing will increase flows in the area between C3 and C6 that could potentially promote scour and maintain an excavated channel. Alternatively, the excavated channel could eventually infill with sediment, however sedimentation rates are expected to be relatively low in this reach, thus the excavated channel would likely provide fish passage for many years.

The reach between the perennial pond (near point C12) and point C15 is thickly vegetated with cattail marsh and is considered an area of poor channel connectivity. Excavation of a small fish passage channel with a depth of 1 to 2 ft and a width of 3 to 5 ft could provide immediate channel connectivity in this reach. The excavated channel would eventually infill with sediment, however sedimentation rates are expected to be relatively low in this reach, thus an excavated channel would likely provide fish passage for many years.

Monitoring Plan

The proposed monitoring plan of lower Willow Creek is designed to collect data necessary to determine trends in channel development, sedimentation and avulsion. Monitoring is necessary for adaptive management, and can help avoid problems with channel migration and sedimentation. The Monitoring Plan includes collection of cross section data at five specified cross sections and a thalweg survey similar to the reconnaissance level survey conducted as part of this study. The proposed thalweg survey is simple and is designed to be completed within two days.

Monitoring Timeline

Monitoring is recommended to be conducted within a year following completion of construction of the proposed bridge at the second crossing and approximately every three years afterward. At this time, long term objectives of adaptive management do not identify an end point for management, so monitoring is conceived as an open-ended process.

Cross Sections

Three priority cross sections and two cross sections of secondary priority should be surveyed as part of the Monitoring Plan. The cross sections are all transects surveyed by PCI in 2004 and 2008 (cross sections near the 2nd Bridge crossing were surveyed in 2008).

The three priority cross sections include Cross Section 1, immediately upstream of Willow Creek Road at the 2nd Crossing, Cross Section 8.2, in the area of active avulsion, and Cross Section 9, immediately downstream of the 3rd Bridge (Figure 5). Cross Section 2 is a priority cross section because of its proximity to the proposed 2nd Bridge construction project. Cross Section 9 is a priority because of its proximity to the 3rd

Bridge and potential management issues in this area. Cross Section 8.2 is a priority because the area of active avulsion is prone to significant sedimentation and change.

The two cross sections of secondary priority are Cross Sections 6 and 8. We expect the channel location to be relatively stable in these areas. Cross Sections 6 and 8 will be useful in determining rates of deposition and documenting channel stability.

Thalweg Survey

The proposed thalweg survey would be used to map the location of the channel over time and record changes in channel development, morphology and vegetation. The thalweg survey would be similar to the reconnaissance survey conducted as part of this study. This survey focuses on geomorphic conditions, and could be supplemented by periodic habitat surveys (e.g. California Department of Fish & Game habitat typing).

The surveyed reach should follow the main body of flow from the 2nd Crossing to the 3rd Bridge. A GPS unit should be used to record point locations. A field form that records dominant substrate, dominant vegetation, channel form and channel dimensions should be used.

The above characteristics should be recorded every 100 ft and when the channel morphology changes from one class to another.

Dominant Substrate classes should include the following:

- Vegetated surface, no sediment of surface
- Fine sand and silt (< 0.25 mm)
- Sands (0.25-2mm)
- Gravels (>2mm)

Dominant Vegetation classes should reflect relative hydraulic roughness of vegetation and could include the following classes:

- Perennial grass and marsh plants
- Young willows or alders, less than 10 years in age, thick understory
- Moderately aged tree cover, between 10 and 40 years in age, thin understory
- Mature tree cover, above 40 years in age, thin understory with downed logs.

Channel morphology classes should include the following:

- No channel: no defined bed or banks, typically vegetated with perennial grass and marsh type plants, divergent flow paths
- Poor channel: defined bed and banks with a typical bank full depth less than 0.5 ft
- Intermediate channel: defined bed and banks. Bank full depth ranges from 0.5 to 2 ft.
- Developed channel: defined bed and banks. Bank full depth greater than 2 ft.
- Functioning channel: developed channel with pools > 3 ft deep and significant cover afforded by overhanging vegetation and /or woody debris

Channel dimensions should include the following measurements:

- Bankfull width
- Bankfull depth
- Residual pool depth

The thalweg study should aim to accurately map the area of recent avulsion and locate the points where flow diverges from the historical channel.

Monitoring Feedback and Adaptive Management

Adaptive management involves the analysis of monitoring results and adjustments to the management plan, including monitoring, to fit the observed conditions.

It is expected that passive management will allow for gradual improvement of ecosystem function, including increased channel development and connectivity. The rate of improvement of aquatic habitat conditions could potentially be accelerated through local channel restoration and vegetation management. If monitoring data indicates that ecosystem function and channel connectivity has not increased or has decreased, a more active approach to management may be warranted.

Lower Reach

Monitoring of the Lower Reach is expected to demonstrate that riparian vegetation has matured and that channel connectivity and salmonid habitat has improved.

If the proportion of the Lower Reach classified as having "no channel" increases over the first 5 years following bridge construction, this may be interpreted to demonstrate that passive management is not effective. Likewise, if reaches previously classified as developed channel or functioning channel become reaches classified as poor channel or no channel during the first 5 years following bridge construction, then passive management may be considered ineffective.

If passive management is deemed ineffective then active management should be considered. Active management could include focused channel restoration in areas classified as "poor channel" or "no channel".

Upper Reach

It is expected that the channel in the Upper Reach will continue to avulse and the channel will migrate onto the floodplain to the south of the channel. The newly developed channel is likely to be poorly defined, similar in form to channel conditions found in the Lower Reach. Poor channel conditions should not be an indication that passive management is not effective in this Upper Reach. Channel development is expected to take several years, and should be given time before active management techniques are applied.

If channel restoration or vegetation removal is applied in the Lower Reach and the management technique proves effective, then similar management techniques should be applied to areas classified as "poor channel" or "no channel" in the Upper Reach. Where sedimentation rates are high, and proximate to the zone of active or expected future avulsion, active management techniques may not be appropriate owing to the high likelihood of channel migration.

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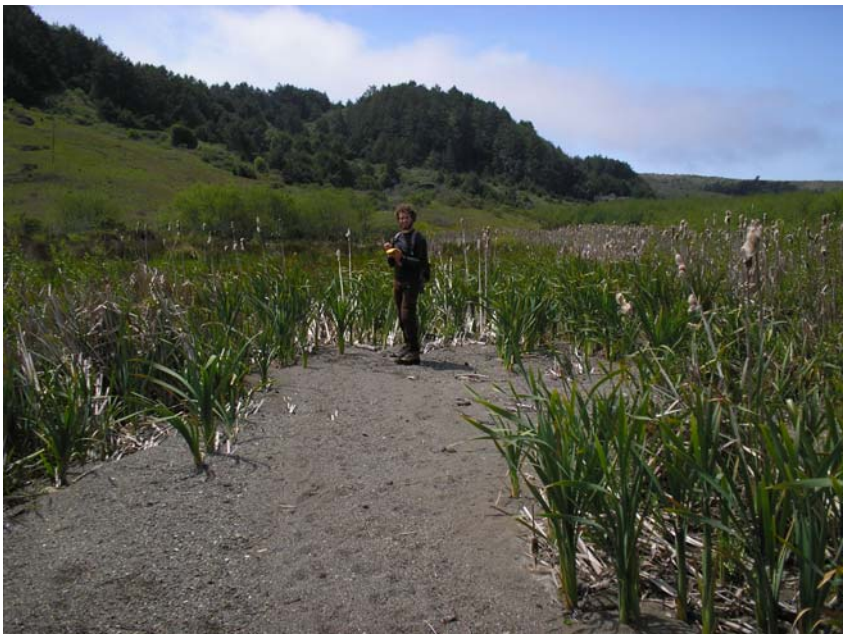
OEI 2008 FIELD PHOTOS

C1: Inflow of culvert at 2nd crossing

C8: Channel in lower reach. Exposed roots, evidence of scour.

C6-B: Channel in lower reach. Dominant Vegetation young alders.

C3: Dispersed flow in perennial grass and marsh plants



C21: Lobe of sand and gravel extending into flood plain. Deposit associated with area of recent avulsion.

S19-A: Channel in upper reach near the existing point of flow divergence. Note the low bank full width.

S26: Historical Channel.

S25: Historical channel directly upstream of 2nd bridge.

S1-C: Channel directly downstream of 3rd bridge.

APPENDIX A: OEI 2008 FIELD FORMS

Willow Creek Geomorphic Study 4/28/08 SURVEY C – CHANNEL BY ROAD & FLOODPLAIN,

Point Name	Location	Photo #	Photo Description	Ch. Form	Dom Sub	Sec Sub	Active Dep	Deposit	Vegetation	Comment
C1	TH.	0032	ROB @ CULVERT.	2	SLT	VEG	YES.	SLT.	3	BOTTOM OF CH BY ROAD - FLAT AREA - MANY CHANNELS
C2	TH	0033	ROB IN FLOW	2	SLT	VEG	YES	SLT	1/2	PARRALLEL CH NORTH OF CH @ ROAD.
C3	TH.	0034	ROB IN TH - NO BANKS	1	SLT	VEG	NOT RECENT	SLT.	1	PARRALLEL CH NORTH + CLOSE TO CH @ ROAD - CH HAS NO BANKS.
C4	TB			2	SLT		YES	SLT	2	WHERE CH @ ROAD VEERS NORTH INTO FLOODPLAIN - AWAY FROM RD.
C5	TH.			1	VEG	SLT	NO		3	NO DEFINED CH - FLOW SPREAD OUT THROUGH WETLAND VEG.
C6	TH.	0035/36	CH REFORMS.	2	VEG	SLT	NO		2	VISIBLE CH AGAIN AFTER NONE IN WETLAND.
C7	TH.	0037.	CH - STARTING TO HAVE BANKS. BRAIDING	2	SLT	FINE SAND	YES	SLT	3	CHANNEL BRAIDED. STARTING TO HAVE BANKS 1.5 FT HIGH.
C8	TH.	0038	ROB IN CH - BANKS ~ 2FT VISIBLE SCOUR	2	SLT	SAND	YES	SLT	3	CHANNEL SCOURING - NETWORK OF SIDE CHANNELS FROM HIGHER FLOW. GRAVEL DEP ON BARS. PIC 0037/0046
C		0041	ALDER ROOT STRUCTURES.							
C9	TH.	0043/0044	UNDERCUT BANKS 2FT HIGH. SIDE CH COMING IN FROM SOUTH.	2	GRAVEL	SAND	YES	5/5	EDGE OF FOREST 1/3.	SIDE CH COMING IN FROM FLOODPLAIN TO SOUTH - W/ PRIMARY FLOW. - FISH SEEN 3" LONG
C10.	TH.	0045	ROB IN WETLAND LOOKING TOWARDS EDGE OF TREES.	1	VEG	SLT	NO		1	CHANNEL LOST DEFINITION - MAYBE AREA OF MAIN FLOW - REMNANT CH RUNS EDGE OF TREES
C11	TH	0046	ROB IN NEW MAIN CH	2	SLT	VEG	NO		1	MAIN FLOW - 20 FT SOUTH OF ALDER TREE LINE - CHANNEL IN TREES IS STAGNANT.
C12	TH	0047.	POND W/ CH OUTFLOW	2	SLT	VEG	NO		1	D/S END OF POND - MAIN FLOW COMING FROM POND.
C13	TH	0048	CH RUNNING NORTH/SOUTH.	2	SLT		NO		3	CHANNEL RUNNING NORTH AWAY FROM POND - 2-3 FT FROM TH-TO-TB. FLOW FROM DREDGED CH ROUTED TOWARDS FLOW @ OUTLET OF POND.

BAP SIGNAL

Willow Creek Geomorphic Study 4/23/08 Survey S

Point Name	Location	Photo #	Photo Description	Ch. Form	Dom Sub	Sec Sub	Active Dep	Deposit	Vegetation	Comment
S1	3rd Th Bridge upstream	0005/0004	OF channel above 3rd Bridge	2	Gr	Sed	yes	Gs/S	3	Thalweg
		006	downstream OF 3rd Bridge.	2	Gr	Sed	yes	Gs	3	
S2	Th			2	Gr	Sed	yes	Gs	3	Thalweg
S3	TB RR			0	Veg	Sed	no not mobile	S/T/FS	3	RR Bank ≈ 4 ft above Thal
S4	TB RL			0	Veg	Sed	no	S/T/FS	3	RL Bank ≈ 5 ft. above Thalweg.
S5	Th	007	OF Phoebe next to alder in Thal.	2	Gr	Sed	yes	Gs/S	3	undercut bank. Channel migration.
S6	Th			2	Gr	Sed	yes	Gs/S	3	eroding bank LB overbank flow. concentrating into marsh
S7	TB RL	008		1	Sed	Veg	yes	FS/SIT	1	overbank flow
S8	End Debris	009	Phoebe in meadow	1	Veg	Sed	yes	FS/ST	1	Sed deposit over bank into meadow.
S9	TB RL	010/011	Phoebe on Bank	1	Sed	Veg	yes	FS	1	Over bank flow/avulsion main channel widening/shallow
S10	End Debris	012	Phoebe in meadow	1	Sed Veg	Veg Sed	yes	FS	1	
S11	RB Trib →		actually 2nd ch.	2	Sed		yes	SIT	3	confluence of Trib and ch. channel will infill of silt
S12	Th 2nd Ch			2	Sed		yes	SIT	2	2nd Channel on RB dense. West Trib.
										lots of connectivity with LB floodplain.
S13	Th	013	Phoebe in CL	2	Sed		yes	S/T/S	2	fine sediment deposits over bank

transition to deep ch silt sub. conn. with ch.

Willow Creek Geomorphic Study 4/23/08 Survey 5

Point Name	Location	Photo #	Photo Description	Ch. Form	Dom Sub	Sec Sub	Active Dep	Deposit	Vegetation	Comment
S14	TB AV			1	Sed	veg	yes	FS	2	Appears to be Avulsion. ch bottom close to level of Banks → 5 ft from
S15	TB AV	014	Deposit of fines on LB	1	Sed	veg	yes	FS	1	Thalweg 2.5 ft from water edge
S16	TB End AV	015	Deposits of fine, with Rob in Rush and young Alders	1	veg	Sed	yes	FS	1	lots of young Alders 2-3 yrs. Represent recent avulsion.
S17	TB RL AVUI	016	Phoebe on bank	2	Sed	veg	yes	FS/SIT	2/3	Point of Major Avulsion Bed of Ch 1.5 ~~2~~ 2 ft ~~above~~ ~~Bed~~. below
S18	Th AVUI	017	Phoeb in ch.	2	Sed		yes	GS/S	2/3	bank Major Avulsion on LB
S19	Th AVUI	018	Phoebe in ch	2	Sed		yes	GS/S	2/3	Major Avulsion Bank on Right of Th.
	AVUI	019	course Sed deposits in							Right Bank also hard to see. Rocks
			ch to the left of main channel. Coming from point S19 of Major Avulsion.							and willow.
~~AVUI~~ S20	TH Dry ch	022		2	Sed	veg	yes	GS/S/SIT	2/3/1	~~Right~~ Head channel has gings/veg or Sed indicating decreased flow.
S21	Th AVUI RR	023	Avulsion to River Right	1	Sed	veg	yes	SIT	1	very little, disconnect with FP. very little
			DS of Main Avulsion on left Bank							Surface flow.
S22	Th	022	ch.	2	Sed	veg	yes	SIT/FS/GS	3	Channel reformed since The points of avulsion

Photo 24/25/26 from ridge north of valley wher river makes a big bend.

Willow Creek Geomorphic Study 4/23/08 survey 5

Point Name	Location	Photo #	Photo Description	Ch. Form	Dom Sub	Sec Sub	Active Dep	Deposit	Vegetation	Comment
S23		028	Phoebe kneeling.	2	Sed	veg	yes	SIT	3	Stagnant pools. veg little flow.
S24	Slump	029		1	veg		yes	SIT	2/3	ponded water. No flow. lots of Sumac
S25	Th	030	2 nd Bridge	2	Sed		yes	gs	3	dead wood. ~~The gravel deposit is~~
S26	Th	031	for dredged channel.	2	Sed		yes	gr	~~thickly~~ rated to localized high flow digging The ponded area.	
≈ 200 FT up flow	no signal		2nd Bridge						~~very little~~ gravel deposits ~~or sign~~.	
		Channel to	exists for vegetation.	200 ≠ 250 The	gravel	FT up flow is likely	remnant	bridge	flow and	gives way related to
		localized	flow.							

Willow Creek Geomorphic Study — Survey B → points on newly formed channel. 4/23/08

Point Name	Location	Photo #	Photo Description	Ch. Form	Dom Sub	Sec Sub	Active Dep	Deposit	Vegetation	Comment 50 Ft South of
B1	on Th FCH	020	Phoebe in ch.	3	Sed	veg	yes	FS/SIT	2/1 young trees	Point where flow leaves dredged channel and enters flood plain.
	Flood Plain channel									
B2	Th AMVI	021	Phoebe on Sand Bar not ID'ed							
	Main Ch Avulsion			3	Sed		yes	FS/SIT	2/3	Point where (Main) Dredged Flow leaves ch.
B3				3	Sed	veg	yes	SIT/FS	3	Low energy flow. Off of dredged channel.
										~~Flow flee main flow~~ Flow diverted flow dredge ch TO flood plain.

Willow Creek Geomorphic Study 4/28/08 SURVEY C CONTINUED

Point Name	Location	Photo #	Photo Description	Ch. Form	Dom Sub	Sec Sub	Active Dep	Deposit	Vegetation	Comment
C14.	TH	0049,	ROD NEXT TO CH @ ROAD	2	VEG	SLT	NO		1	CH NXT TO ROAD - MIGHT BE MAIN CH.
NO SIGNAL. C15	TH	0050	ROD NXT TO CH IN WILLOWS	2	SLT		YES	SLT	3	SMALL CH IN WILLOWS ~ 40 FT NORTH OF TREELINE/FLOODPLAIN. BANKS ~ 6" HIGH. - NOT MUCH FLOW.
"CHPACK BAD. C16	TH.	0051	ROD IN CH.	2	G	S	YES	G	3	FLOW IN CH - GRAVEL DEPOSITS. - TH TO TD ~ 1 HOUR.
		0052	GRAVEL DEPOSITS.							
C17.	TH.	0053	ROD NXT TO CH.	2	SLT	S	NO		3	UNDERCUT BANKS/SCOUR - STEELHEAD. CH 15 FT WIDE + 3 FT DEEP. BANKS ABOUT 1FT ABOVE H_2O
C18	TH			1	SLT		YES	SLT	2	FLOW SPREAD OUT IN MARSHY AREA - NO DEFINED CH.
C19	TH.			1	VEG	SLT	YES	SLT	1	DISPERSED FLOW THROUGH CATTAIL MARSH. H_2O 6" DEEP
C20	TH	0054	ROD IN FLOW.	2	S/G	SLT	YES	G	2	CH JUST D/S OF WHERE MAIN CH AVULSED & FLOW DIVERTED
		0055 - 0057.	CHANNEL FORMS WHERE MAIN AVULSION HAPPENED & SUBSTRATE SIZE							
C21	DEP	0058	ROD @ END OF AVUL DEP.	0	S	G	YES	G/S	3.	END OF LARGE DEP FROM AVULSION.
C22	TH.	0059	ROD @ CH FORMATION NXT TO RD	2	VEG	SLT	NO		3	START CH NXT TO ROAD. / GRAVEL PRESENT
		0060	STAGNANT CH NXT TO RD							
		0061	POND FROM ROAD.							

APPENDIX B: OEI ADAPTIVE MANAGEMENT TABLE

FOR MAP OF SURVEY AREA INCLUDING LOCATION OF SURVEY PTS SEE FIGURE 1

Reach	Current State	Connectivity	Dominant Substrate Observed in Field Apr 2008	Channel Deposition/ Scour	Future Considerations	2nd Bridge Crossing Design	Veg Management Considerations	Adaptive Management Suggestions
Historical Channel (northern channel from existing main divergence C20 down to 2nd bridge crossing)	Stable, mature vegetation holding previous deposition in place- contains little to none of current flow	Lack of water precludes fisheries utilization- connectivity not applicable	Silt and fine sand with some gravel deposits	Channel deposits present- fine sand, sand and gravel- deposits were no fresh - water doesn't appear to flow in the historical channel except for directly u/s of 2nd crossing	Channel stabilized by mature vegetation- deposits wouldn't mobilize if flow frequented channel due to the dense vegetation	Doesn't pose a problem for the bridge design	None applicable- no longer primary channel- no direct benefit from vegetation management	None applicable
Lower Reach (southern channel from existing main channel divergence pt C20 to 2nd bridge crossing)	Meanders through riparian forest and marshy areas- channel defined in areas with bed and banks, channel undefined in many areas	Connectivity and salmonid utilization inhibited by dispersion of flow among many channels. Connectivity patchy, channels poorly defined and shallow, migratory conditions suboptimal, . Upstream adult migration and downstream smolt migration potentially possible in high flows. Substrates dominated by silt and vegetation. Habitat complexity poor- lack of overhanging banks, LWD and pools. Perennial pond may provide good salmonid rearing habitat.	Silt and fine sand dominated with vegetation as a secondary substrate	Active deposits of silt from 2nd bridge up to small emergent wetland, active silt deposits seen from C7-C9 between two emergent wetlands, active gravel, sand and silt deposits seen from large emergent wetland up to major channel divergence C20	Intermittent connectivity problematic for fish passage	Sediment mobility should be considered in bridge design	Consideration of vegetation removal to facilitate channel development and potential for scour. This could decrease width to depth ratio and increase fish passage.	Potential for minimal earth movement to facilitate fish passage. Monitoring of channel development Resurvey crossections every 3 years at X5, X6 and X8
Upper Reach (from existing main channel divergence-survey pt C20 up to 3rd bridge)	Many Recent avulsions noted in 2008 field visit- avulsions migrating upstream- deposition occurring at 3rd bridge	Connectivity very good- 1 main channel with defined banks and channel complexity (pools, riffles, spawning size gravels)	Gravel dominant substrate with sand secondary	Active deposition of gravel and sand at top of reach, many dead mature alders in channel with many feet of deposition up trunks, deposits get finer becoming fine sand and silt going down stream towards main channel divergence C20	Most dynamic reach in study area- needs plan going forward- avulsions and deposition migrating upstream and may compromise future integrity of 3rd bridge. Continued aggradation and avulsions could additionally decrease stream connectivity in this reach going forward	Dynamic and unstable character of the upper reach could cause elevated sediment loads to lower reach with continued avulsions	Planting of redwoods in the open flood plain south of the upper reach.	Monitoring of channel and avulsion. Resurvey crossections every 3 years at X8.2 and X9 to track changes and determine potential problems at the 3rd bridge

APPENDIX C: AQUATIC HABITAT ASSESSMENT BY MIKE PODLECH

Willow Creek Road 2nd Bridge Crossing
Adaptive Geomorphic Plan

Aquatic Habitat Assessment

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May 20, 2008

Introduction

Willow Creek is a tributary to the Russian River near the town of Jenner in coastal Sonoma County, California. The Willow Creek watershed is under 85% fee title ownership by the Department of Parks and Recreation (DPR). Since 2001, a focused effort has been made by DPR and its partners to restore the ecological function of this degraded system. The Willow Creek Watershed Plan (PCI, 2005) provides background information and describes the overall goals and objectives DPR and its partners have identified and prioritized. Improvement of fish passage and channel forming processes at the second Willow Creek Road crossing (2nd bridge) is a high priority for the stakeholders of Willow Creek.

Willow Creek is also considered a high priority watershed for the California Department of Fish and Game (CDFG) coho salmon re-stocking program (CDFG, 2004). Viability of the watershed for the coho recovery program is presently limited due to fish passage restrictions related to the second Willow Creek Road crossing of the creek. In spring 2007, the Willow Creek Technical Advisory Committee (TAC) reviewed a range of culvert and bridge options to restore fish passage at the 2nd bridge roadway. A consensus was reached to design and install a channel crossing at the valley thalweg (west side of the 2nd bridge roadway) that will provide for channel development, hydraulic connectivity, fish passage, and a 20-50 year lifespan. Choices include a freespan bridge or multiple arched or box culverts. In support of this effort, O'Connor Environmental, Inc. (OEI) is preparing an adaptive geomorphic plan that considers a range of options for passive restoration of a properly functioning stream channel and floodplain above the 2nd bridge.

This aquatic habitat assessment report describes current habitat conditions for fisheries resources within the Willow Creek watershed between the 2nd (downstream) and 3rd (upstream) road crossings and presents recommendations for future management of the project area.

Methods

A reconnaissance-level aquatic habitat assessment of Willow Creek between the 2nd and 3rd road crossings was conducted by Mike Podlech, Aquatic Ecologist, on April 23, 2008. The primary objective of the assessment was to qualitatively describe the existing aquatic habitat characteristics of the project reach with regards to its suitability for all life stages of coho salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss*). Observations regarding channel form, channel substrate, instream shelter, habitat complexity, and fish passage potential were documented.

Concurrent with the aquatic habitat assessment, OEI staff mapped and surveyed portions of the flood plain and channel network of the project reach on April 23 and 28, 2008. The primary objective of the OEI survey was to map the existing and historic channels and observe geomorphic characteristics of Willow Creek. Results of the channel mapping work are incorporated into this aquatic habitat assessment.

In addition to the reconnaissance habitat assessment, existing sources of project area information were reviewed. These included the Willow Creek Watershed Management Plan (PCI, 2005), a

1994 CDFG stream inventory report (CDFG, 2000), and a Mendocino Redwood Company watershed analysis (MRC, 2001). These reports provide valuable overviews of the Willow Creek watershed and summarize available data on current and historic coho salmon and steelhead presence and abundance, habitat characteristics, and other pertinent information. The results of these studies are not repeated in this aquatic habitat assessment report, but are incorporated by reference herein. The following discussion focuses solely on currently existing aquatic habitat conditions.

Assessment Results

The following description of aquatic habitat characteristics in Willow Creek is presented in an upstream direction, beginning at the 2nd bridge and extending to the 3rd bridge. Reach designations used in the description are depicted in Figure 1 and photographs of representative sites are provided in Appendix A.

On April 23, 2008, streamflow in Willow Creek was backed up at the culverts. The culverts were mostly to entirely submerged with water depths of up to 24 inches immediately upstream of the culverts. Although the existing culverts are adequately sized, submerged, and inclined to allow for adult coho salmon and steelhead upstream migration and smolt downstream migration, the culverts are known to be partially blocked (PCI, 2005) and may thus impede fish passage. Immediately upstream of the culverts, the backed up streamflow forms a shallow (4-8 inch depth) marsh-like habitat (Photo 1) with no definable channel extending approximately 75 feet upstream Reach A). Adult upstream passage through this area would likely be possible only during large winter flow events and smolt downstream migration may be impeded by a lack of attraction flow through the culverts (i.e., fish may not be able to identify the culverts as the downstream pathway).

Upstream of the ponded reach, Willow Creek flows through a relatively well defined-channel adjacent to Willow Creek Road for approximately 700 feet (Reach B; Photo 2). Average channel widths are approximately 2 feet and average depths range from 6 to10 inches. Channel substrates are dominated by silt and sand. This reach of Willow Creek offers no suitable salmonid spawning or rearing habitat as significant pools, large woody debris (LWD), and undercut banks are largely absent. Moreover, give the shallow depths and low velocities of streamflow observed in April 2008, summer and fall water temperatures in this reach may exceed the tolerance ranges of juvenile coho salmon and steelhead even though the riparian canopy cover is dense. However, this reach likely provides an adequate migratory corridor for adult salmonids in the winter (when streamflows are presumably higher) and smolt salmonids in the spring.

The reach described above is formed by a number of small “tributary” channels that originate in a small cattail-dominated marsh (Reach C; Photo 3). Channels through this area are poorly defined and shallow, offering no spawning or rearing habitat. Upstream adult migration through this marsh area may be possible during high water events, but migratory conditions would be suboptimal. Downstream smolt migration may also be possible when streamflows are high enough to provide migratory cues (i.e., direction) for coho salmon and steelhead.

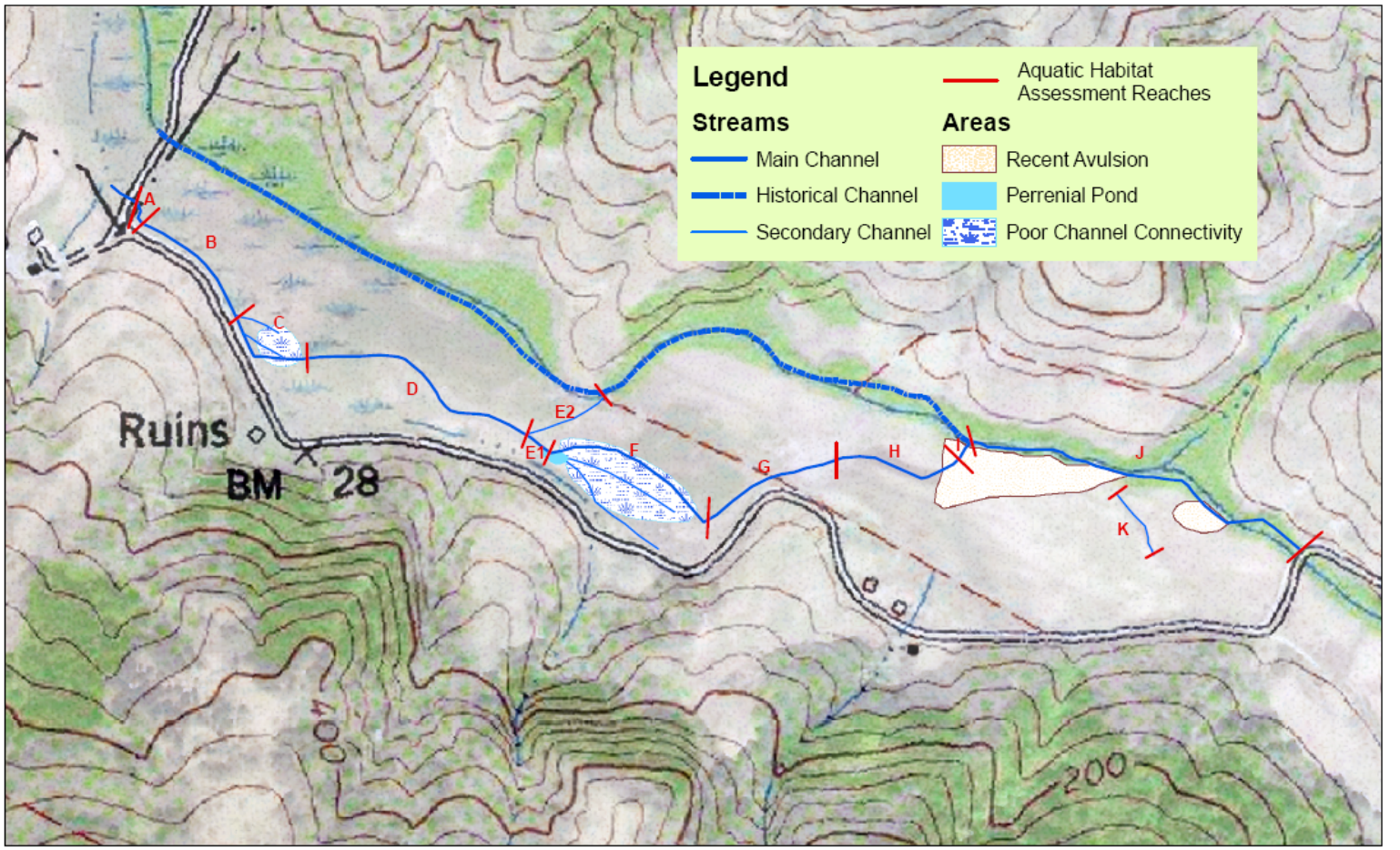

Figure 1. Aquatic Habitat Assessment Reaches, Willow Creek, April 2008.

Upstream of the cattail marsh, the channel Reach D) veers eastward toward the center of the narrow valley and extends approximately 1,200 feet upstream to another larger freshwater pond. Throughout this reach, the channel is relatively well-defined, substrates are dominated by silt and sand with some gravel, and patches of emergent vegetation are present in the channel. Similar to downstream reaches, this reach lacks significant habitat complexity. Some undercut banks and minor amounts of downed logs and branches provide only limited cover and pool formation is sparse. Again, this reach likely serves as an adequate, albeit suboptimal, migration route for adult and juvenile salmonids to and from spawning habitat in the upper watershed, but year-round use of this area by coho salmon and steelhead is unlikely.

The upstream end of the reach described above is formed by the confluence of two channels, one originating from a perennial pond and associated marsh (Photo 4) and the other originating from the historic flood control channel on the north side of the valley. The channel exiting the pond (Reach E1; Photo 5) is approximately 3 feet wide and 1.5 feet deep with relatively swift streamflow. This channel contains no riparian vegetation but flows through dense sedges lining both sides of the channel. Although habitat complexity is lacking, this reach may provide limited rearing habitat for juvenile salmonids, depending on the temperature of the water exiting the pond. Migration through this channel does not appear to be impeded. Depths in the pond itself have been estimated at approximately 2 feet during previous surveys. Given those shallow depths and the likely excessive summer water temperatures, the pond is currently unlikely to support juvenile coho salmon or steelhead. However, both on-channel and off-channel ponds have been shown to provide highly productive juvenile rearing habitat, particularly for coho salmon (e.g., Peterson, 1982; Nickelson *et al.*, 1992; ESA 2003). It is entirely conceivable that prior to the onset of excessive sediment deposition in the valley, this pond may have provided high quality rearing habitat for juvenile coho salmon.

The secondary channel originating from the north is shallow (2-3 inches) and approximately 4 feet wide (Reach E2; Photo 6). One minor pool with a depth of 1.5 feet was observed in this channel reach. Upon entering the main channel below the perennial pond, the northern channel splits into a number of small, poorly-defined channels (Photo 7) that likely impede fish passage during all but significant flow events. The entire reach also lacks suitable spawning and rearing habitat due to the prevalence of silt and sand substrates and the overall lack of instream cover and depth.

Upstream of the perennial pond (reach F), the current Willow Creek channel alignment veers northeast toward the historical channel. The downstream portion of this channel segment is relatively well-defined (Reach G; Photo 8). Water depths, channel widths, and habitat complexity are more suitable for juvenile salmonids than the downstream reaches discussed above. Mature riparian vegetation, undercut banks, and some 3-4 feet deep pools are present. OEI staff observed juvenile salmonids, presumably steelhead, in this reach. While some gravel patches are present, the spawning potential of this reach is limited. Rearing habitat is present, albeit suboptimal due to relatively uniform streamflow characteristics, and migratory passage conditions for both adults and smolts are adequate. A number of minor, poorly-defined channels appear to split away from this section and drain south toward a channel located along Willow Creek Road (Photo 9).

Upstream of this reach section, the channel traverses approximately 600 feet of poorly-defined channel (Reach H) with intermittent flows through marshes and perennial grasses, indicating relatively recent channel formation. Water depths are approximately 6-10 inches and salmonid migration conditions are adequate but suboptimal due to the lack of channel definition. Suitable spawning and rearing habitats are absent.

The upstream end of this channel segment (Reach I) prior to reaching the historic channel alignment is once again relatively well-defined with 4 to 8 inch water depths and 3 to 4 feet channel widths. Riparian vegetation is immature along this section and habitat complexity is low with no significant pools or instream cover.

The upstream 1,200 feet of Willow Creek below the 3rd bridge (Reach J) is contained within the historic channel alignment and offers by the far the most suitable salmonid habitat within the entire assessment reach. Several LWD formations have created pools up to 4 feet deep (Photo 10) and minor channel meanders have created undercut banks. Several groups of young-of-the-year salmonids, presumably steelhead, were observed in this reach, primarily within the pools but also in run habitats. Suitably-sized spawning gravels are also present in this reach. Adult passage is expected to be adequate during winter flows. Juvenile outmigration conditions are largely adequate, but several shallow riffle sections (Photo 11) observed under April 23, 2008 streamflow conditions may impede downstream passage of larger steelhead smolts.

Backwater channels were observed to the south of this reach, but the source of the water could not be determined as no clear hydrologic connection with the main channel could be found. One of these channels (Reach K; Photo 12) was well-defined, 6 to 12 inches deep, and 4 to 5 feet wide. Freshwater emergent vegetation lines the banks of this channel. Upon approaching this backwater channel, several "plops" of frogs jumping into the water could be heard. Although no positive identification was made, the frogs were likely California red-legged frogs based on habitat characteristics, the rapidity of the escape, and the relatively small "plops" indicative of small individuals.

The lower reaches of the historical (flood control) channel on the north side of the valley below the point where streamflows exit the channel were not was not assessed in detail as the lack of water precludes fisheries utilization of this abandoned channel (Photo 13).

Conclusions and Recommendations

As has been described in numerous previous reports, Willow Creek has been severely degraded by past landuse practices. Excessive sedimentation, past channelization projects, and the subsequent cessation of dredging between the 2nd and 3rd bridge have resulted in an aquatic ecosystem undergoing a transitional phase. Aquatic habitat characteristics for coho salmon and steelhead are severely degraded and only the upstream-most reach provides moderately suitable salmonid habitat. An overall lack of channel definition, pools, and LWD, as well as a preponderance of fine sediment deposits, severely limit salmonid spawning and rearing potential within the assessment reach.

A primary objective of this reconnaissance-level assessment was to identify potential barriers or impediments to salmonid migration. While no absolute barrier was identified, several areas are characterized by multiple poorly-defined channels. Streamflows are spread out among the various channels, resulting in shallow depths and low velocities. Adult and juvenile fish passage through these sections is likely possible only during high winter and moderate spring flows, respectively. The primary locations of these undefined channel assemblages are associated with marsh/pond habitats as well as recent channel avulsions. The three culverts at the 2nd bridge roadway likely present passage impediments due to a lack of attraction flow and potential blockages.

Given the low gradient of this valley reach, as well as its close proximity to the Russian River and the ocean, it is conceivable that even prior to the development and degradation of the watershed, Willow Creek was a dynamic channel system in which natural channel realignment across the floodplain occurred frequently. Meanders, oxbows, and side channels likely provided complex aquatic habitat structure ideal for rearing juvenile salmonids. Prior to vegetation clearing and excessive sedimentation, the freshwater ponds and marshes within the assessment reach likely provided deep off- and/or on-channel habitat features with high productivity and low water temperatures that would have supported excellent juvenile salmonid production.

Considering the current transitional state of the channel system through the assessment reach, and the conjectured pre-development conditions described above, I agree with the following Willow Creek Watershed Management Plan (PCI, 2005) recommendation for an essentially passive restoration approach:

> "After the second bridge roadway barrier is addressed, small-scale, low impact solutions for encouraging channel development processes, such as selective vegetation removal and placement of large woody debris or other bioengineering structures should be examined and implemented if necessary. This approach (opening up the floodplain at the second bridge and assisting in natural channel development) would provide a long-term, sustainable solution for the sedimentation and fish passage issues at the second bridge." (p.50)

After conditions at the 2nd bridge roadway have been remediated, the channel system should be allowed to undergo several high flow events and channel formation tendencies should then be assessed. From a fisheries perspective, the most significant problem in the assessment reach is that a limited amount of streamflow is spread out over several channels, limiting channel and habitat formation processes. Encouraging the majority of streamflows, including winter scouring flows, to follow one primary channel through the use of strategically-placed LWD and/or bioengineering structures would likely result in natural improvement of fisheries habitat in Willow Creek over time. At present, the most likely candidate location for such structures is at the downstream end of Reach J where streamflows exit the historic channel and traverse the floodplain. Even under moderate spring flows, a portion of the flow remains within the historic channel and only joins the new main channel below the perennial pond. Blocking the historic

channel at the upstream exit point so that most of the streamflow follows the new channel may improve scour and thus channel and habitat formation processes.

While lower Willow Creek is currently severely degraded, the area offers a rare opportunity to conduct, monitor, and assess largely passive restoration.

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Appendix A

Assessment Reach Photographs

Photo 1: Reach A

Photo 2: Reach B

Photo 3: Reach C

Photo 4: Reach F

Photo 5: Reach E1

Photo 6: Reach E2

Photo 7: Reach E2

Photo 8: Reach G

Photo 9: South of Reach G

Photo 10: Reach J

Photo 11: Reach J

Photo 12: Reach K

Photo 13: Abandoned segment of historic flood control channel

APPENDIX E
Biological Resources Evaluation and Preliminary Wetland Assessment

PRUNUSKE CHATHAM, INC.

Artwork by Susan Holve

BIOLOGICAL RESOURCES EVALUATION AND PRELIMINARY WETLAND ASSESSMENT WILLOW CREEK ROAD 2ND BRIDGE AREA FISH PASSAGE PROJECT SONOMA COAST STATE PARK

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OCTOBER 2008

PRUNUSKE CHATHAM, INC.

BIOLOGICAL RESOURCES EVALUATION AND PRELIMINARY WETLAND ASSESSMENT WILLOW CREEK ROAD 2ND BRIDGE AREA FISH PASSAGE PROJECT SONOMA COAST STATE PARK

PROJECT DESCRIPTION

The Willow Creek Road 2nd Bridge Area Fish Passage Project is located in rural northwestern Sonoma County on a county-maintained road and adjacent habitats in the lower Willow Creek watershed (Figure 1). Outside of the road right-of-way, the site is owned and operated by the California Department of Parks and Recreation (State Parks) as part of Sonoma Coast State Park,. Willow Creek, a tributary to the lower Russian River, is considered a high priority watershed for California Department of Fish and Game's (CDFG) coho salmon restocking program. Viability of the watershed for the coho salmon recovery program is presently limited due to fish passage restrictions related to the county road at the second bridge. In spring 2007, the Willow Creek Technical Advisory Committee reviewed a range of culvert and bridge options to restore fish passage at the second bridge roadway. A consensus was reached to design and install a channel crossing at the valley thalweg that will provide for fish passage, channel development, hydraulic connectivity, and a 20- to 50-year lifespan. The current design includes a precastcast, concrete, 43-foot, single-span bridge system with on-pile footings and precastcast abutments. The proposed project will involve working within the existing road, fill within jurisdictional wetlands and other waters of the U.S., and channel realignment.

Stewards of the Coast and Redwoods (Stewards) has retained Prunuske Chatham, Inc. to perform a biological evaluation of the project site to assess potential project impacts on botanical and wildlife resources and to make a preliminary determination of jurisdictional wetlands. This report is a summary of that evaluation. The final section contains findings and recommendations to ensure impacts on special-status species and sensitive resources are avoided or minimized.

FIELD SURVEY METHODOLOGY

Biological Resources

Field surveys of the project site were conducted on March 12, September 29, and October 5, 2008. The purpose of the surveys was to characterize biological communities within the project site and to determine whether or not suitable habitat for special-status plant and animal species is present. The potential presence of and impacts on special-status species were determined based on a comparison of existing habitat conditions and presence of unique habitat features, proximity of the site to reported occurrences, and geographic range of subject species.

The field survey consisted of evaluating all areas of potential disturbance plus a buffer around the impact areas. During the survey, an inventory of all plant and animal species observed was compiled. The survey was conducted with the aid of binoculars. Visual cues, calls, and songs were used to identify bird species. Unique habitat features (e.g., woody debris, water sources, etc.) and other plant materials were examined for presence of fish, mammals, amphibians, reptiles, and invertebrates.

Preliminary Wetland Assessment
An assessment was conducted on September 29, 2008, to determine if potential jurisdictional wetlands[1] and other waters of the U.S.[2] are present within the project site. The delineation followed protocols described in the Corps of Engineers' (Corps) Wetland Delineation Manual (Corps 1987) and Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual (Corps 2006). Wetlands are identified using three diagnostic environmental characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology. Under normal circumstances and in unproblematic areas, jurisdictional wetlands exhibit all three diagnostic features. Plant species identified within the wetlands were assigned a wetland indicator status[3] based on the National List of Plant Species that Occur in Wetlands, Region 10 – California (RMG 1993).

Figure 1 is a location map with the approximate project boundary noted. Figure 2 is a map of the existing plant communities prepared by Brendan O'Neil, Environmental Scientist, State Parks Russian River District.

PROJECT SETTING
The project site is located on the Sonoma Coast west of the community of Duncans Mills and southeast of Jenner on a county-maintained road and adjacent habitats in lower Willow Creek, a tributary to the Russian River. The site is mapped on the Duncans Mills USGS quadrangle (T7N, R11W; Section Bodega; 38°26'6.16"N; 123° 5'14.15"W) at 35 feet elevation. Open, natural habitats surround the project area. There is a small State Parks maintenance yard immediately to the south of the site. Surrounding land uses include secondary roads, a small residential community, public recreational facilities, agricultural lands, and open space.

The proposed project will involve installing the new concrete bridge, footings, and abutments, road side sloping and realignment, and channel realignment. The project will occur within the existing footprint of the road and will extend out into adjacent habitats. Project work will include the removal of native vegetation and fill within jurisdictional features to accommodate road widening, side sloping, and bridge placement. Upstream of the new crossing, channel grading and native riparian vegetation will be removed to provide for channel development, hydraulic connectivity, and fish passage.

[1] See Wetlands in Appendix A.
[2] See Waters of the U.S. in Appendix A.
[3] See Wetland Indicator Abbreviations in Appendix A.

EXISTING COMMUNITIES AND WETLANDS

Plant communities[4] within the project site and surrounding areas include coastal broadleaf forest, coastal scrub, palustrine wetlands (emergent and forested), grassland, and Monterey cypress and eucalyptus forest. Work will be restricted to palustrine emergent and forested wetlands and existing disturbed habitats (e.g., road berms, gravel roads, pullouts). The remaining communities occur outside of the project site in surrounding areas.

Coastal scrub habitat occurs to the south and northwest upslope of the project site. It is dominated by coyote brush (*Baccharis pilularis*) intermixed with poison oak (*Toxicodendron diversilobum*), grasses, and herbaceous species. Coastal broadleaf forest occupies upper elevations to the northeast of the site and a narrow band adjacent to the maintenance yard. It is dominated by California bay (*Umbellularia californica*) and a mix of understory species (e.g., California blackberry (*Rubus ursinus),* poison oak, etc.). To the southwest of the site, an expansive Monterey pine (*Cupressus macrocarpa*) and eucalyptus (*Eucalyptus* sp.) forest borders the maintenance yard. To the northeast of the project site, immediately adjacent to Willow Creek Road, a small serpentine outcropping occurs with the upper slopes dominated by grasses. The surrounding hillsides are primarily coastal scrub. There is a small, mowed grassland to the south of the maintenance yard.

Three emergent-dominated wetlands are located within the project site (Figure 2). The largest (Wetland A) occurs at the eastern edge of the project site. Wetland A will remain largely undisturbed with the exception of a narrow band along the existing road that will be filled to allow the road to be properly side-sloped. The second (Wetland B) is a small, isolated feature between the existing access road to the maintenance yard and an adjacent pullout. Wetland B will be filled to allow for the realignment of the road. The last feature is narrow wetland paralleling Willow Creek Road (Wetland C) that runs in a northwest-southeast direction; it will be partially filled to allow for road side-sloping. All of the features are connected via underground culverts.

Hydrophytic vegetation dominates the wetland habitats. Wetland A is dominated by spikerush (*Eleocharis* sp., FACW to OBL), broadleaf cattail (*Typha latifolia*, OBL), smallfruit bulrush (*Scirpus microcarpus*, OBL), slough sedge (*Carex obnupta* OBL), and spreading rush (*Juncus patens*, FAC). Adjacent upland habitats are dominated by weedy, opportunistic species and a few native species, including poison-hemlock (*Conium maculatum*), sweet fennel (*Foeniculum vulgare*), brassbuttons (*Cotula coronopifolia*), Canada thistle (*Cirsium arvense*), unidentifiable annual grasses, and small clumps of rush (*Juncus* sp.) and coyote brush.

Wetland B is highly disturbed and consists primarily of tall flatsedge (*Cyperus eragrostic*, FACW), smallfruit bulrush, and frequently mowed arroyo willow shrubs (*Salix lasiolepis*, FACW). Species composition in adjacent, disturbed areas (e.g., pullout, road berm) and wetland margins includes common velvet grass (*Holcus lanatus*), Italian thistle (*Carduus pycnocephalus*), annual beard grass

[4] Botanical nomenclature follows Hickman, et al., (1993) and Biedleman and Kozloff (2003).

(*Polypogon monspeliensis*), skunkweed (*Navarretia squarrosa*), lotus (*Lotus* sp.), pearly everlasting (*Anaphalis margaritacea*), wild oat (*Avena fatua*), and greater periwinkle (*Vinca major*).

Wetland C is dominated by California blackberry (FACW), slough sedge, rush (*Juncus* sp., FAC to OBL), and spreading rush. Additional cover is provided by pennyroyal (*Mentha pulegium,* OBL), Pacific cinquefoil (*Potentilla anserina*, OBL), curly dock (*Rumex crispus,* FACW-), arroyo willow, and black twinberry (*Lonicera involucrate,* FAC). Adjacent upland habitats are dominated by coastal scrub and weedy, opportunistic species on the road berm (e.g., lotus, rough cat's-ear (*Hypochaeris radicata*), English plantain (*Plantago lanceolata*), and miscellaneous grasses).

Soils observed in the wetlands consist of clay loams with low chroma matrices (10YR5/1 (A); 10YR3/1 (B & C)) and redox concentrations (10YR5/4) within the matrices and along root channels. Redox concentrations comprised 10% to 30% of the soil samples. The wetlands receive hydrologic input from direct precipitation, runoff (surface and subsurface) from the surrounding watershed, and inundation during high flows along the stream channel. Positive wetland hydrology indicators observed in the wetlands consist of saturated soils (March 2008), high water tables (March 2008), and oxidized rhizospheres along living roots.

Willow Creek is a blue-line stream channel, as indicated on the Duncans Mills USGS quadrangle. It originates between two steep ridges of the Coast Range and flows in a northwest direction through the valley floor. Watershed elevations range from zero feet to 1,481 feet at Koerber Peak. Stream gradients are steep in the upper watershed (7% to over 20%) and typically less than 1% in the lower watershed. Streamflow patterns are typical of small, coastal watersheds in temperate climates (PCI 2005). No well-defined channel occurs upstream of the culverts, and that habitat is very marsh-like. Further upstream, the channel becomes more well-defined (Podlech 2008). The substrate is comprised primarily of active deposits of silt and sand.

Within the project site and surrounding areas, the Willow Creek floodplain is characterized as palustrine forested wetland. The canopy is dominated by arroyo willow and red alder (*Alnus rubra*). It is extremely dense, and overall canopy cover ranges from 75% to nearly 100%. Understory species include native California blackberry, black twinberry, western sword fern (*Polystichum munitum*), red elderberry (*Sambucus racemosa*), American stinging nettle (*Artica dioica*), thimbleberry (*Rubus parviflorus*), common scouring-rush (*Equisetum hyemale*), giant horsetail (*E. telmateia*), smallfruit bulrush, slough sedge, hedge nettle (*Stachys* sp.), California rose (*Rosa californica*), and common water-plantain (*Alisma plantago-aquatica*). In portions of the habitat that are very marsh-like, *Scirpus* sp., *Carex* sp., and *Equisetum* sp. dominate the understory.

Roadside berms are primarily dominated weedy, opportunistic species with the occasional native plant. Representative species include lotus, rough cat's-ear, English plantain, miscellaneous grasses, greater periwinkle, cow parsnip

(*Heracleum lanatum*), poison hemlock (*Conium maculatum*), cutleaf geranium (*Geranium dissectum*), and low-growing California blackberry and coyote brush.

WILDLIFE RESOURCES

The wildlife resources described below are those that would be expected to occur on the project site and/or in nearby areas where suitable habitat exists. Although the characteristic assemblages may occur predictably within certain vegetation types, it should be recognized that relatively few wildlife species are restricted to a single habitat, and, indeed, some species may require more than one habitat type. Wildlife species common names are used because they are unequivocal.

In general, riparian woodlands, wetlands, and stream channels such as those occurring within the project site provide nesting opportunities, food, and shelter and may serve as corridors or islands during migration for a variety of wildlife species. Birds represent the most abundant and prominent wildlife species within the project area. Bird species typical of riparian woodlands, such as those found within the project area, are chestnut-backed chickadee, ruby and golden-crowned kinglets, Steller's and western-scrub jays, American robin, winter wren, hermit thrush, and common bushtit. The most common finch species include house, purple, and lesser goldfinch. The understory also provides foraging and nesting habitat for ground dwelling species such as the California towhee, California quail, dark-eyed junco, and spotted towhees. Additional migratory species likely to occur and possibly breed within the project area include orange crowned-warbler, Swainson's thrush, Wilson's warbler, Pacific-slope flycatcher, and vireos. Tree climbing birds are also abundant (e.g., Nuttall's, downy, and hairy woodpeckers, white-breasted nuthatch, brown creeper). Large trees and snags provide nesting opportunities for cavity-nesting birds. Birds, like the black phoebe, are often seen sallying over water sources for aerial insects, and ducks (e.g., mallard) may also utilize aquatic habitat.

Suitable foraging and breeding habitat also exists for raptors, including the American kestrel and Cooper's, sharp-shinned, red-shouldered, and red-tailed hawks. Small vertebrates within the habitat are likely to serve as a food source for predatory birds. The large trees within the project area are prime habitat for nesting raptors. Nocturnal avian predators include northern spotted, western screech, and great horned, northern pygmy, and northern saw-whet owls.

The riparian and adjacent habitats support a variety of mammals. The understory and tree cavities provide escape, cover, and nesting sites. The presence of a large number of vertebrate species may serve as a significant food source for larger predatory mammals (e.g., bobcat and mountain lion). Some of the most commonly observed mammals include western gray squirrel, dusky-footed woodrat, northern raccoon, and black-tailed deer. In addition, common bat species may forage over the site, and potential roosting sites for various bat species exist in the crevices and tree hollows found throughout the area. A number of dusky-footed woodrat nests were observed at the margins of the road within the riparian habitat.

Woody debris piles and layers of duff provide habitat for amphibians, such as California slender salamander and *Ensatina*. Additional amphibians, such as northwestern and arboreal salamanders, and western toad, may utilize the area during the breeding and/or nonbreeding season. Common reptiles of this community include western fence lizard, alligator lizard, and snakes (i.e., gopher and garter snakes).

The stream channel itself is an important community for a variety of aquatic organisms. Aquatic salamanders (e.g., rough-skinned and California newts, California giant salamander) utilize channels seasonally. Macroinvertebrates (e.g., waterstrider (*Gerris* sp.), water boatman (*Corisella* sp.)) serve as the food base for terrestrial and other aquatic species. In addition, fish utilize creeks for spawning, rearing, and/or as migratory corridors. The proposed project will significantly improve habitat conditions within the lower watershed and facilitate fish passage and utilization of upstream habitats.

The adjacent palustrine, emergent wetlands and open water habitat provide additional resources for wildlife species. Freshwater wetlands fringing the site provide important foraging and breeding habitat for amphibians, such as the California red-legged frog and Pacific treefrog. Northwestern pond turtles utilize the mud banks for thermoregulation and nesting. Wading birds (e.g., green and great blue herons) forage in the shallows. A number of local bird species are adapted to the marsh environment, including marsh wren, common yellowthroat, red-winged blackbird, and rails.

Adjacent grassland and coastal scrub plant communities provide habitat for a range of wildlife species. Grasses, shrubs, and associated invertebrates provide foraging opportunities for a variety of ground-foraging birds, such as American robin, sparrows (e.g., white-crowned, golden-crowned, song), dark-eyed junco, northern flicker, western meadowlark, and numerous other resident and migratory birds. Predatory hawks, including northern harrier, American kestrel, and white-tailed kite, frequent these areas, as well. Small vertebrates and invertebrates within the habitat are likely to serve as a food source for these birds and other predatory vertebrates. Existing shrubs and small trees provide nest structures for breeding birds. Flowering plants provide important food sources for pollinators.

Subterranean foragers, such as Botta's pocket gopher and California mole, commonly occur in grassland and coastal scrub habitats. In addition, small mice (e.g., deer and harvest), California vole, black-tailed jackrabbit, coyote, gray fox, and black-tailed deer are frequently observed. American badgers utilize grasslands year-round, and evidence of active burrows can often be seen. Reptiles of this community include western fence lizard, alligator lizard, and snakes (e.g., gopher and garter). Bat species may also forage over this habitat.

Nonnative forests (Monterey cypress and eucalyptus) provide additional habitat for wildlife. These habitat types are most commonly used by larger birds for breeding, roosting, and perching. Owls (e.g., barn and great horned) are commonly observed using these areas, and egrets and herons have an affinity for

establishing heronries within these species. Some of the more common mammals (e.g., deer, raccoons) are also frequently observed. While a number of bird species utilize eucalyptus groves, flowering trees are considered to be detrimental to small, native songbirds whose feathers and nasal passages become clogged with gum produced by the flowers. Locally, eucalyptus groves are known to provide winter roost sites for monarch butterflies.

Within the project area, wildlife observations (direct and indirect: scat, tracks, burrows) included violet-green swallow, chestnut-backed chickadee, marsh wren, Anna's hummingbird, fox sparrow, dark-eyed junco, ruby-crowned kinglet, black phoebe, wrentit, Steller's jay, turkey vulture, northern flicker, white-tailed kite, California quail, Nuttall's woodpecker, Wilson's warbler, yellow-rumped warbler, California slender salamander, Pacific treefrog, dusky-footed woodrat, black-tailed deer, northern raccoon, and gray fox.

RARE, THREATENED, AND ENDANGERED PLANTS AND ANIMALS

Special-status species are taxa listed as endangered or threatened by the U.S. Fish and Wildlife Service (USFWS), NOAA's National Marine Fisheries Service (NOAA Fisheries Service), or California Department of Fish and Game (CDFG); taxa designated as candidates for listing; or any species of concern or local concern. In addition, the California Native Plant Society (CNPS) has compiled a list of plant species that are considered rare, threatened, or endangered. Consideration of these plants must be included during project evaluation in order to comply with the California Environmental Quality Act (CEQA) Guidelines concerning special-status species.

The most recent data available from the CDFG Natural Diversity Data Base (CNDDB) were obtained for the Duncans Mills USGS quadrangle where the project is located and surrounding quadrangles and were reviewed to determine potentially occurring rare, threatened, or endangered animal and plant species within the project area's region (CDFG 2008a). The CNDDB reports occurrences of special-status species that have been entered into the database and does not generally include inventories of more common animals or plants. The absence of a species from the database does not necessarily mean that they do not occur in the area, only that no sightings have been reported. In addition, sightings are subject to observer judgment and may not be entirely reliable as a result. The CNDDB/Spotted Owl Viewer database was also reviewed for the reported sightings of northern spotted owl within the project area's region (CDFG 2008b). The CNPS Inventory of Rare and Endangered Vascular Plants of California on-line inventory was reviewed for potentially occurring special-status plants (CNPS 2008). USFWS online species lists of special-status species potentially occurring within the project area were reviewed for the Duncans Mills quadrangle and Sonoma County (USFWS 2008).

SPECIAL-STATUS PLANTS

CNDDB and CNPS records indicate that 57 special-status vascular plants and one lichen have the potential to occur or are known to occur within the project area's region. Based on the suitability of habitat within the project area and proximity of recorded sightings, all 58 species were evaluated for potential

occurrence within the project site during the background literature research. Those species that are known to occur closest to the project area (i.e., on the Duncans Mills quad) include the following 20 species:

Blasdale's bent grass (*Agrostis blasdalei*)
Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*)
Napa false indigo (*Amorpha californica* var. *napensis*)
Baker's manzanita (*Arctostaphylos bakeri* ssp. *bakeri*)
Coastal bluff morning glory (*Calystegia pupurata* ssp. *saxicola*)
Swamp harebell (*Campanula californica*)
Pennell's bird's-beak (*Cordylanthus tenuis*)
Baker's larkspur (*Delphinium bakeri*)
Yellow larkspur (*Delphinium luteum*)
Streamside daisy (*Erigeron biolettii*)
Coast fawn lily (*Erythronium revolutum*)
Pale yellow hayfield tarplant (*Hemizonia congesta* ssp. *congesta*)
Short-leaved evax (*Hesperevax sparsiflora* var. *brevifolia*)
Thin-lobed horkelia (*Horkelia tenuiloba*)
Perennial goldfiels (*Lasthenia californica* ssp. *macrantha*)
Woolly-headed lessingia (*Lessingia hololeuca*)
Tidestrom's lupine (*Lupinus tidestromii*)
Point Reyes checkerbloom (*Sidalcea calycosa* ssp. *rhizomata*)
Purple-stemmed checkerbloom (*Sidalcea malviflora* ssp. *purpurea*)
Two-fork clover (*Trifolium amoenum*)

Status and life history characteristics, along with the observed presence of suitable habitat, potential for occurrence, and reporting details, are described below for those special-status plant species that occur in habitat types found within the project area and/or have reported sightings within close proximity to the site. The remaining species do not occur in habitat types found within the project area, and/or have no local occurrences and are not likely to be impacted by project activities. No special-status plant species were observed during the field survey, and no special-status plants have been reported within the immediate area based on the background literature review.

CNDDB records also indicate the occurrence of three special-status plant communities: coastal terrace prairie, coastal brackish marsh, and coastal and valley freshwater marsh. Coastal terrace prairie and freshwater marsh occur in the project area. Coastal terrace prairie will not be impacted by project activities. There will be project impacts on freshwater marsh.

Special-status Plant Descriptions
The following descriptions include those special-status plant species that occur in habitat types found within the project area and/or have reported sightings within close proximity to the site based on the background literature search.

Blasdale's bent grass (*Agrostis blasdalei*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Perennial rhizomatous herb
Habitat: Coastal bluff scrub, coastal dunes, coastal prairie.
Blooms: May to July

According to the CNDDB overlay, an occurrence of Blasdale's bent grass was documented within 2.0 miles of the project site in 1957. Marginally suitable habitat for Blasdale's bent grass occurs within the project area; however, work will occur outside of these habitats. Impacts on this species are not anticipated.

Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Perennial herb
Habitat: Marshes and swamps, riparian scrub.
Blooms: May to July

According to the CNDDB overlay, the nearest occurrence of Sonoma alopecurus is over 5.0 miles from the project site. Marginally suitable habitat for Sonoma alopecurus occurs within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Napa false indigo (*Amorpha californica* var. *napensis*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Deciduous shrub
Habitat: Broadleafed upland forest (openings), chaparral, cismontane woodland.
Blooms: May to July

According to the CNDDB overlay, there are two historic records of Napa false indigo in the project area's region, but no recently reported occurrences. Potentially suitable habitat for Napa false indigo occurs within the project area; however, work will occur outside of these habitats. Impacts on this species are not anticipated.

Coastal bluff morning-glory (*Calystegia purpurata* ssp. *saxicola*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Perennial herb
Habitat: Coastal dunes, coastal scrub, North Coast coniferous forest.
Blooms: May to September

According to the CNDDB overlay, the nearest occurrence of coastal bluff morning-glory was documented less than one mile from the project site. Marginally suitable habitat for Sonoma alopecurus occurs within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Swamp harebell (*Campanula californica*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Perennial rhizomatous herb
Habitat: Bogs and fens, closed-cone coniferous forest, coastal prairie, meadows and seeps, marshes and swamps (freshwater), North Coast coniferous forest (mesic).
Blooms: June to October

According to the CNDDB overlay, a reported occurrence of swamp harebell within 2.5 miles of the project site was made in 1965, but it may be extirpated. Potentially suitable habitat for swamp harebell occurs within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Sonoma white sedge (*Carex albida*)

Status: List 1B.1 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Seriously endangered in California. Federally and state endangered.
Life form: Perennial rhizomatous herb
Habitat: Bogs and fens, freshwater marshes and swamps.
Blooms: May to July

The CNPS Inventory lists Sonoma white sedge as extirpated from the Camp Meeker quad. The species is only currently known from one location near Sebastopol. Marginally suitable habitat for Sonoma white sedge occurs within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Bristly sedge (*Carex comosa*)

Status: List 2.1 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Seriously endangered in California.
Life form: Perennial rhizomatous herb
Habitat: Coastal prairie, marshes and swamps (lake margins), valley and foothill grassland.
Blooms: May to September

According to the CNDDB, the nearest reported occurrence of bristly sedge is near the town of Bodega Bay, over 5.0 miles from the project site. Marginally suitable habitat for bristly sedge occurs within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Deceiving sedge (*Carex saliniformis*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Perennial rhizomatous herb
Habitat: Coastal prairie, coastal scrub, meadows and seeps, marshes and swamps (coastal salt)/mesic.
Blooms: June, sometimes July

According to the CNDDB overlay, the nearest reported occurrence of deceiving sedge is over 4.0 miles from the project site. Potentially suitable habitat for deceiving sedge occurs within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Baker's larkspur (*Delphinium bakeri*)

Status: List 1B.1 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Seriously endangered in California. State and federally endangered.
Life form: Perennial herb
Habitat: Broadleafed upland forest, coastal scrub, valley and foothill grassland (decomposed shale, often mesic).
Blooms: March to May

According to the CNDDB overlay, the nearest reported occurrence of Baker's larkspur is over 2.5 miles from the project site, and it may be extirpated. Potentially suitable habitat for Baker's larkspur occurs within the project area;

however, no work will occur within this habitat. Impacts on this species are not anticipated.

Golden larkspur (*Delphinium luteum*)

Status: List 1B.1 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Seriously endangered in California. Federally endangered and state-listed as Rare.
Life form: Perennial herb
Habitat: Chaparral, coastal prairie, coastal scrub (rocky).
Blooms: March to May

According to the CNDDB overlay, the nearest reported occurrence of golden larkspur is over 5.0 miles from the project site, and it may be extirpated. Potentially suitable habitat for golden larkspur occurs within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Streamside daisy (*Erigeron bioletti*)

Status: List 3 – more information needed.
Life form: Perennial herb
Habitat: Broadleafed upland forest, Cismontane woodland, North Coast coniferous forest (rocky, mesic).
Blooms: June to October

According to the CNPS Inventory, streamside daisy occurs in the Duncans Mills quad, but no records for it exist in the CNDDB. Potentially suitable habitat for the species exists within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Coast fawn lily (*Erythronium revolutum*)

Status: List 2.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California.
Life form: Bulbiferous herb
Habitat: Broadleafed upland forest, bogs and fens, and North Coast coniferous forest/mesic, streambanks.
Blooms: March to July (August – uncommon)

According to the CNPS Inventory, coast fawn lily occurs in the Duncans Mills quad, but no records for it exist in the CNDDB. This species is typically associated with streambanks in North Coast coniferous forest. Impacts on this species are not anticipated.

Pale yellow hayfield tarplant (*Hemizonia congesta* ssp. *congesta*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California or elsewhere. Fairly endangered in California.
Life form: Annual herb
Habitat: Valley and foothill grassland; sometimes roadsides.
Blooms: April to November

According to the CNPS Inventory, pale yellow hayfield tarplant occurs in the Duncans Mills quad, but no records for it exist in the CNDDB. Potentially suitable habitat for the species exists within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Short-leaved evax (*Hesperevax sparsiflora*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California.
Life form: Annual herb
Habitat: Coastal bluff scrub (sandy), coastal dunes.
Blooms: March to May

According to the CNDDB overlay, short-leaved evax occurs in the project region but is typically on sandy bluffs immediately adjacent to the coast. Marginally suitable habitat for short-leaved evax occurs within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Thin-lobed horkelia (*Horkelia tenuiloba*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California
Life form: Perennial herb
Habitat: Broadleafed upland forest, chaparral, valley and foothill grassland (mesic openings, sandy).
Blooms: May to July

According to the CNDDB overlay, the nearest reported occurrence of thin-lobed horkelia is over 5.0 miles from the project site. Potentially suitable habitat for thin-lobed horkelia occurs within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Baker's goldfields (*Lasthenia californica* ssp. *bakeri*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California.
Life form: Perennial herb
Habitat: Closed-cone coniferous forest (openings), coastal scrub, meadows and seeps, marshes and swamps.
Blooms: April to October

The CNDDB lists several historic occurrences of Baker's goldfields near the town of Bodega Bay, over 5.0 miles from the project site, but no recent observations. Marginally suitable habitat for Baker's goldfields occurs within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Perennial goldfields (*Lasthenia californica* ssp. *macrantha*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California.
Life form: Perennial herb
Habitat: Coastal bluff scrub, coastal dunes, coastal scrub
Blooms: January to November

According to the CNDDB overlay, there is one historic occurrence, but no recent records, of perennial goldfields in the project area's region. Marginally suitable habitat for perennial goldfields within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Woolly-headed lessingia (*Lessingia hololeuca*)

Status: List 3 – more information needed.
Life form: Annual herb
Habitat: Broadleafed upland forest, coastal scrub, lower montane coniferous forest, valley and foothill grassland (on clay, serpentinite)
Blooms: June to October

According to the CNPS Inventory, woolly-headed lessingia occurs in the Duncans Mills quad, but no records for it exist in the CNDDB. Potentially suitable habitat for woolly-headed lessingia exists within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Point Reyes checkerbloom (*Sidalcea calycosa ssp. rhizomata*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California
Life form: Perennial rhizomatous herb
Habitat: Freshwater marshes and swamps near coast
Blooms: April to September

According to the CNDDB overlay, there is one historic occurrence, but no recent records, of Point Reyes checkerbloom in the project area's region. Potentially suitable habitat for Point Reyes checkerbloom exists within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Purple-stemmed checkerbloom (*Sidalcea malviflora* ssp. *purpurea*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Fairly endangered in California.
Life form: Perennial rhizomatous herb
Habitat: Broadleafed upland forest, coastal prairie.
Blooms: May to June

According to the CNDDB overlay, purple-stemmed checkerbloom occurs in the project area's region. Potentially suitable habitat for Point Reyes checkerbloom exists within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Two-fork clover (*Trifolium amoenum)*

Status: List 1B.1 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Seriously endangered in California. Federally endangered.
Life form: Annual herb
Habitat: Coastal bluff scrub, grassland (sometimes serpentine).
Blooms: April to June

According to the CNDDB, one individual plant of two-fork clover has been documented in the project area's region, over 5.0 miles from the project site. Potentially suitable habitat for the species exists within the project area; however, no work will occur within this habitat. Impacts on this species are not anticipated.

Saline clover (*Trifolium depauperatum* var. *hydrophilum*)

Status: List 1B.2 - considered by CNPS to be rare, threatened, or endangered in California, but more common elsewhere. Seriously endangered in California.
Life form: Annual herb
Habitat: Marshes and swamps, valley and foothill grassland (mesic, alkaline), vernal pools.
Blooms: April to June

According to the CNDDB, saline clover has been documented in the project area's region, over 5.0 miles from the project site. Marginally suitable habitat for the species exists within the project site. This species was not observed during the field survey; however, focused botanical surveys were not completed. A follow-up survey in spring/summer 2008 will occur to definitively determine this species' presence within the area of impact. However, due to the lack of reported occurrences, impacts on this species are not anticipated.

Special-Status Animals

The CNDDB records and background literature review identified the potential presence of 30 special-status animal species within the project area's region. These include:

Northwestern pond turtle (*Actinemys marmorata marmorata*)
Pallid bat (*Antrozous pallidus*)
Sonoma tree vole (*Arborimus pomo*)
Great blue heron (*Ardea herodias*)
Burrowing owl (*Athene cunicularia*)
Marbled murrelet (*Brachyramphus marmoratus*)
Rhinoceros auklet (*Cerorhinca monocerata*)
Western snowy plover (*Charadrius alexandrinus nivosus*)
Townsend's big-eared bat (*Corynorhinus townsendii*)
Monarch butterfly (*Danaus plexippus*)
Tidewater goby (*Eucyclogobius newberryi*)
Tufted puffin (*Fratercula cirrhata*)
Hoary bat (*Lasiurus cinereus*)
Gualala roach (*Lavinia symmetricus parvipinnis*)
Bumblebee scarab beetle (*Lichnanthe ursina*)
Long-eared myotis (*Myotis evotis*)
Fringed myotis (*Myotis thysanodes*)
Coho salmon – central California coast (*Oncorhynchus kisutch*)
Steelhead – central California coast (*Oncorhynchus mykiss)*
Chinook salmon – California coastal (*Oncorhynchus tshawytscha)*
Osprey (*Pandion haliaetus*)
Double-crested cormorant (*Phalacrocorax auritus*)
California red-legged frog (*Rana aurora draytonii*)
Foothill yellow-legged frog (*Rana boylii*)
Bank swallow (*Riparia riparia*)
Myrtle's silverspot (*Speyeria zerene myrtleae*)
Northern spotted owl (*Strix occidentalis caurina*)

California freshwater shrimp (*Syncaris pacifica*)
American badger (*Taxidea taxus*)
Mimic tryonia (=California brackishwater snail) (*Tryonia imitator*)

Based on the suitability of habitat within the project area and proximity of recorded sightings, the above-listed species were evaluated for potential occurrence within the project site. Status and life history characteristics for those species with potential habitat within the project area and/or recorded occurrences within the immediate area are described below (Zeiner, et al., 1990). The remaining species do not occur in habitat types found within the project area and/or have no local occurrences and are not likely to be impacted by project activities.

Descriptions of Special-Status Animals and Discussion of Potential Impacts
The following descriptions include those special-status animals that occur in habitat types found within the project area, that have reported sightings within close proximity to the project site, and/or that have a high probability of occurring on the site based on the background literature search and on-site evaluation.

Northwestern pond turtle *(Actinemys marmorata marmorata)*
Status: California Species of Special Concern

The northwestern pond turtle is one of two distinct subspecies of the western pond turtle, which occurs from Washington south to Baja, Mexico. The northwestern subspecies occurs from the San Francisco Bay north, and the southwestern pond turtle (*A. m. pallida*) occurs from the San Francisco Bay south. There is a zone of intergradation between the two subspecies throughout the San Francisco Bay area and the San Joaquin Valley.

Pond turtles are most commonly found in or near permanent or semi-permanent water sources in a variety of suitable habitats throughout much of western California. This omnivorous species requires basking sites such as emergent logs, rocks, mud banks, or mats of aquatic vegetation for thermoregulation. Underwater retreats are also required for predator avoidance. Nesting sites of this species have been found some distance, up to 400 meters or more, from aquatic habitat. They have also been found using upland sites for aestivation and overwintering.

According to the CNDDB, pond turtles are known to occur along tidally influenced habitats on mainsteam Russian River within 0.5 miles of the project site. Habitat within and surrounding the project may support seasonal habitat for turtles. Pond turtles may utilize the creek channel and wetland habitats as migratory corridors, foraging habitat, and uplands for breeding. This species was not observed or detected during the field survey, and impacts on this species are unlikely. However, pond turtles should be protected in accordance with the following recommendations.

Sonoma tree vole (*Arborimus pomo*)
Status: California Species of Special Concern

The California red tree vole occurs in coniferous forest in humid areas where it is reported to be rare or uncommon. Tree voles are largely nocturnal and active year-round. Their home range generally consists of one to several fir trees. They primarily feed on the needles of Douglas fir and grand fir. Nests are typically constructed from 6 to 150 feet above ground and are made primarily of resin ducts from Douglas fir needles, which they remove before feeding. Males are also known to nest in burrows at the base of trees. Breeding occurs year-round, with peak activity from February to September. The primary predators of voles are spotted owls, saw-whet owls, and possibly raccoons.

According to the CNDDB, a number of reported occurrences of tree vole have been made within the project area's region, including two sightings within 1.0 of the project site in forested habitats on the north side of the Russian River and upstream of the site, respectively. There are 10 reported occurrences on the Duncans Mills quadrangle alone. Suitable habitat for tree voles occurs within the forested habitats upslope of the project site; however, work will not occur within these areas. This species was not observed during the field survey, and project impacts on this species are unlikely.

Great blue heron (*Ardea herodias*; rookery site)
Status: Not formally listed. Considered to be a sensitive resource by California Department of Fish and Game.

The great blue heron is the largest heron in North America and the most widespread. Great blue herons feed primarily in saline and freshwater habitats. Their diet is comprised primarily of fish, but they will also take smaller animals. Like most egrets and herons, they feed by slowly stalking their prey and then striking with their large, dagger-like bill. Colonial nests are built in large trees or snags, often in association with great egrets. Monogamous pairs lay 3 to 4 eggs from February to March.

Heron and egret nesting colonies have been monitored by Audubon Canyon Ranch since the early 1990s (Kelly, et al., 2006). There is an active heronry on Freezeout Road between Jenner and Duncans Mills. The colony is within 0.75 miles of the project site (CDFG 2008a) and is located in a mature Douglas fir forest on the south side of the river. Suitable breeding habitat for great blue herons and similar species occurs within the eucalyptus and Monterey cypress grove upslope of the project site; however, work will not occur within this area. Currently, there is no evidence to suggest the immediate project area is being utilized as a colony nest site; however, birds may forage within and surrounding the project site. No herons or egrets were observed during the field survey. All birds should be protected in accordance with the following recommendations.

Monarch butterfly (*Danaus plexippus*)
Status: Not formally listed.

The monarch is medium-sized (3-inch wingspan), milkweed butterfly of the Family Danaidae. Monarchs are dependent on milkweed plants of the Family Asclepiadaceae. They utilize milkweeds as a food source during all life stages and as a substrate for depositing their eggs. Monarchs migrate annually in the fall from northern breeding grounds of North America to temperate wintering grounds, including coastal California and Mexico. Within California, wintering grounds include wind-protected tree groves (eucalyptus, Monterey pine, cypress) along the coast.

According to the CNDDB, there are a number of reported occurrences of winter roost sites of monarch butterfly in the Bodega Bay area. The closest observation to the project site is within 2.5 miles at Wright's Beach Campground from the mid-1980s. Suitable habitat for wintering monarchs occurs within the eucalyptus and Monterey cypress grove upslope of the project site; however, work will not occur within this area. This species was not observed during the field survey, and project impacts on this species are unlikely.

Coho salmon - central California coast (*Oncorhynchus kisutch*)
Status: Federally and state-listed as endangered

Coho salmon spend their adult life in the ocean, migrate up freshwater streams to spawn, rear at least partially in freshwater, and migrate to the ocean as juveniles. Unlike other Pacific salmon in California, their reproductive strategy is completed over a three-year cycle and is fairly rigid. Spawning years with relatively poor reproductive success can result in poor spawning runs three years later. Adult coho start to arrive at spawning grounds in late summer and fall to begin acclimation to freshwater before they migrate upstream. Upstream migration is usually triggered by an increase in flow from a winter storm event. The spawning period in creeks occurs between late October and early February. Coho die soon after spawning. Juvenile coho emerge from the gravel the following spring and usually rear in the stream for one year before migrating to the ocean.

Fisheries population surveys in the Willow Creek watershed have documented the occurrence of central California coast – coho salmon (Cox 2000; NOAA Fisheries Service 2000). Surveys in the early to mid-1960s found abundant coho, with subsequent surveys documenting a steady decline (PCI 2005). In 1990, seventeen coho salmon were detected in the upper watershed. By 1994, only two could be found in the mainstem, and the last coho seen in the watershed was in September 1995 (PCI 2005). Current population surveys need to be completed.

Existing site conditions at the second bridge are acting as a low-head dam, trapping streamflow and sediment and restricting fish passage (PCI 2005). The proposed project will significantly improve habitat conditions within the lower watershed and facilitate fish passage and utilization of upstream habitats. If water is present in the stream channel during project activities, and dewatering is

necessary, precautionary measures should be taken to avoid impacts on this and other aquatic species in accordance with the following recommendations.

Steelhead - central California coast ESU (*Oncorhynchus mykiss*)
Status: Federally listed as threatened

Steelhead are anadromous salmonids, meaning they spawn in fresh water and mature at sea. Steelhead generally spend their first and sometimes second year of life in freshwater creeks and then one to four years at sea. They return to spawn in their natal streams as many as four times. Juvenile steelhead generally occupy glides and riffles and less frequently pools. Adult steelhead spawn from December through April in cool, clear, well-oxygenated streams with pea to apple-sized gravel, usually at the head of a riffle. Steelhead populations have declined from historic levels due to past land use practices and more recent impacts, such as development, sedimentation, and increasing water usage.

Fisheries population surveys in the Willow Creek watershed have documented the occurrence of central California coast - steelhead trout (Cox 2000; NOAA Fisheries Service 2000). Steelhead trout were once abundant in the watershed, but they have suffered a precipitous decline beginning in the late 1960s and 1970s (PCI 2005). The population stabilized in the early 1990s. Current population surveys need to be completed.

Existing site conditions at the second bridge are acting as a low-head dam, trapping streamflow and sediment and restricting fish passage (PCI 2005). The proposed project will significantly improve habitat conditions within the lower watershed and facilitate fish passage and utilization of upstream habitats. If water is present in the stream channel during project activities, and dewatering is necessary, precautionary measures should be taken to avoid impacts on this and other aquatic species in accordance with the following recommendations.

Chinook salmon - California coastal ESU (*Oncorhynchus tshawutscha*)
Status: Federally listed as threatened

Chinook salmon are the largest member of the *Oncorhynchus* genus and can reach up to 30 pounds. They typically spawn in large, coastal streams and rivers. Locally, Chinook salmon enter the Russian River in late summer through winter with peak spawning occurring in November and December. Spawning occurs in fast-moving, shallow riffles with clean, loose gravel. Chinook salmon die after spawning. Shortly after emerging from the gravel (after 30 to 150 days), young Chinook salmon begin the downstream migration to the ocean where they spend two to fours years before returning to freshwater. Chinook salmon populations have declined dramatically from historic levels.

Chinook salmon are known to occur and successfully spawn in the Russian River watershed. This species is typically confined to the mainstem and larger tributaries and not typically found in small drainages. The likelihood of occurrence within Willow Creek is low, and impacts are unlikely. If water is present in the stream channel during project activities, and dewatering is

necessary, precautionary measures should be taken to avoid impacts on this and other aquatic species in accordance with the following recommendations.

California red-legged frog (*Rana aurora draytonii*)
Status: Federally listed as threatened and California Special Concern Species

The California red-legged frog (CRLF) is most common in marshes, streams, lakes, reservoirs, ponds, and other water sources with plant cover. Breeding occurs in deep, slow-moving waters with dense, shrubby, or emergent vegetation. Breeding generally occurs from late November through April. Egg masses are attached to emergent vegetation (e.g., *Typha* or *Scirpus*) near the water's surface. Tadpoles require 3.5 to 7 months to attain metamorphosis. Adults take invertebrates and small vertebrates. Larvae are thought to be algal grazers.

According to the CNDDB, there are reported occurrences of red-legged frogs in the coastal valley and foothill marsh habitat downstream of the site. An observation of frogs was reported in 1999 within 0.5 miles of the site. Suitable habitat for CRLF occurs within the project site and surrounding areas. Frogs may utilize the stream channel and all of the wetlands for foraging habitat, aestivation, and/or as migratory corridors throughout the year. They may use the adjacent palustrine, emergent wetland for breeding. Precautionary measures should be implemented to avoid impacts on this species, and frogs should be protected in accordance with the following recommendations.

Foothill yellow-legged frog (*Rana boylii*)
Status: California Special Concern species.

The foothill yellow-legged frog occurs from southern Oregon south to the Salinas River in Monterey County, California, and in isolated patches in the Cascade and Sierra Nevada foothills. The foothill yellow-legged frog is found in or near partly shaded, rocky streams from near sea level to 6,300 feet in a variety of habitats. Breeding generally occurs from mid-March to early June after high winter flows have subsided. Egg masses are attached to the downstream side of rock and gravel in shallow, slow, or moderate-sized streams. Tadpoles require three to four months to attain metamorphosis. Adults take aquatic and terrestrial invertebrates, and tadpoles graze along rocky stream bottoms on algae and diatoms. During all seasons, this species is generally found in or within close proximity to streams.

According to the CNDDB, foothill yellow-legged frogs are known to occur within Austin Creek, an upstream tributary to the Russian River. There is a recent observation from 2005 near the mouth of Austin Creek within 2.75 miles of the project site. Foothill yellow-legged frogs typically occur in rocky streams with perennial flow. Current conditions at the project site may preclude frogs from occupying the site. Frogs may utilize more suitable, upstream habitats in the upper watershed; however, there are no documented occurrences. Frogs were not observed during the field survey, and the likelihood of occurrence is low. However, if water is present in the stream channel during project activities,

and dewatering is necessary, precautionary measures should be taken to avoid impacts on this and other aquatic species in accordance with the following recommendations.

Myrtle's silverspot (*Speyeria zerene myrtleae)*
Status: Federally listed as endangered

The Myrtle's silverspot is a medium-sized (2.2-inch wingspan), brush-footed butterfly of the Family Nymphalidae. Historically, they occupied coastal dune, prairie habitat, dunes, and bluffs from San Mateo County north to the Russian River in Sonoma County. Four remaining populations occur in western Marin County and southwestern Sonoma County. Larvae typically feed on violets (*Viola adunca*) where eggs are laid.

According to the CNDDB, no recent occurrences of Myrtle's silverspot have been reported within the project area's region. There are a number of occurrences for the Bodega Bay area from the 1960-70s, an occurrence near Goat Rock State Beach from 1975, and one near Portuguese Beach from 1973. Neither suitable host plants nor individuals of this species were observed during the field survey. Suitable habitat may occur within surrounding grassland and coastal scrub habitats; however, work will not occur within these areas. This species was not observed during the field survey, and project impacts on this species are unlikely.

Northern spotted owl (*Strix occidentalis caurina*)
Status: Federally listed as threatened and California Special Concern Species

The spotted owl is an uncommon, permanent resident of dense forest habitats in northern California and oak and oak-conifer habitats in southern California. This nocturnal species requires dense, multi-layered canopy cover for roosting sites. The spotted owl has experienced a population decline due to the loss and degradation of existing mature and old growth forests. Spotted owls feed upon a variety of small mammals, birds, and large arthropods. Nest sites include tree or snag cavities or broken tops of large trees. The typical breeding period lasts from early March through June. A pair of owls may utilize the same breeding site for 5 to 10 years; however, they may not breed every year.

According to the CNDDB/Spotted Owl Viewer database, northern spotted owls have a reported occurrence approximately 1.5 miles from the project site within forested habitats in the upper Willow Creek watershed. Suitable habitat for owls occurs within the forested habitats upslope of the project site; however, work will not occur within this area. Birds may forage within the project site and surrounding areas. Project impacts on this species are unlikely. However, all birds should be protected in accordance with the following recommendations.

California freshwater shrimp (*Syncaris pacifica*)
Status: Federally and state-listed as endangered

The California freshwater shrimp is a small, 10-legged crustacean occurring in low-elevation and gradient (less than 1%) perennial streams in Marin, Sonoma, and Napa counties. They occur in shallow pools away from the main current where they feed primarily on detritus and, to a lesser extent, on decomposing vegetation, dead fish, and invertebrates. Most shrimp appear opaque to nearly transparent with colored flecks across their bodies. Females can appear dark brown to purple under certain conditions. Breeding occurs in the autumn, but young do not hatch until the following May or early June. After breeding, female shrimp carry the fertilized eggs attached to their abdominal swimming legs throughout the winter. The freshwater shrimp has been extirpated from many streams and continues to be threatened by introduced predators, pollution, and habitat loss.

According to the CNDDB, California freshwater shrimp are known to occur within Austin Creek, an upstream tributary to the Russian River. There are reported occurrences in Austin Creek within 3.5 miles of the project site. Freshwater shrimp occur in stream channels with perennial flow. Current conditions at the project site may preclude shrimp from occupying the site. Shrimp may utilize more suitable upstream habitats in the upper watershed; however, there are no documented occurrences. If water is present in the stream channel during project activities, and dewatering is necessary, precautionary measures should be taken to avoid impacts to all aquatic species in accordance with the following recommendations.

Special-Status Bat Species
In addition to the above-mentioned species, the background literature search identified the potential presence of a number of special-status and common bat species, including pallid bat, Townsend's big-eared bat, long-eared myotis, fringed myotis, and hoary bat. Pallid and Townsend's big-eared bats are listed by the California Department of Fish and Game as California Species of Special Concern. The remaining species are not currently listed but are considered sensitive by a number of resource agencies.

According to the CNDDB, there is a reported occurrence of hoary bat near the town of Bodega Bay from 1975; Townsend's big-eared bat, long-eared myotis, and fringed bat near Pinnacle Rock from 1999; and pallid bat in inland habitats near Bodega Bay. Suitable habitat (e.g., roosting, foraging) occurs on site. All bats should be protected in accordance with the following recommendations.

PROTECTED BIRD SPECIES
Under the Migratory Bird Treaty Act (MBTA), it is unlawful to take, kill, and/or possess migratory birds at any time or in any manner, unless the appropriate permits are obtained. Protections extend to active nests, eggs, and young birds still in the nest. Most bird species, with a few specific exceptions, are protected under this act. Construction activities (in work areas with suitable breeding

habitat) during the breeding period, typically mid-March to mid-August in this region (RHJV 2004), could result in losses to these and other native wildlife species. All breeding birds should be protected in accordance with the following recommendations.

CONCLUSIONS AND RECOMMENDATIONS

The Willow Creek Road 2nd Bridge Area Fish Passage Project will restore fish passage to the upper watershed by replacing existing culverts with a single-span bridge system. The project will involve working within the stream channel and adjacent palustrine wetlands (emergent and forested). These habitats are considered sensitive biological resource areas.

Based on the background literature and data search and on-site evaluation, the following biological resource impact determinations were made:

- The project will impact jurisdictional wetlands and a "water of the U.S."
- The project site supports habitat for common wildlife species (e.g., reptiles, amphibians, and mammals).
- The project site supports breeding habitat for birds protected under the Migratory Bird Treaty Act (e.g., songbirds, etc.).
- The project site supports potential habitat for California red-legged frogs.
- The project site supports potential roosting and foraging habitat for special-status and common bat species.
- The project site supports potential habitat for northwestern pond turtles.
- The project site supports potential habitat for special-status fish species.
- The project site supports potential habitat for special-status plant species.

To ensure impacts on special-status species and sensitive resources are avoided or minimized, the following recommendations should be implemented:

1. If water is present during any part of project activities, and dewatering is deemed necessary, a dewatering and species protection plan should be developed by the project's biologist. This would include developing a set of procedures and protective measures to follow during the dewatering process. The plan would need to be developed under guidance from California Department of Fish and Game and NOAA Fisheries Service and implemented by a qualified and permitted biologist. Guidelines established in *California Salmonid Stream Habitat Restoration Manual* by CDFG (1998) and *Juvenile Fish Screen Criteria for Pump Intakes* by NOAA Fisheries Service (1996) should be utilized.

2. To avoid impacts on aquatic (e.g., fish) and terrestrial species (e.g., reptiles, amphibians, and mammals) within the immediate work area, a preconstruction survey (on the day preceding work and/or ahead of the construction crew) should be performed prior to the disturbance of the stream channel and removal of vegetation to ensure no special-status species are occupying the site. If special-status species are observed within the project site or immediate surroundings, these areas should be avoided until the animal(s) has (have) vacated the area, and/or the animal(s)

should be relocated out of the project area by a qualified biologist, upon approval by the regulatory agencies. In addition, the site should be surveyed periodically during construction to ensure that no aquatic and terrestrial are being impacted by construction activities. The biologist should also monitor to ensure water quality standards are being met and sediment and/or debris is not entering downstream aquatic habitats.

3. To avoid impacts to special-status and common bat species, prior to the removal of any trees, a qualified biologist should survey for roosting bats. If occupied roosts are identified, removal of the roost trees should not occur until the roost is unoccupied. In addition, construction should be limited to daylight hours to avoid interference with the foraging abilities of bats.

4. To avoid potential losses to breeding birds, construction activities should occur outside of the critical breeding period. If activities must occur during the normal breeding season (mid-March to mid-August), and suitable breeding habitat is present, work areas should be surveyed by a qualified biologist prior to commencing. If active nests or behavior indicative of nesting birds are encountered, those areas plus a 75-foot buffer area for small songbirds and 200 feet for larger species (e.g., raptors, owls, etc.) designated by the biologist should be avoided until the nests have been vacated.

5. To avoid potential impacts on special-status plants, a focused botanical survey should be completed during the appropriate blooming period for the above-mentioned species. If special-status plants are found occupying the site, avoidance measures should be in place during construction to minimize disturbance (e.g., temporary construction fencing around existing populations). If impacts are unavoidable, appropriate mitigation measures should be implemented (e.g., seed collection and revegetation).

6. Nonnative, invasive plant species should be removed from the project site, and revegetation with native trees, shrubs, and herbs to improve plant diversity and wildlife habitat should occur.

7. Hand labor should be used to control exotic and unwanted vegetation. The use of chemical agents and mechanical equipment within the stream channel should be avoided. Only under extreme circumstances, and with regulatory approval, should herbicides be used to control unwanted species. Only herbicides that have been registered for use in an aquatic environment should be used on target vegetation.

8. Proper erosion control and other water quality Best Management Practices (BMPs) should be implemented to avoid sedimentation and disturbance into downstream and adjacent aquatic habitats. All work should occur in dry or dewatered sections of aquatic habitats. An erosion and sediment control plan should be developed and implemented for the project.

9. Temporary wildlife exclusionary and tree protection fencing should be installed around the work area in sensitive wetland and riparian habitats to preclude animals from entering the work site once construction has commenced (following the preconstruction survey) and to protect riparian trees during construction activities.

10. During vegetation removal, large trees with extensive canopy should be maintained, as feasible, to preserve the existing cover over the stream channel.

11. A preconstruction training session should be provided for construction crew members by the project's biologist. The training should include a discussion of the sensitive biological resources within the project area and the potential presence of special-status species. This should include a discussion of special-status species' habitats, protection measures to ensure species are not impacted by project activities, and project boundaries.

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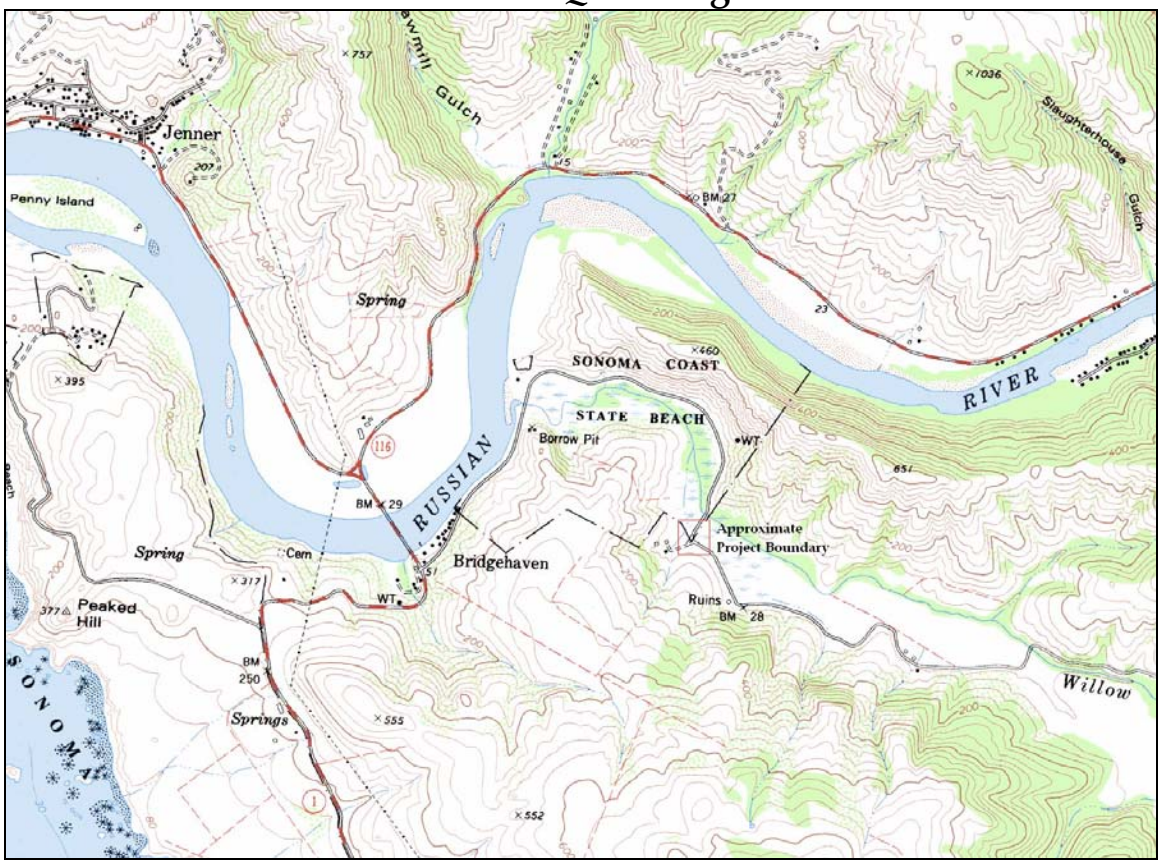
Figure 1. Location map with approximate project boundary indicated. Duncans Mills USGS Quadrangle.



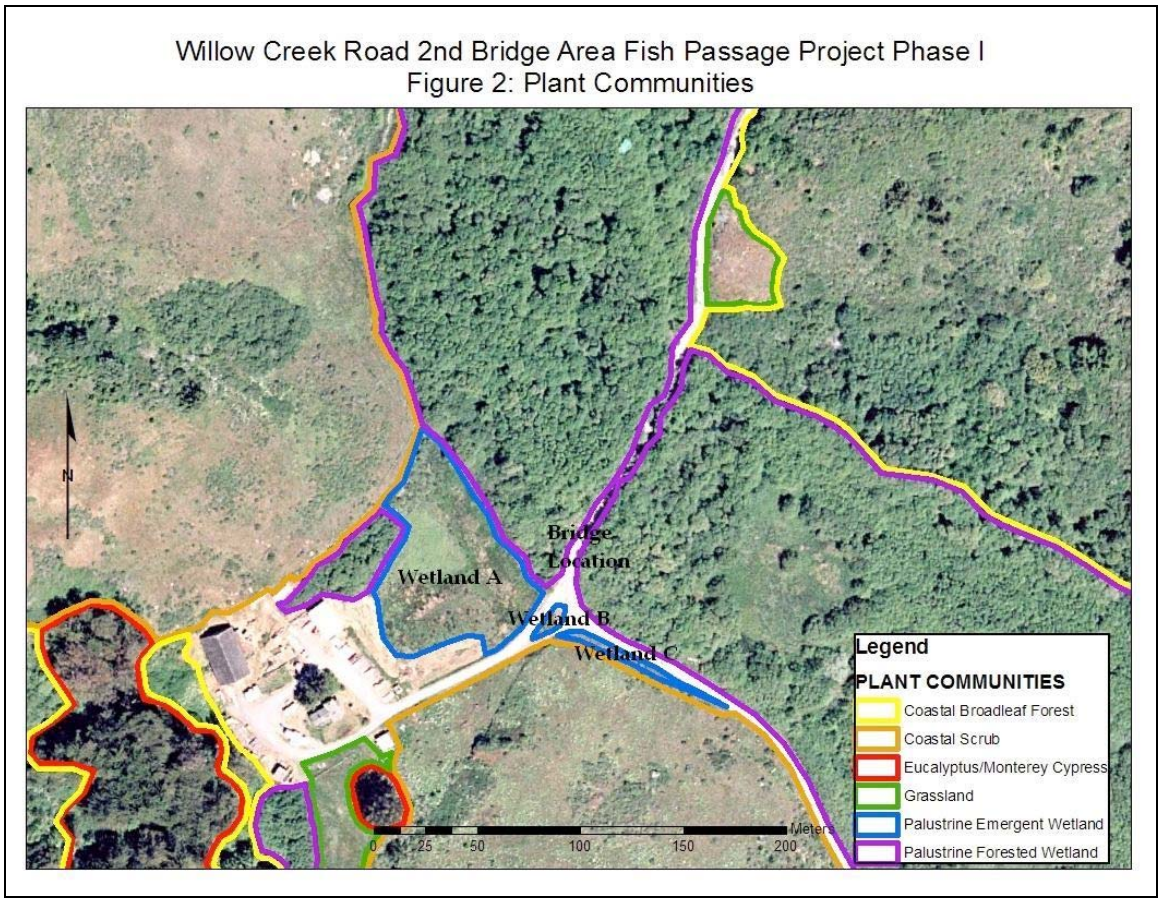


Figure prepared by Brendan O'Neil, Environmental Scientist, California State Parks Russian River District.

APPENDIX A
DEFINITIONS AND ABBREVIATIONS

Wetlands: The U.S. Army Corps of Engineers (*Federal Register* 1982) and the Environmental Protection Agency (*Federal Register* 1980) jointly define wetlands as: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (Corps 1987)

Waters of the U.S.: Waters of the U.S. include, but are not limited to the following: any channel that has real or potential interstate commerce value including lakes, rivers, streams [including perennial and intermittent streams, and ephemeral streams that have an ordinary high water mark (OHWM)], tributaries to waters, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, natural ponds, and impoundments of waters (33 CFR 328.3). The OHWM is described as the elevation delineating the highest water level that has been maintained for a sufficient period of time to leave evidence on the landscape.

Wetland Indicator Abbreviations

OBL	=	Obligate Wetland Plant (estimated probability of occurring in wetlands >99%)
FACW	=	Facultative Wetland Plant (estimated probability >67% to 99%)
FAC	=	Facultative Plant (estimated probability 33% to 67%)
FACU	=	Facultative Upland Plant (estimated probability 1% to <33%)

Corps of Engineers Jurisdiction: Following the U.S. Supreme Court's decision in the cases of *Rapanos v. U.S.* and *Carabell v. U.S.*, the Corps and the Environmental Protection Agency have issued guidance on which features are now under their jurisdiction. In a summary of key points:

" The agencies will assert jurisdiction over the following waters:

- Traditional navigable waters
- Wetlands adjacent to traditional navigable waters
- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months)
- Wetlands that directly abut such tributaries

"The agencies will decide jurisdiction over the following waters based on a fact-specific analysis to determine whether they have a significant nexus with a traditional navigable water:

- Non-navigable tributaries that are not relatively permanent
- Wetlands adjacent to non-navigable tributaries that are not relatively permanent

- Wetlands adjacent to but that do not directly abut a relatively permanent non-navigable tributary

"The agencies generally will not assert jurisdiction over the following features:

- Swales or erosional features (e.g., gullies, small washes characterized by low volume, infrequent, or short duration flow)
- Ditches (including roadside ditches) excavated wholly in and draining only uplands and that do not carry a relatively permanent flow of water

"The agencies will apply the significant nexus standard as follows:

- A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by all wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical and biological integrity of downstream traditional navigable waters
- Significant nexus includes consideration of hydrologic and ecologic factors"

(EPA and Corps 2007)

APPENDIX F
Vascular Plants of Willow Creek 2nd Bridge Project Area

Vascular Plants of Willow Creek 2nd Bridge Project Area

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
FERNS AND FERN ALLIES					
BLECHNACEAE					
Woodwardia fimbriata	Western Chain Fern		facw	y	n
DRYOPTERIDACEAE					
Athyrium filix-femina var. *cyclosorum*	Lady Fern		fac	y	n
Polystichum munitum	Western Sword Fern		upl	n	n
EQUISETACEAE	HORSETAIL FAMILY				
Equisetum arvense	common horsetail		fac	y	n
Equisetum telateia ssp. *braunii*	giant horsetail		facw	y	n
FLOWERING PLANTS: DICOTS					
ANACARDIACEAE					
Toxicodendron diversilobum	poison oak		upl	n	n
APIACEAE	CARROT FAMILY				
Conium maculatum	poison hemlock		facw	y	i
Daucus pusillus	rattlesnake weed		ni	n	n
Heracleum lanatum	cow parsnip		facu	n	n
Oenanthe sarmentosa	water parsley		obl	y	n
Sanicula bipinnatifida	purple sanicle		ni	n	n
Sanicula crassicaulis	gamble weed		ni	n	n
APOCYNACEAE					
Vinca major	periwinkle		ni	n	i
ARALIACEAE					
Aralia californica	elk clover		facw	y	n
ARISTOLOCHIACEAE	PIPEVINE FAMILY				
Asarum caudatum	wild ginger		ni	n	n

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
ASTERACEAE	SUNFLOWER FAMILY				
Agoseris apargioides var. *apargioides*	coast dandelion		upl	n	n
Anaphalis margaritacea	pearly everlasting		upl	n	n
Baccharis pilularis	coyote brush		upl	n	n
Carduus pycnocephalus	Italian thistle		ni	n	I
Centaurea melitensis	napa star thistle		ni	n	I
Chamomilla suaveolens	pineapple weed		ni	n	I
Cirsium quercetorum	brownie thistle		ni	n	n
Cirsium vulgare	bull thistle		upl	n	I
Gnaphalium purpureum			facu	n	n
Hypochaeris glabra	smooth cat's ear		ni	n	i
Hypochaeris radicata	hairy cat's ear		upl	n	i
Lasthenia californica	California goldfields		ni	n	n
Madia grassilus	gumweed madia		ni	n	n
Madia sativa	coast tarweed		ni	n	n
Microseris douglasii	douglas's microseris		ni	n	n
Petasites frigidus var. *palmatus*	coltsfoot		ni	n	n
Psilocarphus tenellus	slender woolyheads		fac	y	n
Sonchus asper	prickly sow thistle		fac	y	i
Taraxacum officinale	dandelion		facu	n	i
Wyethia glabra	mule ears		facu	y	n
BORAGINACEAE	BORAGE FAMILY				
Myosotis discolor	changing forget-me-not		facw	y	i
BRASSICACEAE	MUSTARD FAMILY				
Barbarea orthoceras	wintercress		facw	y	n
Cardamine oligosperma	little western bittercress		facw	y	n
Rorippa nasturtium-aquaticum	water cress		obl	y	i
CAPRIFOLIACEAE	HONEYSUCKLE FAMILY				
Lonicera involucrata var. *ledebourii*	twinberry		fac	y	n
Sambucus racemosa var. *racemosa*	red elderberry		facu	n	n
CARYOPHYLLACEAE	PINK FAMILY				
Cerastium glomeratum	mouse-eared chickweed		upl	n	i
Paronychia franciscana			ni	n	i
Silene gallica	common catchfly		upl	n	i
CONVOLVULACEAE	MORNING-GLORY FAMILY				
Calystegia subacaulis	hill morning-glory		ni	n	n

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
CORNACEAE	DOGWOOD FAMILY				
Cornus sericea	western dogwood		facw	y	n
CRASSULACEAE	STONECROP FAMILY				
Dudleya farinosa	dudleya		upl	n	n
FABACEAE	PEA FAMILY				
Lotus corniculatus	bird'sfoot trefoil		fac	y	i
Lotus wrangelianus	calf lotus		upl	n	n
Lupinus arboreus	bush lupine		upl	n	i
Medicago polymorpha	california burclover		ni	n	i
Trifolium barbigerum	sonoma clover		facw	y	n
Trifolium dubium	shamrock clover		upl	n	i
Trifolium microdon	square-head clover		ni	n	n
Trifolium repens	white clover		facu	n	i
Trifolium subterraneum	subterranean clover		upl	n	i
Vicia sativa	common vetch		upl	n	i
Vicia ludoviciana			ni	n	n
GERANIACEAE	GERANIUM FAMILY				
Geranium dissectum	cut-leaved geranium		ni	n	i
GROSSULARIACEAE	GOOSEBERRY FAMILY				
Ribes sanguineum	pink flowering currant		ni	n	n
HIPPOCASTANACEAE	HORSE-CHECSNUT, BUCKEYE FAMILY				
Aesculus californica	California buckeye		upl	n	n
LAMIACEAE	MINT FAMILY				
Mentha pulegium	pennyroyal		obl	y	i
Prunella vulgaris var. *lanceolata*	self heal		fac	y	n
Stachys ajugoides var. *rigida*	rigid hedge nettle		facw	y	n
Stachys chamissonis	coast hedge nettle		obl	y	n
LINACEAE					
Linum bienne	pale flax		upl	n	i
LYTHRACEAE	LOOSESTRIFE FAMILY				
Lythrum hyssopifolium	loosestrife		obl	y	i
ONAGRACEAE	EVENING-PRIMROSE FAMILY				
Epilobium ciliatum	willow herb		facw	y	n

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
Epilobium ciliatum ssp. *glandulosum*	western willow herb		facw	y	n
PAPAVERACEAE					
Eschscholzia californica	California poppy		ni	n	n
Platystemon californicus	cream cups		ni	n	n
PLANTAGINACEAE	PLANTAGO FAMILY				
Plantago erecta	dwarf plantain		upl	n	n
Plantago lanceolata	English plantain		fac	y	i
POLEMONIACEAE	PHLOX FAMILY				
Gilia capitata ssp. *tomentosa*		CNPS 1B.1	ni	n	n
POLYGONACEAE	BUCKWHEAT FAMILY				
Eriogonum nudum	nude buckwheat		upl	n	n
Polygonum punctatum	water smartweed		obl	y	n
Rumex acetosella	sheep sorrel		fac	y	i
Rumex crispus	curly dock		facw	y	n
PORTULACACEAE	PURSLANE FAMILY				
Claytonia perfoliata	miners lettuce		fac	y	n
PRIMULACEAE	PRIMULA FAMILY				
Anagallis arvensis	scarlet pimpernel		fac	y	i
RANUNCULACEAE	BUTTERCUP FAMILY				
Ranunculus californicus	California buttercup		fac	y	n
Ranunculus occidentalis	western buttercup		facw	y	n
Ranunculus repens	creeping buttercup		facw	y	i
RHAMNACEAE	BUCKTHORN FAMILY				
Rhamnus californica ssp. *californica*	california coffeeberry		upl	n	n
ROSACEAE	ROSE FAMILY				
Horkelia californica			ni	n	n
Oemleria cerasiformis	oso berry		ni	n	n
Potentilla anserina ssp. *pacifica*	pacific potentilla, silverweed		obl	y	n
Rosa californica	california rose		fac	y	n
Rubus parviflorus	thimbleberry		fac	y	n

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
Rubus spectabilis	salmon berry		fac	y	n
Rubus ursinus	California blackberry		facw	y	n
RUBIACEAE	MADDER FAMILY				
Galium aparine	goosegrass		facu	n	i
Galium trifidum var. *pacificum*	small bedstraw		facw	y	n
SALICACEAE	WILLOW FAMILY				
Salix laevigata	red willow		ni	n	n
Salix lasiolepis	arroyo willow		facw	y	n
Salix lucida ssp. *lasiandra*	shining willow		ni	n	n
Salix sitchensis	sitka willow		facw	y	n
SCROPHULARIACEAE	FIGWORT FAMILY				
Parentucellia viscosa			ni	n	i
URTICACEAE	NETTLE FAMILY				
Urtica dioica ssp. *holosericea*	stinging nettle		facw	y	n
VIOLACEAE					
Viola adunca	western dog violet		fac	y	n
VITACEAE	GRAPE FAMILY				
Vitis californica	California wild grape		facw	y	n
FLOWERING PLANTS: MONOCOTS					
ALISMATACEAE					
Alisma plantago-aquatica	water plantain		obl	y	n
CYPERACEAE	SEDGE FAMILY				
Carex barbarae	santa barbara sedge		facw	y	n
Carex obnupta	slough sedge		obl	y	n
Cyperus eragrostis	nut grass		facw	y	n
Eleocharis macrostachya	spikerush		obl	y	n
Scirpus microcarpus	panicled bullrush		obl	y	n
IRIDACEAE					
Sisyrinchium bellum	blue-eyed grass		fac	y	n

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
JUNCACEAE	RUSH FAMILY				
Juncus bolanderi	Bolanders rush		obl	y	n
Juncus bufonius	toad rush		facw	y	n
Juncus effusis	soft rush		obl	y	n
Juncus occidentalis	western rush		ni	n	n
Juncus patens	spreading rush		facw	y	n
Juncus phaeocephalus var. *phaeocephalus*	brown-head rush		facw	y	n
LILIACEAE					
Chlorogalum pomeridianum var. *pomeridianum*	soap plant		ni	n	n
Kniphofia uvaria	red hot poker		ni	n	i
Smilicina racemosa	false solomon's seal		fac	y	n
Triteleia laxa	ithuriels spear		upl	n	n
POACEAE					
Agrostis capillaris	colonial bent grass		ni	n	i
Alopecurus aequalis	short-awn foxtail		obl	y	n
Aira caryophyllea	silvery hairgrass		upl	n	i
Avena barbata	slender wild oat		upl	n	i
Briza maxima	rattlesnake grass		upl	n	i
Briza minor	little quaking grass		facw	y	i
Bromus diandrus	ripgut		upl	n	i
Bromus hordeaceus	soft chess		upl	n	i
Bromus stamineus			ni	n	i
Bromus sterilis	sterile brome		ni	n	i
Cynosurus echinatus	hedgehog dogtail		upl	n	i
Dactylis glomerata	orchard grass		facu	n	i
Danthonia californica var. *californica*	california oatgrass		facw	y	n
Deschampsia cespitosa ssp. *holicformis*	tufted hairgrass		facw	y	n
Deschampsia danthonioides	annual hairgrass		facw	y	n
Elymus glaucus	blue wildrye		facu	n	n
Festuca idahoensis	idaho fescue		upl	n	n
Glyceria occidentalis	manna grass		obl	y	n
Holcus lanatus	velvet grass		fac	y	i
Hordeum murinum ssp. *leporinum*	foxtail		facu	n	i
Lolium perenne	perennial ryegrass		fac	y	i
Melica torryana	Torrey's melic		ni	n	n
Nasella pulchra	purple needlegrass		upl	n	n
Poa annua	annual bluegrass		facw	y	i
Poa secunda	pacific bluegrass		ni	n	n
Polypogon monspeliensis	annual beard grass		facw	y	i

SCIENTIFIC NAME	COMMON NAME	LISTING	INDICATOR	WETLAND Y/N	n= Native i= Introduced
Trisetum canescens	tall trisetum		fac	y	n
Vulpia bromoides	six-weeks fescue		facw	y	i
TYPHACEAE	CAT-TAIL FAMILY				
Typha angustifolia	narrow-leaved cattail		obl	y	n

APPENDIX G
Dewatering and Species Protection Plan

PRUNUSKE CHATHAM, INC.

DEWATERING AND SPECIES PROTECTION PLAN
WILLOW CREEK ROAD 2ND BRIDGE AREA FISH PASSAGE PROJECT
SONOMA COAST STATE PARK
NOVEMBER 2009

Project Description

The Willow Creek Road 2nd Bridge Area Fish Passage Project is located in rural Sonoma County on a county-maintained road and adjacent habitats in the lower Willow Creek watershed. Outside of the road right-of-way, the site is owned and operated by the California Department of Parks and Recreation (State Parks) as part of Sonoma Coast State Park. Willow Creek, a tributary to the lower Russian River, is considered a high priority watershed for California Department of Fish and Game's (CDFG) coho salmon restocking program. Viability of the watershed for the coho salmon recovery program is presently limited due to fish passage restrictions related to the County road at the 2nd bridge. In spring 2007, the Willow Creek Technical Advisory Committee reviewed a range of culvert and bridge options to restore fish passage at the 2nd bridge roadway. A consensus was reached to design and install a channel crossing at the valley thalweg that will provide for fish passage, channel development, hydraulic connectivity, and a 20- to 50-year lifespan.

The current design includes a 43-foot precast concrete, single-span bridge system with on-pile footings and precast abutments. In addition, a pilot channel encompassing approximately 1,000 linear feet (4 feet wide by 2 feet deep) will be excavated in two sections of cattail-dominated (*Typha* sp.) wetland, as outlined in the *Adaptive Geomorphic Plan for the Willow Creek Valley above the 2nd Bridge Crossing, Sonoma County, California* by OEI (2008). This pilot channel will facilitate fish passage in areas with poor channel connectivity upstream of the bridge crossing. The proposed project will involve working within the existing road embankment, minor fill of jurisdictional wetlands, and minor excavation within jurisdictional wetlands and other waters of the U.S./State.

The project is located within a sensitive biological resources zone. The Willow Creek watershed is known habitat for federally listed as threatened central California coast steelhead (*Oncorhynchus mykiss*), federally listed as threatened and California Species of Special Concern (SSC) California red-legged frog (*Rana draytonii*), historic and potential future habitat for endangered coho salmon (*O. kisutch*), and potential habitat for SSC northwestern pond turtle (*Actinemys marmorata marmorata*). It also supports habitat for breeding birds protected under the federal Migratory Bird Treaty Act and California Fish and Game Code, special-status bats, and common fish and wildlife species. Larval host plants, western dog violet (*Viola adunca*), of the federally endangered Myrtle's silverspot butterfly are also present adjacent to the project area as noted by State Park staff in summer 2009; however, the larvae and adult butterflies have not been observed.

To protect sensitive biological resources, consultation with State and federal regulatory agencies will occur, and all recommendations provided by these regulators will be incorporated into the project description and design. To avoid discharge of silt-laden water into Willow Creek during construction, work will occur during summer low-flow conditions, and construction Best Management Practices (BMPs) will be utilized to avoid erosion, sedimentation, and water quality impairments. In addition, impacts on sensitive biological resources, including terrestrial communities, will be avoided or minimized through implementation of the following plan by a qualified biologist; see *Qualified Biologist* paragraph below.

Dewatering Plan

If water is present within the project reach during construction, the creek will need to be dewatered, and aquatic species will be relocated pursuant to the requirements of State and federal permits. Dewatering and aquatic species relocation will occur simultaneously. Water diversion will occur at appropriate locations that minimize disturbance to the aquatic environment, and aquatic organisms will be placed in appropriate habitats. Surface flow in Willow Creek may cease during the summer months leaving only isolated perennial pools or a dry creek bed, in which case, cofferdams will not be required. If only isolated pools are present, they will be pumped out, as necessary.

If utilized, cofferdams or other approved water diversion structures will be placed in locations that will minimize the amount of stream reach dewatered while allowing adequate construction access. Dams will be constructed at the up- and downstream ends of the project site with the use of river-run gravel and/or sand bags to isolate the work, and water will be diverted around the site. On-site materials used during the dewatering will be returned to the stream channel; off-site materials will be removed from the site.

Placement is critical; for example, at riffle crests is typically not advisable as water tends to flow subsurface at these locations. When located at riffle crests, the dam and backwater head it creates push water through the gravel crest at a faster rate. If the dam is located at a riffle crest, an excavated sump is usually required directly downstream of the cofferdam. The best place for a cofferdam is in a pool tail out or glide leaving 50-75% of the pool volume upstream of the cofferdam for habitat upstream. In these instances, the inlet will need to be screened with a setback fence to avoid velocity entrapment at the pipe inlet.

An approved screened pump intake will be used to divert water around the work area or from the isolated pools. If minimal surface flow is present, it may be diverted through the cofferdam by a gravity-fed pipe. Pumps will be screened in accordance with *Juvenile Fish Screen Criteria for Pump Intakes* developed by NOAA's National Marine Fisheries Service (NOAA Fisheries Service 1996) and will consist of 3/32-inch screen mesh. The pump will be placed in a large basin with holes to allow water to be drawn into the pump. Both the outside of the basin and the pump will be screened with 3/32-inch mesh to ensure aquatic species do not get sucked into the pumps.

The water diversion pipe will consist of a large, plastic HDPE or ABS pipe or similar material and will be placed along the stream channel. Four-inch flex pipe may also be used, but PVC pipe should be avoided, if possible. The inlet and outlet of the diversion pipe will be screened so aquatic and terrestrial species do not enter the structure. Throughout construction, a sump pump of adequate capacity may be needed to remove subsurface water flowing into the work area, especially if cofferdams are located at riffle crests. If needed, sump pumps will be powered by a generator or external power source and properly screened.

A CDFG and NOAA Fisheries Service-authorized biologist will be on site to oversee installation and decommissioning of the water diversion structures and to conduct aquatic species relocation; see *Qualified Biologist* paragraph below. Cofferdams and temporary water diversions will meet all permit requirements. The stream will be returned to its natural flow and bed condition upon project completion.

Protection of Aquatic Species
To avoid impacts on aquatic species (e.g., steelhead, turtles, frogs, and resident fish), surveys and relocation activities by a qualified biologist will occur prior to beginning construction. If found, all species will be relocated as described in *Procedures for Removing Fish and Other Vertebrate Aquatic Species* below. The site will also be swept periodically during construction to ensure no aquatic species have moved into the work area.

Methods for Determining Presence/Absence of Vertebrate Aquatic Species
Immediately prior to beginning construction work, a qualified biologist will determine if any vertebrate aquatic species are present in the project area. An assessment of the site will be fashioned after protocols described in the *California Salmonid Stream Habitat Restoration Manual* (CDFG 1998). Observations will take place in the following sequence:

1. **Streambank Observation**. A qualified biologist experienced with species identification techniques will observe aquatic species from the streambank to determine presence/absence and to avoid handling of listed species. The project site and the adjacent up- and downstream habitats will be surveyed. If aquatic species are not observed, aquatic sampling will take place.

2. **Aquatic Sampling**. With the use of weighted seines and/or heavy-duty aquatic dip nets (12" D-Frame Net), aquatic species will be captured for in-hand examination and immediately released to determine presence/absence. The entire work area will be surveyed, if necessary, including all pools, riffles, and runs, as well as up- and downstream of the area.

If, prior to construction, no vertebrate aquatic species are detected utilizing the above-mentioned techniques, no additional aquatic sampling measures will be implemented. A qualified biologist will also survey the site periodically during

the construction process to ensure vertebrate aquatic species have not moved into the work area. If aquatic species are observed after construction begins, work will be stopped and appropriate actions taken.

Procedures for Removing Fish and Other Vertebrate Aquatic Species
If fish and other vertebrate aquatic species (e.g., frogs, turtles) are present within the work area, they will be encouraged to move downstream from the upstream end of the site with the aid of weighted seines operated by the permitted biologist with assistants as needed. Once they have been guided to the downstream end of the work area, barrier seines will be placed across the creek at the downstream end to restrict them from moving back upstream if needed. At the upstream end, a barrier seine will be placed across the creek immediately upstream of the cofferdam and pump location to prevent aquatic species from entering the work area.

Once the barrier seines are in place and aquatic species have relocated downstream, cofferdams or similar water diversion structures will be constructed immediately downstream of the upstream barrier and immediately upstream of the downstream barrier. When the cofferdams are in place and the construction area is sealed off, the biologist will make his/her best effort to relocate aquatic species remaining within the work area as the water surface elevation begins to drop. Aquatic species will be relocated to suitable habitat up- and/or downstream of the work area. Release sites will contain suitable cover and foraging habitat and natural barriers present that are likely to preclude species from traveling back upstream or downstream into the work area. A complete record of all fish and wildlife species observed during the observation and relocation process will be kept and provided to CDFG, NOAA Fisheries Service, and other permitting agencies as necessary.

Electrofishing can be used as an alternative fish capture method in accordance with *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act* (NOAA Fisheries Service 2000). If electrofishing is utilized, the qualified biologist overseeing the aquatic species relocation must have the appropriate training and experience.

Throughout project construction, a qualified biologist will make frequent visits to the site to ensure that no fish or other aquatic species are being impacted by construction activities. If fish and other vertebrate aquatic species are observed in the work area after construction commences, work will be stopped and appropriate actions taken. The biologist or designated observer will also monitor to ensure water quality standards are being met and sediment in not entering the watercourse.

Protection of Nesting Birds
Most bird species, with a few specific exceptions, are protected under federal and state laws. Under the federal Migratory Bird Treaty Act (MBTA), it is unlawful to take, kill, and/or possess migratory birds at any time or in any manner, unless the appropriate permits are obtained. Protections extend to active nests, eggs, and young birds still in the nest. Birds and their nests are also protected under

the California Fish and Game Code (Sections 3503 and 3503.5). Disturbance activities (e.g., grading, vegetation removal, etc.) in areas with suitable habitat during the breeding period, typically mid-March to mid-August in this region (RHJV 2004), can result in direct losses to nests or disturbance to nesting birds. To avoid potential losses to breeding birds, construction activities (e.g., vegetation removal, grading) should occur outside of the critical breeding period.

If construction commences after March 15th, the work area will be surveyed by a qualified biologist to determine if active nests are present. If the construction site is left unattended for more than two weeks during the breeding season, another survey will be completed to determine if breeding birds have moved back into the area and are occupying active nests. If active nests or behavior indicative of nesting are encountered, those areas plus a 50-foot buffer area for small songbirds and 200 feet for larger species (e.g., raptors, owls, etc.) designated by the biologist will be avoided until the nests have been vacated.

If construction commences prior to the start of the current breeding season, preconstruction surveys will not be necessary. To prevent birds from establishing nests within the work area prior to construction, vegetation slated for removal as part of construction should be removed during the nonbreeding season (August 15 to March 15).

Protection of Terrestrial Species
To avoid impacts on terrestrial species (e.g, reptiles, amphibians, mammals) within the work area, a preconstruction survey (on the day preceding work and/or ahead of the construction crew) will be performed prior to disturbance of the site and stream channel to ensure that no terrestrial species are occupying the area or immediate surroundings. If terrestrial species are observed, these areas will be avoided until the animal(s) has (have) vacated, and/or the animal(s) will be relocated out of the area by a qualified biologist. In addition, the site will be surveyed periodically during construction to ensure that no terrestrial species are being impacted by construction activities.

There are established dusky-footed woodrat (*Neotoma fuscipes*) nests adjacent to the project site. These are large, dome-shaped structures consisting of small sticks and detritus that are several feet in height. These areas will be clearly identified with all field personnel and avoided, if feasible.

To avoid impacts on special-status and common bat species, prior to the removal of any trees, a qualified biologist will survey for roosting bats. If occupied roosts are identified, removal of the trees will not occur until the roost is unoccupied. In addition, construction will be limited to daylight hours to avoid interference with the foraging abilities of bats.

Protection of Myrtle's Silverspot Butterfly and Host Plants
To avoid impacts on Myrtle's silverspot butterflies and their host plants, pre-construction butterfly surveys will be completed to determine presence/absence of adults or larvae. If present, additional protection measures may be necessary,

and further consultation with U.S. Fish and Wildlife Service will be required. If not found, the following protection measures will be implemented:

- Existing populations of larval host plants (western dog violet (*Viola adunca*)) will be avoided, as feasible.
- Plants will be protected through the installation of temporary fencing around all known occurrences and these areas avoided.
- If western dog violets are found to be present within the area of impact, they will be transplanted to appropriate habitat off-site.
- As feasible, adult nectar plants (e.g., coyote mint (*Monardella villosa*), bull thistle (*Cirsium vulgare*)) will be flagged and avoided during construction.

Vegetation Management Practices

Nonnative, invasive plant species will be removed from the work area where feasible. Hand labor will be used to control exotic and unwanted vegetation, and the use of herbicides and mechanical equipment within the stream channel will be avoided. Only herbicides that are registered for use in an aquatic environment will be used on target vegetation. Temporary wildlife exclusionary and tree protection fencing will be installed around the work area in sensitive wetland and riparian habitats to preclude animals from entering the work site once construction has commenced (following the preconstruction survey) and to protect riparian trees during construction activities. During vegetation removal, large trees (> 11" dbh) with extensive canopy will be maintained, as feasible, to preserve the existing cover over the stream channel.

Preconstruction Training

A preconstruction training session will be provided for construction crew members by the qualified biologist. The training will include a discussion of the sensitive biological resources within the project area and the potential presence special-status species. This will include a discussion of special-status species habitat, protection measures to insure species are not impacted by project activities, and project boundaries.

Qualified Biologist

For the purposes of the Willow Creek Road 2nd Bridge Area Fish Passage Project, aquatic species relocation activities and preconstruction surveys will be conducted by a qualified biologist, which may include:

- California Department of Fish and Game and/or NOAA Fisheries Service staff with appropriate authorizations; or

- A person holding a valid collector's permit for steelhead, coho salmon, and California red-legged frog subject to take from NOAA Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game and valid Scientific Collecting Permit from CDFG; or

- A person with a bachelor's or higher degree in fisheries biology, wildlife biology, marine biology, aquatic biology, hydrology, wetland ecology or equivalent other course of study; and 5 or more years of

professional experience in fisheries research, management, and/or habitat restoration; and direct participation in 5 or more fish capture and transport events and experience with the identification of salmonids; or

- Jennifer Michaud, M.A., Senior Wildlife Biologist at Prunuske Chatham, Inc.; or

- Michael Fawcett, Ph.D., a private biological consultant in Bodega, CA; or

- Brendan O'Neil, Senior Environmental Scientist or Daniella Dekelaita, Environmental Scientist with California State Parks, Russian River District.

As noted above, if electrofishing is utilized, the qualified biologist overseeing the aquatic species relocation must have the appropriate training and experience.

References

California Department of Fish and Game (CDFG). 1998. *California Salmonid Stream Habitat Restoration Manual*.

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NOAA's National Marine Fisheries Service (NOAA Fisheries Service). 2000. *Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act, June 2000*.

O'Connor Environmental, Inc. (OEI). 2008. *Adaptive Geomorphic Plan for the Willow Creek Valley above the 2nd Bridge Crossing, Sonoma County, California, December 2008*.

Riparian Habitat Joint Venture (RHJV). 2004. Version 2.0. The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian Associated Birds in California. California Partners in Flight. Accessed at http://www.prbo.org/calpif/plans.html.

APPENDIX H
Acronyms

ACRONYMS

AB	Assembly Bill
ABAG	Association of Bay Area Governments
APCD	Air Pollution Control District
AQMD	Air Quality Management District
BAAQMD	Bay Area Air Quality Management District
BCDC	San Francisco Bay Conservation and Development Commission
BMPs	Best Management Practices
CalEPA	California Environmental Protection Agency
CalFire	California Department of Forestry and Fire Protection
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resources Board
CCR	California Code of Regulations
CDFG	California Department of Fish & Game
CDP	Coastal Development Permit
CDTSC	California Department of Toxic Substance Control
cfs	cubic feet per second
CGS	California Geologic Survey
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
Corps	U.S. Army Corps of Engineers
dB	decibels
DPR	California Department of Parks and Recreation
EIR	Environmental Impact Report
ESU	evolutionarily significant unit
GHG	greenhouse gas
IS	Initial Study
IS/MND	Initial Study/Mitigated Negative Declaration
LCP	Local Coastal Plan
LOS	level of service
MBTA	Migratory Bird Treaty Act
MLD	most likely descendant
MND	Mitigated Negative Declaration
MT	metric ton
MT CO_2 E	metric tons of carbon dioxide equivalent
MTC	Metropolitan Transit Commission
NAHC	Native American Heritage Commission
NCAB	North Coast Air Basin
NMFS	NOAA's National Marine Fisheries Service

ACRONYMS (continued)

NO_2	nitrogen dioxide
NPS	National Park Service
NSCAPCD	North Sonoma County Air Pollution Control District
O_3	ozone
$PM_{2.5}$	fine particulate matter
PM_{10}	suspended particulate matter
PRC	Public Resources Code
PRMD	Sonoma County Permit and Resource Management Department
RWQCB	Regional Water Quality Control Board
SCDTPW	Sonoma County Department of Transportation and Public Works
TAC	Technical Advisory Committee
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VRPs	visibility reducing particles