# VOLUME II

# Stream Management and Maintenance Program for the San Luis Obispo Creek Watershed

**City of San Luis Obispo**
Department of Public Works
955 Morro Street
San Luis Obispo, California 93401

**County of San Luis Obispo**
Flood Control District - Zone 9
1050 Monterey Street, Room 207
San Luis Obispo, California 93408

# Waterway Management Plan

## VOLUME II

## Stream Management and Maintenance Program

---

Prepared for the

City of San Luis Obispo
Engineering Department
555 Morro Street
San Luis Obispo, CA

and

San Luis Obispo County
Flood Control and Water
Conservation District, Zone 9

Prepared by:
Questa Engineering Corporation
1220 Brickyard Cove Road, Suite 206
Point Richmond, California 94807
(510) 236-6114

Project #98202

March 2003

**TABLE OF CONTENTS**

## LIST OF FIGURES



## APPENDICES

**San Luis Obispo Creek Watershed**
**Stream Management and Maintenance Program**

# PROGRAM EXECUTIVE SUMMARY

**Program Purpose:** This Stream Management and Maintenance Program (SMMP) provides long-term guidance and outlines maintenance procedures that will be used by the City of San Luis Obispo (City) and SLO County Flood Control and Water Conservation District Zone 9 (Zone 9) to effectively implement routine stream maintenance projects in a timely, cost-effective and environmentally-sensitive manner. The Program provides process, policy, and field procedures that will be adopted by City/Zone 9. It will be submitted to appropriate regulatory agencies for their use in environmental evaluation and in preparing long-term permits for routine stream maintenance activities in this watershed. The Program will also be beneficial to private property owners along the creeks in this watershed with management needs such as bank repair and protection. The permit process for private routine projects, such as bank repair and protection will be more efficient, provided the private parties and their consulting engineers and environmental planners follow the design and implementation procedures and Best Management Practices contained in this document, and the related SLO Creek Watershed and Waterway Drainage Design Manual (DDM). To take advantage of this Program, private property owners will be required to contribute to the preparation and submittal of an Annual Work Plan (AWP) by City/Zone 9, for certain kinds of projects. Routine projects that are currently considered CEQA exempt and that do not currently require U.S. Army Corps of Engineers (Corps) permits can proceed as before, and need not be included in the AWP. Large projects that require Individual Corps permits will continue to require such permit review.

**Program Area:** The Program covers SLO Creek and all of its tributaries on a watershed basis, including routine stream maintenance activities (such as sediment removal, vegetation management, and bank protection).

**Environmental Issues:** The Program addresses cultural, biological and other resources, including wetlands, riparian and aquatic habitat. Many streamside habitats support sensitive wildlife and aquatic species that have the potential to be affected by management and maintenance activities. Activities such as vegetation removal or earthwork may also affect the geomorphic (bank stability) and hydrologic (water movement and flooding) function of the creek system. The Program recommends a planning and design approach, and use of Best Management Practices (BMPs) to minimize and mitigate environmental, geomorphic and hydrologic impacts.

**Participants:** The City of San Luis Obispo and San Luis Obispo County Flood Control and Water Conservation District, Zone 9, community stakeholders, and regulatory agencies. Primary resource management and regulatory agencies, including local non-profit groups are:

- U.S. Army Corps of Engineers (Corps)-Ventura field office
- Central Coast Regional Water Quality Control Board (RWQCB) - San Luis Obispo
- California Dept. of Fish and Game (CDFG)
- U.S. Environmental Protection Agency (USEPA)- San Francisco
- Federal Emergency Management Agency (FEMA)
- National Marine Fisheries Service (NMFS)
- U.S. Fish and Wildlife Service (USFWS)- Long Beach
- Land Conservancy of San Luis Obispo County
- California Conservation Corps (CCC)
- Central Coast Salmon Enhancement

Other public entities in the watershed that may find a benefit to formally participating in the Management and Maintenance Program include Caltrans and California State Polytechnic University at San Luis Obispo (Cal Poly). Cal Poly and Caltrans are currently represented on the Zone 9 Advisory Committee.

**Environmental Review:** This proposed Program is subject to review under both the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), and a programmatic EIS/R will be prepared. The Program, EIS/R, and related documents will be presented to SLO City Council and the SLO County Board of Supervisors representing the Zone 9 Board of Directors for certification. The Corps will be the lead agency for federal review under NEPA.

The current schedule anticipates public review in February 2003 through May 2003; with regulatory clearances obtained after June 2003. This would permit ongoing implementation of routine maintenance after finalization of the EIS/R and receipt of 10-year permits and agreements. The first Annual Work Plan outlining maintenance for summer 2003 would be prepared by July 2003. It is anticipated that City/Zone 9 work will focus on willow management in the mid-Higuera area (Reach 8) between the Marsh Street Bridge and Madonna Road, and management of in-channel bars and willows in Reach 7, near the City's wastewater reclamation facility. Routine maintenance by City and County crews could be initiated in late summer/early fall 2003.

**Program Approach:** The Program uses a tiered approach to planning, project review, and implementation. A simple notification procedure will be used for most routine projects. Use of approved BMPs, self-monitoring and verification of work in as-built plans are also central to the program approach.

**Category 1, *CEQA Exempt*** and ***Low Impact*** projects do not require a Corps of Engineers permit. This includes projects such as: culvert cleaning, willow thinning, and maintaining or repairing existing bank protection structures using similar materials. CDFG biologists will be routinely consulted on projects that involve vegetation management and removal of large woody debris.

**Category 2, *Minor Impact*** projects may require a Corps Nationwide Section 404 permit. For these projects, an **Annual Work Plan** will be prepared, based on an annual maintenance and management needs inventory and assessment. The inventory data may be entered into a maintenance layer of the San Luis Obispo Phase II Project Geographic Information System as this system continues to be developed. The AWP will incorporate procedures, policies and BMPs outlined in this Program. The AWP will be reviewed by the City/County environmental officer for compliance with mitigation included in the Programmatic EIS/R. The compliance officer may recommend additional technical studies, environmental review, a change in practices, or additional mitigation. A public meeting will be held by Zone 9, and after approval at the local level, the AWP will be submitted to regulatory agencies for review. Additional requirements, including individual permit review and extra compensatory mitigation may be imposed by the regulatory agencies for those elements of the AWP judged to be outside of the approved Program.

**Category 3** includes major projects with potentially significant impacts; such as bridge replacement and flood control channel modifications (requiring Individual Corps permits) are not included in this Program.

**Mitigation Concept:** This Program provides an approach to vegetation management that involves the phased, gradual conversion of exotic vegetation and select areas of dense shrubby willows, with high flow resistance, to a plant community composed of larger, single trunk native trees that shade the channel and have lower frictional resistance to flow. Such a long-term program will require the training and commitment of a team of experienced creek maintenance workers. The City and Zone 9 have used CCC crews in the past, and will continue this relationship, as well as providing and experienced project manager and biologist to the program. In addition, the City and Zone 9 will experiment with other methods for creek vegetation management,

including the selective use of tethered goats for browsing and removal of undesirable understory exotics like periwinkle and German Ivy.

The Program also recognizes the special biological values of willow shrub communities, and requires that willow management for flood hazard reduction purposes be justified. Not all willow communities along the creeks will be managed for flood reduction, and CDFG, USFWS and NMFS biologists will be invited to comment on all vegetation and instream management projects. Normally, the need for extensive vegetation and sediment management will be dictated by hydraulic analysis of the stream conveyance system and analysis of the biological value of the vegetation, with work prioritized in areas of most need (least flood flow capacity to achieve designated flood conveyance in urban flood prone areas as provided in the Drainage Design Manual). This may be difficult to achieve in many reaches. Final flood management conveyance capacity targets (design flows) are being developed as part of the SLO Creek Waterway Management Plan (Volume I).

Work will alternate from bank side to bank side in management units and be staged over a period of years to reduce short-term biological impacts. Restoration and biological enhancement of work areas will be included in each project element of the AWP. This includes riparian restoration and enhancement of aquatic habitat by creating new scour pools and hiding habitat, using structures such as rock boulder clusters, root wads, and lunker structures. These structures will be designed in accordance with the guidelines in the *California Salmonid Stream Habitat Restoration Manual* (Flosi, et al, 1998), Programmatic permit conditions and adopted design guidelines. For bank repair and protection projects, the Program emphasizes that biotechnical approaches will be used where possible, based on completion of hydraulic, geotechnical, and geomorphic analysis.

Using the above approach, nearly all work will include components to mitigate project impacts. For additional mitigation, City/Zone 9 proposes to work with the Land Conservancy of San Luis Obispo County and/or other non-profit agencies to identify additional restoration/mitigation opportunities. City/Zone 9 will budget money each year for watershed and stream restoration programs. The amount of money contributed annually will be based on the external off-site mitigation needs of the program. In addition, the City/Zone9 should cooperate with the Land Conservancy and other non-profits in obtaining grant funding for watershed and stream corridor restoration and enhancement.

Most of the public lands along SLO Creek will be restored as part of ongoing City/Zone 9 and/or Land Conservancy, or other nonprofit programs. On private lands, partnership with the non-profit agencies provides the best opportunity to conduct enhancement/restoration activities. It is envisioned that most of the enhancement work will focus on private lands in Reaches 3 to 6, the unincorporated portion below Los Osos Valley Road to See Canyon, and in Reach 14, above Cuesta Park. The lower reaches have bank erosion problems associated with natural adjustment to historic straightening, and a predominance of low diversity shrubby willows. The upper reaches have bank erosion problems from channel incision that are undermining old streamside stands of native sycamores, causing toppling into the creek. In this area, protection of valuable shaded pools associated with undercut banks is the key management issue, along with provision of instream habitat structures to provide additional pool habitat and cover.

**References:** In addition to the Best Management Practices contained in this document, stream management and stream maintenance procedures will rely on the Bay Area Stormwater Management Agency's 2000 publication entitled, *Channel Maintenance Best Management Practices*, and a California Department of Fish and Game publication by Flossie, et al., February, 1998, *California Salmonid Stream Habitat Restoration Manual*.

# Section 1
# INTRODUCTION

## 1.1 BACKGROUND

This **Stream Management and Maintenance Program** (SMMP, or Program) describes the methods and procedures for how streams in the San Luis Obispo Creek (SLO Creek) watershed will be managed to reduce flood hazards, control bank erosion, as well as preserve, restore and enhance environmental values of the stream corridor. It is a cooperative effort of the City of San Luis Obispo and San Luis Obispo County Zone 9's (City/Zone 9), and provides design and implementation procedures, and guidelines for the integrated management and maintenance of the natural stream corridors, which also serve as flood control channels within the watershed. Stream management and maintenance is required to meet City/Zone 9's mandates to reduce flood hazards and protect public infrastructure. The Program:

- **Identifies** resource protection and maintenance issues,
- **Defines** routine stream maintenance problems and practices,
- **Describes** the situations where stream maintenance is required, and
- **Provides** a protocol for implementation of routine stream management projects.

Routine stream management activities include sediment removal, vegetation management, hydraulic structure (culverts, storm drain outfalls, and bank revetments) maintenance, bank repair and protection, weed control, maintenance of revegetation sites, fence repair, trash removal, and removal of downed trees or other blockages.

This Program has been developed to guide the long-term implementation of City/Zone 9's routine stream maintenance work. Site-specific maintenance work will be identified each spring following a stream inventory reconnaissance to be conducted by City and County staff. Information provided by stakeholders and streamside property owners regarding stream management needs will be an important tool to develop a target list of management and maintenance sites. It is the goal of this Program (along with the supporting EIS/R, and long-term permits) to provide the guidance and regulatory compliance documentation necessary for routine maintenance of streams and waterways without having to perform separate CEQA/NEPA review or obtain permits for each individual routine stream maintenance project. The Program also enables a watershed-wide approach to environmental protection. SLO/Zone 9 is committed to implement individual maintenance projects in an environmentally sensitive manner, and from a watershed-wide perspective, to eliminate or minimize cumulative impacts.

Emergency repairs and large-scale capital improvement projects (e.g. flood management channel improvements) are not within the scope of this Program. The Program is not designed to establish a legal standard of care. It is not intended that any standard of conduct or duty toward public safety shall be created by application of this program. Such a duty remains the obligation of the individual project design engineer and appropriate public agency officials.

## 1.2 STUDY AREA

Zone 9 of the County Flood Control and Water Conservation District was formed after the 1972-73 floods (under State of California enabling legislation) to help control and minimize impacts of frequent flooding in the SLO Creek watershed. Within the city limits, the City of San Luis Obispo is responsible for creek maintenance on public lands, and where creek easements have been granted. The County has jurisdiction over all unincorporated areas, including Avila Beach, but there is a general lack of easements for creek maintenance.

The California Department of Transportation (Caltrans) has an easement over certain areas along SLO Creek, conveying the right (but not necessarily the duty or obligation) to perform creek maintenance. This is generally in areas near Highway 101 between South Higuera and Avila Bay Drive. This Program covers SLO Creek and all its tributaries, including Stenner, East Fork, See Canyon, Prefumo, Garden, and Brizziolari Creeks.

**Figure 1** is a location map of the SLO Creek watershed. **Figure 2** shows the location of the sub-basins and the major creeks within the SLO Creek watershed. The Program addresses both Phase I and Phase II study reaches. (The Phase I area was evaluated in a 1997 study, and focused primarily on bank stabilization needs in the southern or lower 1/3 of the city, mainly below the Marsh Street Bridge. The Phase II study revisits this area, and includes the remainder of the major named streams in the watershed.)

## 1.3 PURPOSE

Many forms of vegetation management can adversely impact biological resources. In addition, channel modification, vegetation management, hydraulic structure maintenance and repair, and stream bank stabilization projects can also have significant impacts on channel hydraulics, water quality, and stream physical processes (geomorphology). Unless designed and maintained correctly, such projects can have unintended, unwanted effects, both upstream and downstream. Armoring a stream bank can, in some circumstances, translate energy and bank erosion problems up and downstream. Bank stabilization and other hydraulic structures that intrude into the floodway can also, in some cases, cause effects cross-bank through flow deflections, and upstream through backwater induced flooding effects, or sediment accumulation.

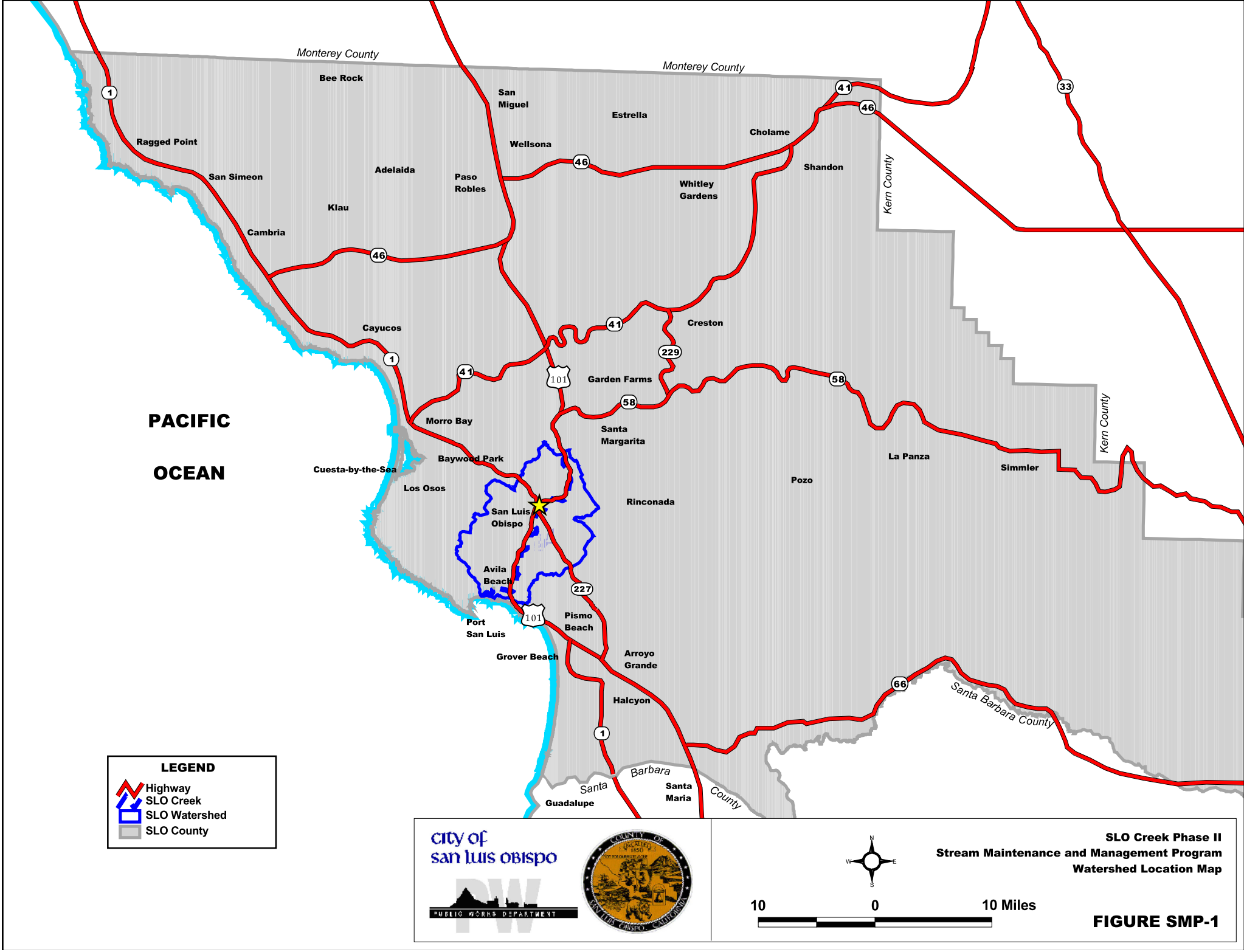
Most of these management actions, although routine in nature, can potentially impact wetlands and associated streamside riparian habitat within the stream zone, and surface water quality. Because of these concerns, a comprehensive Management and Maintenance Program was requested by a number of State and Federal regulatory agencies and will form the basis for future project planning, decision making and permitting. A long-term programmatic permit agreement (in the form of a Corps Individual Permit) and a Memorandum of Understanding (MOU) with the regulatory agencies is sought that (provided the terms of this Management and Maintenance Program are acceptable and faithfully implemented) will reduce the permit submittal efforts by City/Zone 9, and reduce the time and effort by the regulatory agencies in reviewing routine annual maintenance plan updates. Agencies involved include the U.S. Army Corps of Engineers (Corps), Central Coast Regional Water Quality Control Board (RWQCB), and California Department of Fish and Game (CDFG) (collectively Regulatory Agencies). When endangered species or their habitat may be present and are potentially affected by maintenance and management activities, consultation with the US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) is also required. This is the case for most streams within the SLO Creek watershed.

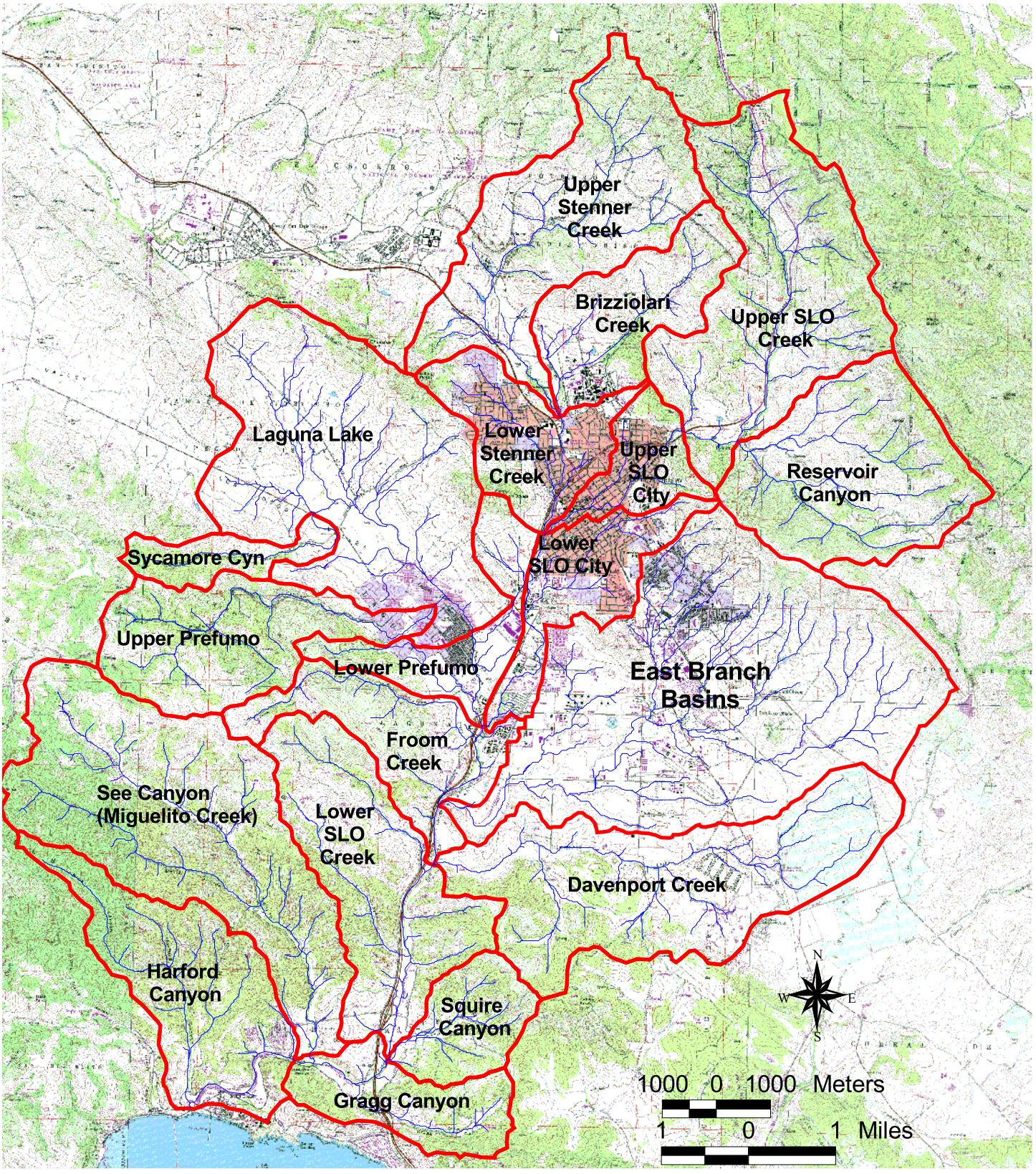
The Program also provides guidance to private creek side property owners and other local and state government entities, (such as Cal Poly State University and Caltrans), and will increase the efficiency of the permitting process for them.

## 1.4 MAINTENANCE AND MANAGEMENT ACTIVITIES

Many reaches of SLO Creek and its tributaries have on-going problems, including areas of flooding, sediment accumulation and bank instability. These require active management. Other reaches have degraded habitat, but provide opportunities for habitat enhancement and/or restoration.

***Maintenance*** activities primarily involve the ***repair, care and upkeep*** of a channel at a pre-existing or approved design condition, within a designated flow conveyance capacity. Maintenance activities are geared to maintaining the channel's design condition.


Monterey County
Monterey County
Bee Rock
San Miguel
Estrella
Cholame
Ragged Point
Wellsona
Shandon
San Simeon
Adelaida
Paso Robles
Whitley Gardens
Kern County
Klau
Cambria
Cayucos
Creston
Garden Farms
PACIFIC
OCEAN
Morro Bay
Santa Margarita
Kern County
Baywood Park
La Panza
Cuesta-by-the-Sea
Simmler
Pozo
Los Osos
Rinconada
San Luis Obispo
Avila Beach
Pismo Beach
Port San Luis
Grover Beach
Arroyo Grande
Halcyon
Santa Barbara County
Santa Barbara County
Santa Maria
Guadalupe
LEGEND
Highway
SLO Creek
SLO Watershed
SLO County
city of san luis obispo
PUBLIC WORKS DEPARTMENT
SLO Creek Phase II
Stream Maintenance and Management Program
Watershed Location Map
10 0 10 Miles
FIGURE SMP-1




City of San Luis Obispo
PW PUBLIC WORKS DEPARTMENT

# Watershed and Major Sub-Basins

**SLO Creek Phase II**
**Stream Maintenance and Management Program**

QUESTA ENGINEERING CORPORATION

**Figure**

**SMP-2**

FILE REFERENCE: c:\arcview projects\98202 slo phase ii\98202hydrology.apr
LAYOUT: Figure 1 - Base Map B
DATE: Feb 4, 2002

***Management*** involves ***modification, alteration and change***, where necessary, physical and biological site conditions in response to evolving goals, objectives and changing environmental conditions. For the SLO Creek watershed, stream corridor management must consider water quality, aquatic habitat, flood management, and protection of buildings and infrastructure from channel erosion. Management actions may consist of channel sediment removal, vegetation control and riparian enhancement, repair of bank protection structures, and construction of new bank protection and flood management improvements.

Maintenance and management activities include:

- **Flood Conveyance and Channel Constrictions.** This includes thinning of vegetative obstacles, sandbar management, and removal and retrofit of failing structures within the stream.

- **Bank Erosion Repair**. This includes bank maintenance to prevent erosion, management of existing bank repair structures, and repair of stream banks that are eroding. All bank protection devices have a practical design life and require periodic maintenance. Repair is needed when erosion:

  - **Threatens valuable bank top** improvements,
  - **Jeopardizes public safety**,
  - **Affects important roadways** ,
  - **Significantly impacts water quality**, or
  - **Impacts riparian** and aquatic habitat.

  Bank repair of existing structures using similar materials and within the same footprint can be made as routine maintenance (no permit). Extension (additional foot print) and use of differing materials may require engineering, permitting and environmental review as described in **Section 3**.

- **Bank Protection**. Erosion prevention can reduce sedimentation and improve water quality. Protection includes:

  - **Vegetative and Biotechnical slope repair** (soft structures such as brush mattresses, erosion blankets, wattles, pole cutting placement, vegetated geogrids, live crib walls, etc.). This is the preferred approach.
  - **Installation of hard structures** (rock rip-rap, concrete or rock walls, gabions) in limited cases with geotechnical instability, high velocity flows, threatened structures at top of bank, or flow conveyance constraints.
  - **Combinations of hard and soft structures** (planted rip-rap and planted gabions). This (planted gabions) approach will also be very limited.

  Hard structures will be used sparingly. City/Zone 9 (or other applicant) will provide the rationale for selection of hard structures in work plans submitted to the regulatory agencies prior to their authorized usage in the SLO Creek watershed. Bank stabilization design procedures are provided in a new, companion Hydrology/Hydraulic Design Manual.

- **Vegetation and Large Woody Debris Management**. Vegetation management is performed to maintain the channel's ability to function for flood conveyance. This involves thinning and selective removal of dense willow thickets and other woody vegetation, and selectively cattails and/or tules that

occur near and on the bottom of the stream channel. This task also includes removal of hazardous leaning trees and downed logs (large woody debris) to reduce the threat of collecting on bridges or culverts, or deflecting erosive stream flow against channel banks. Vegetation removal may be needed to comply with local fire code requirements, or to control invasive non-native vegetation. Management techniques include mowing, disking, hand clearing and/or herbicide applications.

Woody debris management needs to be undertaken very cautiously, because this material can provide valuable in-stream and stream bank aquatic habitat. This includes hiding and nesting sites for many wildlife species. The American Fisheries Society and CDFG *Salmonid Stream Habitat Restoration Manual* provides guidance for woody debris management.

- **Sediment Management**. Sediment is removed to restore the flood carrying capacity of existing stream channels, and habitat values. Typically, sediment is removed when it: (1) reduces stream capacity, (2) prevents drainage facilities or structures such as culverts or bridges from functioning as intended, (3) impedes fish passage and access to fish ladders, such as at the Prefumo Creek ladder above Laguna Lake, or (4) occurs as sand or gravel bars that deflect flow against an eroding stream bank. Sediment removal involves the mechanical removal of material that has been deposited within a stream or sediment detention structure. This typically is accomplished using a large track excavator and scooping sediment into dump trucks. Live stream flow must be diverted around the active work areas. The "scoop and lift" method, where excavated material is loaded directly into trucks, or out of channel, and not moved in the channel (pushed by bulldozers into piles for loading), must be used for routine maintenance under this program.

- **Maintenance of Hydraulic Structures**. Hydraulic structures consist of storm drain outfalls, culverts, grade control structures, and revetments, and have a design life that requires periodic maintenance and repair. Within the expected 20-year life of this Program, some hydraulic structures will require maintenance or replacement. Some existing grade control structures will be removed. Grade control structures over 0.3 meters (about one foot) above channel invert will normally not be constructed as part of the Program.

- **In-stream Aquatic Habitat Enhancement Structures**. The installation of certain kinds of in-stream habitat enhancement projects (rock weirs and channel boulders, root wads, fish ladders) for fisheries improvement may be included in the Annual Work Program.

## 1.5 OTHER PROGRAM DOCUMENTS

Because this Program has been designed to guide the implementation of routine stream maintenance projects and activities over the long-term, it addresses stream management at a general or programmatic level. This document provides the framework, policies, implementation measures and Best Management Practices that characterize how stream management will be conducted in San Luis Obispo's waterways. In addition to the Program described herein, several other related documents will be prepared, as discussed below.

### 1.5.1 Program Environmental Impact Report/Environmental Impact Statement

Consistent with the California Environmental Quality Act (CEQA), an Environmental Impact Report (EIR); and National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) will be prepared and certified by the Corps and City/Zone 9 for this Program, as part of the overall Phase II SLO Creek Waterway Management Plan environmental review. The City and County will be joint lead agencies for the EIR, and the Corps will be lead agency for EIS preparation. The combined

EIS/R will evaluate the potential environmental impacts of the Phase II Plan, and will outline recommended measures to mitigate impacts. The Program EIS/R will look at a 10-year period, since this is the time over which projects and impacts can be reliably projected. Prior to the 10-year anniversary (in the tenth year after the NEPA documents are adopted), the Program will be reviewed and updated, and the EIS/R will be revisited. Additional environmental review could be required at any time within this 10-year horizon if significant impacts not previously evaluated are identified.

### 1.5.2 Habitat Conservation Plan - Functional Equivalent Document

Portions of the SLO Creek corridor contain populations of, and/or potential habitat to support, at least five species of concern.

- Southwestern Pond Turtle (*Federal C1, State SSC*)
- Two Striped Garter Snake (*Federal C2, State SSC*)
- California Red Legged Frog (*Federal T, State SSC*)
- California Tiger Salamander (*Federal C2, State SSC*)
- Southern Steelhead (Federal T, *State SSC*)

These endangered species (listed, proposed, and candidate) may occur in City/Zone 9's jurisdiction and could be affected by routine stream maintenance activities, causing incidental harm (or "take") of a listed species. A permit is required from the USFWS and the NMFS for incidental take of listed species.

A Habitat Conservation Plan (HCP), authorized under Section 10 of the Endangered Species Act, is completed to obtain the take permit. The HCP must include:

- An assessment of impacts likely to result from the proposed taking of one or more federally listed species;
- Measures the permit applicant will undertake to monitor, minimize, and mitigate for such impacts; the funding that will be made available to implement such measures, and the procedures to deal with unforeseen or extraordinary circumstances;
- Alternative actions to the taking that the applicant analyzed, and the reasons why the applicant did not adopt such alternatives;
- Additional measures that the Service may require as necessary or appropriate.

An HCP was not specifically identified as part of the required work during the negotiated development of the Phase II Work Scope with the regulatory agencies, although it was described as being a possible future requirement. This Program and related documents, including the programmatic EIS/R (and its Mitigation and Monitoring component) is proposed to be considered the functional equivalent of a HCP. These documents will outline and examine City/Zone 9 management activities and identify measures to minimize or avoid impacts on federally protected species. In those instances where impacts are unavoidable, compensatory mitigation efforts will be included. The conservation measures normally established through the HCP development process have been incorporated into this Program and will be restated in the Waterway Management Plan EIS/R (EIS/R).

This Program may allow City/Zone 9 to receive a federal permit to unintentionally harm listed species in the course of completing routine maintenance projects. By incorporating BMPs into a permit application, landowners agree to pursue specific management protocols for endangered and threatened species.

### 1.5.3 Long-Term Permits

Four approvals and/or regulatory permits (with Conditions of Approval) are needed:

- ***Individual Programmatic Permit***, under the jurisdiction of the Corps, including Waters of the United States and special aquatic sites (wetlands) pursuant to Section 404 of the Clean Water Act, and Section 10 of the Rivers and Harbors Act. This would grant general authorization and set conditions for all routine stream maintenance activities subject to jurisdiction of the Corps.

- ***ESA Incidental Take Permit*** requirements under the Federal Endangered Species Act, as issued by the USFWS and NMFS. The Corps will initiate formal consultation with the USFWS and NMFS as part of their review and approval of the SMMP. Biological Opinions (BO) may be provided by the agencies as part of the review process. In addition, the Annual Maintenance planning process (Section 4) provides for an annual review and consultation with USFWS and NMFS.

- ***Waste Discharge Requirements*** (WDR) permits under Section 401 of the Clean Water Act, administered by the Central Coast RWQCB.

- ***Memorandum of Understanding*** (MOU) with CDFG for stream maintenance activities under Section 1601 of the State Fish and Game Code.

The permits and approvals from these agencies for routine stream maintenance are expected to be valid for a period of 20-years, with the intent to apply for extension and renewal of these permits prior to expiration.

In addition to these programmatic requirements for adoption and implementation of the Program, City/Zone 9 will utilize supporting documents to guide stream maintenance activities, including the **Annual Work Plan** and other programs discussed in Section 1.6, and permit Conditions of Approval issues by the regulatory agencies. Typical **Conditions of Approval** are presented in **Appendix E**.

## 1.6 OTHER STREAM MANAGEMENT PROGRAMS

Several agencies within California have prepared or are in the process of preparing long-term management plans. The *Draft Santa Clara Valley Water District Stream Management and Maintenance Plan* provided a basis for the approach towards a long-term programmatic permit process. The concept of an annual work plan is used by the Santa Barbara County Flood Control and Water Conservation District in their Long-term Programmatic Permit with the Corps and CDFG. Stream Corridor Management Plans prepared by Questa for the Cities of Petaluma, Novato, and Concord also provide a basis for the Program. Other references are included in **Section 7.**

Channel maintenance **Best Management Practices** have been developed by the Bay Area Stormwater Management Association. (BASMA, 2001). The BASMA BMPs are incorporated by reference in this document and will be used by City/Zone 9 in planning, designing and implementing stream maintenance and management projects, along with **Appendix A**, "Working In The Creek."

This Program is Volume II of the three-volume *Waterway Management Plan for the San Luis Obispo Creek Watershed*, prepared by City/Zone 9. The earlier Phase I program (Questa Engineering Corp, 1997) mainly covered reaches of SLO Creek in the southern half of the City, and focused on bank erosion problems and their repair. Within the watershed, other planning projects include:

- ***Waterway Management Plan***, including project EIS/R and Mitigation and Monitoring Plan
- ***Hydrologic/geomorphic and biologic inventories*** of SLO Creek and major tributaries. This GIS information is available on Cal Poly's web server. These are **Appendices A&B** of Volume I, Waterway Management Plan.
- ***Hydrologic/Hydraulic Analysis Report***, including GIS-based computer models. This is **Appendix C** of Volume I, Waterway Management Plan.
- ***Drainage Design Manual*** (outlining hydrologic/hydraulic analysis procedures and descriptions of drainage improvements, including b*ank stabilization design chapter)*. This is Volume III of the Waterway Management Plan

Section 2

# MITIGATION & RESOURCE PROTECTION

## 2.1 PURPOSE

All routine stream maintenance activities within the SLO Creek watershed shall comply with the goals, principles and policies outlined in this section.

## 2.2 GOALS

A creek management program ideally recognizes the natural processes that occur within a steam channel, such as erosion and sediment deposition, so that damage is minimized and the stream is self-maintaining. However, the streams in the SLO Creek watershed have been significantly affected by prior disturbance and many of the creeks within the City are constrained by existing urban development, making such natural geomorphic solutions largely infeasible, especially in urban areas. Program goals include:

- **Insure that SLO Creek and its tributaries continue to provide a healthy and safe environment** for residents and visitors.
- **Protect, enhance, and restore** the stream ecosystem.
- **Minimize the potential for flood damage**.
- **Incorporate resource protection** and mitigation measures into stream maintenance activities.
- **Balance watershed natural resource benefits** with public health and safety concerns.

## 2.3 PRINCIPLES

1. **Incorporate Best Management Practices (BMPs)** into all projects for routine sediment removal, vegetation management, repair of hydraulic structures, and bank protection for streams within City/Zone 9 jurisdiction. BMPs are contained in **Appendix A.**

2. **Minimize impacts to wetlands** and biological resources, through the use of native woody vegetation (vegetative stabilization) combined with biotechnical stabilization.

3. **Limit use of structural stabilization** to high-energy environments, such as toe of bank, meander bends, or significantly down cutting streams or in soft, unstable bank materials. Structural stabilization may also be selectively used where valuable bank top improvements (such as buildings, not necessarily open space, landscaping or parking areas) are threatened, and there is little or no room at top of bank for laying the slope back.

4. **Utilize hydraulic and geomorphic analysis** to identify maintenance needs, and design repair and bank protection projects.

## 2.4 POLICIES

Eight policies have been developed to guide stream maintenance activities. These include:

- **Policy SM -** Stream Management
- **Policy WM -** Watershed Management
- **Policy ES -** Environmentally Sensitive Species
- **Policy FP -** Fisheries Protection and Aquatic Habitat Enhancement
- **Policy RH -** Riparian Habitat Protection and Enhancement
- **Policy WP -** Wetlands Protection
- **Policy DE -** Work Site Dewatering and Erosion Control
- **Policy HM -** Herbicide and Hazardous Substance Use and Management

## 2.5 STREAM MANAGEMENT (SM)

**SM-1**: An **Annual Work Plan** (AWP) will be prepared for routine maintenance projects to ensure that environmental assessment, and sensitive species protocols are incorporated into each project. Activities shall be completed in a manner that demonstrates an appropriate effort to avoid and minimize environmental impacts. The AWP will be used for Category 2 projects only.

**SM-2**: **Hydraulic and geomorphic analysis** will be completed as part of the AWP or individual project designs to identify sediment removal; vegetation management and hydraulic maintenance needs; and select appropriate technologies. The Zone 9 HEC-RAS hydraulic computer model will be used to conduct the hydraulic analysis. This information will be incorporated into the AWP.

**SM-3**: **Stockpiling, transport and disposal or placement of sediments** removed from stream maintenance projects shall avoid impacts to the stream channel and surrounding habitats.

Actions-Standards

A. Sediments and gravels removed from streams will be reused where appropriate and feasible, considering environmental, regulatory, and fiscal impacts.

B. Wet sediments will be stockpiled outside the riparian corridor to dry before being transported and disposed of in accordance with applicable regulations. Saturated sediments set aside for drying will be inspected for sensitive species before being moved again.

C. When sediment or rock structures are placed to improve spawning, such as in scoured areas, or where instream structures have been removed or placed to facilitate pool formation, gravels must be clean and of the appropriate size, and structures designed appropriately to support spawning. This will only be done after consultation with USFWS and NMFS.

D. All temporary fills (such as cofferdams and sandbag diversion structures) will be removed in their entirety, and the affected areas will be returned to their pre-existing conditions.

**SM-4**: **Short-term noise and air quality impacts** associated with stream maintenance activities shall be minimized.

Actions-Standards

A. Stream maintenance projects shall comply with City Noise Control Regulations (Ch. 9.12 of the Municipal Code), and applicable County regulations.

B. County Air Pollution Control District (APCD) BMPs will be used to avoid and minimize air quality impacts associated with stream maintenance projects.

**SM-5**: **Cultural resources** at work sites shall be protected, and projects will be undertaken in such a way to reduce the potential for adversely impacting previously undiscovered cultural resources.

Actions-Standards

A. The State Architect's Office will be contacted to determine if there is the potential for occurrence of a state or nationally recognized historic site. The Regional Archaeological Center at Cal Poly and other sources such as the County Historical Society and Museum will be contacted and a Phase I Survey conducted by a qualified professional to determine the possibility of significant cultural resources. A Phase II Survey will be conducted, depending on the findings.

B. If any archaeological or historic materials or objects are unearthed, all work in the immediate area must cease until a qualified archaeologist has evaluated the finds and developed recommended actions. City/Zone 9 shall comply with all agreed upon mitigation measures.

C. Stream maintenance projects that require the removal or reconfiguration of stream bank materials shall comply with the City of San Luis Obispo's *Archaeological Resource Preservation Guidelines* (October, 1995).

D. In the event that human remains are encountered, there shall be no further excavation or disturbance of the site or nearby area suspected to overlie adjacent human remains. The SLO County Coroner will be contacted and appropriate measures implemented. These actions would be consistent with the State Health and Safety Code Section 7050.5, which prohibit disinterring, disturbing, or removing human remains from any location other than a dedicated cemetery.

## 2.6 WATERSHED MANAGEMENT (WM)

**WM-1**: **A watershed approach** to management activities will be employed. Future projects will be designed based on evaluation of the stream corridor, watershed, and urban landscape as a complex of working ecosystems that each influence management tasks. A watershed approach looks at the entire watershed and all of its resources holistically, and not just as a local problem to be addressed with temporary or local solutions.

**WM-2**: **Sediment load reduction** through watershed management will be coordinated with the Phase II Stormwater NPDES (National Pollutant Discharge Elimination System) and TMDL (Total Maximum Daily Load) planning efforts currently under way.

Actions-Standards

A. Restoration projects such as stream corridor fencing and vegetated buffer strips will be implemented to reduce upland erosion, increase nutrient uptake within buffer strips and reduce sediment delivery through the riparian zone.

B. Upland erosion control should include stabilization of dirt access roads throughout the watershed.

**WM-3**: **Partnerships with agencies** such as Caltrans, Cal Poly, Land Conservancy, San Luis Obispo Resource Conservation District and the local CCC to implement watershed management programs will be encouraged. Activities to support restoration and watershed management efforts include:

- Grant participation,
- Cost-sharing,
- Technical training,
- Labor and technical resources,
- Provision of support services, and
- Work training programs (CCC).

## 2.7 ENVIRONMENTALLY SENSITIVE SPECIES (ES) PROTECTION

**ES-1**: **Impacts will be avoided** to sensitive species through project-specific resource protection measures.

Actions-Standards

A. The USFWS, NMFS and CDFG will be notified of all potential projects that might occur in sensitive species habitat. Notification will occur as part of preparation and submittal of the AWP, and then again two weeks prior to the initiation of any sensitive project, as determined by the City/County project manager.

B. Resource protection measures will be included in individual project plans for stream maintenance projects including:

- Project timing and implementation practices
- Special design features
- Species-specific protocols
- BMPs.

C. During breeding, nesting or migration periods, or other sensitive seasons, avoid maintenance activities within an area of known or likely to occur listed species or species of concern.

D. Instream work will be limited to June 1 to November 1. The instream channel includes the channel bottom up to 10 feet minimum above the Ordinary High Water (OHW) mark, or the 2-year peak flow line.

E. Work may occur during these seasons (exclusive of fisheries), if pre-construction surveys conducted according to species protocols do not find sensitive animal species.

F. Work may occur near listed plants only if a fenced buffer of adequate dimensions (as determined by a qualified biologist) around the individual plant can be maintained within which no activities (even indirect) may occur.

G. Listed species, such as California red-legged frog (CRLF), need emergent vegetation and willows for various stages of their life cycles. Maintenance projects will leave some shrubs and emergent vegetation for habitat diversity, as determined by the City or County project biologist, and in consultation with CDFG.

H. High quality aquatic habitat (deep pools with overhanging and/or emergent vegetation) is especially valuable and special care will be taken to preserve and protect these areas.

**ES-2: All work in Navigable Waters of the U.S. will be avoided to the maximum extent practicable,** including structures and discharges of dredged fill material into breeding areas for migratory waterfowl.

**ES-3: Potential habitat will be surveyed** by a biologist to ensure that listed species and species of concern are not present on-site.

Actions-Standards:

A. If sensitive species are found, all work must comply with adopted BMPs and permit conditions for that species.

## 2.8 FISHERIES PROTECTION AND AQUATIC HABITAT ENHANCEMENT (FP)

**FP-1**: **Aquatic resources shall be protected** when completing stream maintenance projects.

Actions-Standards

A. Enhancement of aquatic habitat will be included in the design of all bank repair projects, such as creek shading, pools, lunker structures, etc.

B. Undercut banks may remain in place for aquatic habitat, as long as they are stable and do not endanger public infrastructure or top of bank property improvements.

C. Bank protection projects will preserve existing habitat, and incorporate artificial habitat such as lunker structures, root wads, and channel boulders whenever technically feasible.

D. Hydraulic structures such as rock weirs or drop structures will be designed and constructed to insure that they will not impede migration of steelhead.

E. All instream hydraulic structures must be designed and constructed such that pre-construction flows are maintained, and do not result in upstream/downstream erosion or sediment deposition. This may require completion of a geomorphic/hydraulic analysis.

F. CDFG and NMFS biologists will be notified and consulted.

**FP-2**: **Potential impacts to steelhead** will be avoided by timing stream maintenance projects in streams where there are, or could be, steelhead so that work is conducted outside of the migration and spawning season. Steelhead migration and spawning season is generally between December 15 and June 1 in the SLO Creek watershed.

**FP-3:** A **fish and native aquatic vertebrate relocation plan** will be implemented when cofferdams, water bypass, and silt barriers are installed to ensure that fish and native aquatic vertebrates are not stranded.

## 2.9 RIPARIAN HABITAT PROTECTION AND ENHANCEMENT (RH)

**RH-1**: **Potential impacts to riparian and shaded riverine aquatic habitat** will be avoided. Project-specific measures (such as protection of mature canopy trees, nesting trees and snags) will be incorporated into work projects to avoid and minimize impacts.

**RH-2: Biotechnical bank protection** methods will be emphasized to restore riparian streambank vegetation and shaded aquatic habitat. Projects where bank protection is performed will be evaluated to determine whether vegetated methods of bank protection are appropriate.

**RH-3: Temporary access routes** to project sites will be replanted with native species appropriate for the site.

**RH-4: Native woody vegetation** will be left on banks to maintain shaded habitat, consistent with the design flows for each reach contained in the *Waterway Management Plan* and *Drainage Design Manual*. Non-native exotics may be removed and additional native woody plants interplanted to enhance habitat conditions.

Actions-Standards

A. Project designs will include provisions to selectively retain and anchor woody vegetation in place using the California Salmonid Stream Habitat Restoration Handbook.

B. When woody material is removed, consideration will be given to reuse it in bank protection projects, such as root-wad construction.

C. CDFG biologists will be consulted on all vegetation management projects.

## 2.10 WETLANDS PROTECTION (WP)

**WP-1**: **Wetland habitat impacts** in project areas will be avoided or minimized to the maximum extent feasible. Work will be limited to only that required to achieve a reasonable flow capacity of the stream, construct a biotechnical repair project, or restore the proper function of existing necessary hydraulic structures.

**WP-2: Wetlands impacts will generally be mitigated at a ratio of 2:1** (e.g. 2 acres replaced for every acre disturbed or filled), where possible.

Actions-Standards

A. Up to one-half of the mitigation area may consist of stream or riparian enhancement, to compensate for temporary disturbance or temporal impacts.

B. Biotechnical bank stabilization will be designed so that it does not preclude the establishment of wetland vegetation where site-specific conditions can support a wetland.

## 2.11 WORK SITE DEWATERING AND EROSION CONTROL (DE)

**DE-1: All temporary water diversions must maintain pre-construction flows** of similar quality and quantity downstream of the project site.

Actions-Standards

A. A water diversion/water management plan will be prepared by City/County work crews and private contractors prior to any stream diversion. The plan will be submitted to the CEQA Compliance office (and regulatory agencies upon request) for review and approval. The plan will detail the methods and materials that will be used in diverting, filtering, and returning flows to the creek.

**DE-2: Stream turbidity** (water cloudiness) will be controlled when completing maintenance activities. Increased turbidity can result from maintenance activities, installation of cofferdams and water bypass structures, and/or reintroduction of bypassed flows to dewatered areas.

Actions-Standards

B. Where feasible, stream maintenance activities will be completed in dry conditions.

C. If there is flowing water within the work area, the area will be isolated through the use of cofferdams, berms, or bypass systems. Items placed in the streambed to isolate water need to be placed by hand, and sandbags shall be pre-filled. If pumps are used in water diversions, they must be screened with an appropriate mesh size (typically at least 0.25") to prevent the entrance of sensitive species.

D. If necessary, water will be diverted around, and subsequently reintroduced to, the streambed in a non-disruptive manner and at appropriate distances upstream and downstream of the project area, respectively.

E. Project design features will include: geotextile fabrics (splash apron), silt fences, straw bale barriers, filter fabrics, sand bag barriers, brush or rock filters, sediment basins, and sediment traps.

**DE-3:** All **diversion piping** shall be adequately sized for the expected flows (as determined by the Project Engineer), to prevent backwater conditions, dissolved oxygen and temperature changes. A secondary low-flow channel constructed with sandbags and plastic visqueen sheeting or other methodology can also be used to isolate the work area.

**DE-4:** When **diversion structures and silt barriers** are utilized, a relocation plan will be implemented if fisheries or native aquatic vertebrates are present.

**DE-5**: The **work site shall be restored and maintained in a vegetated condition** after individual projects are implemented, to reduce erosion and sedimentation potential.

Actions-Standards

A. Control of exotic species and the use of selective, least toxic herbicides (instead of disruptive mechanical control) can be effective in maintaining habitat quality. All herbicide use will be consistent with approved product specifications.

B. Vegetation control along levees and maintenance roads will be limited to that necessary for inspection, to meet regulatory requirements, or to comply with fire codes.

C. If maintenance work leaves slopes in a bare soil condition, slopes will be stabilized using seeding and erosion control blankets, then replanted with native vegetation.

D. All exposed soil will be permanently stabilized using a combination of vegetative and structural measures as appropriate, at the earliest practical date. Temporary soil erosion and sediment control materials will be available at the job site by October 1, and will be in-place by October 15 of each year, unless an extension is granted by appropriate regulatory agencies.

## 2.12 HERBICIDE AND HAZARDOUS SUBSTANCE USE AND MANAGEMENT (HM)

**HM-1**: **Herbicides** will be used selectively, only where necessary to treat aggressive, invasive species. Application will be done to avoid negative environmental effects, consistent with environmental goals.

Actions-Standards

A. The emphasis will be on manual and integrated pest management (IPM) methods for weed control.

B. Control methods will generally follow the recommendations of the California Exotic Plant Pest Council and the University of California IPM practices and procedures.

C. All herbicide use will be consistent with approved product specifications.

D. Only herbicides and surfactants registered for aquatic use will be applied within the banks of channels when water is present.

E. Vegetation management on bank tops will be limited to selective broadleaf herbicides (least preferred), hand removal, and mowing.

**HM-2:** A licensed **California Pest Control Advisor** will supervise all herbicide applications.

**HM-3: No construction or maintenance activity may use or place unsuitable or toxic material** (trash, debris, tires, car bodies, asphalt, etc) and material used for construction must be free from toxic pollutants.

**HM-4**: **Hazardous materials** shall be properly handled and water quality shall be protected by all reasonable means when removing sediments from the streams.

Actions-Standards

Handling and disposal of sediments will be in accordance with all applicable state and federal regulations, including those of the Central Coast RWQCB.

**HM-5: Training of field supervisor or foreman** will include spill prevention and containment, hazardous material control, and clean-up of accidental spills.

Actions-Standards

A. Spill prevention and containment kits shall always be in close proximity when using hazardous materials (e.g., crew trucks and other logical locations).

B. All field personnel will be advised of these locations and trained in their appropriate use.

C. Daily tailgate safety briefings will be required of all City, County, and private contracting work crews. The tailgate meetings will address hazardous materials mixing, use and disposal issues and will focus on water quality, fisheries, and sensitive species.

## Section 3

# STREAM MAINTENANCE ACTIVITIES

### 3.1 BACKGROUND

This Program provides a framework for the implementation of routine stream maintenance activities within the SLO Creek watershed. These include: sediment removal, vegetation and woody debris management, hydraulic structure maintenance and repair, and bank repair and protection. This section describes the watershed management needs, maintenance activities and implementation schedule. Known and projected locations of persistent stream maintenance problems and long-term stream maintenance activities are summarized. These are described in detail in *Section 3* of the Volume I *Waterway Management Plan for the San Luis Obispo Creek Watershed*, entitled *Problem Identification and Waterway Management Needs*. An overview of stream management and maintenance needs is provided in **Figures 3a** and **3b.**

Many of the streams in the watershed are predominantly seasonal, with significant flows occurring only during the winter and spring months. It is also common for some streams to not flow at all in drought years, and to maintain perennial flow during wet years. The native fish and aquatic organisms of the SLO Creek watershed have adapted their life histories to meet these environmental challenges. Significant disturbances to the physical conditions and habitat can have profound adverse impacts on them. Because most of the streams in coastal California have been impacted by urban uses, many of the native fish and aquatic organisms are considered sensitive, threatened, or endangered species by state and federal resource agencies.

Significant variations in rainfall can cause extensive, widespread channel erosion and sedimentation in wet years. In addition to degrading aquatic habitat, erosion and sedimentation can reduce the flow capacity of streams. Vegetative growth (from a channel conveyance perspective) occurs in moderate or drought years due to the lack of flushing flows. With SLO County's moderate climate, vegetation can flourish throughout the year. Obstructive vegetation includes young shrubby willows, introduced exotic woody plants and ground cover. The natural stream courses in many areas originally had a higher conveyance capacity in their upper bank, because the natural climax vegetation along the stream corridors consisted of mature sycamores, cottonwoods and tree willows. These tall single-trunk species have lower flow retardance (Manning's "n" value) than shrubby willows and exotics. Nearly all of the streams in the watershed have significant conveyance capacity limitations, often less than 25-year flood flow capacity (with several reaches in the 10 to15 year flow capacity range). However, not all conveyance limitations are related to in-channel vegetation. Other problems include sediment accumulation and limited channel cross section.

Fire in the watershed, such as the Highway 41 area in 1994, can also have a significant effect on erosion and sedimentation. The sediment load detracts from channel capacity and alters fluid dynamics. The effects can persist over many years as the sediment bedload slowly works its way through the fluvial system. Increased flood risks result from sedimentation and dense channel growth. In urban areas of limited channel capacities, management of shrubby lower bank vegetation and sediment management are critical.

Some small headwater tributaries originate on upper alluvial fans, at the front of the foothills and mountain slopes that ring SLO valley. These fans were formed during debris and massive sediment flow events, and their natural stream courses may not be stable. There are significant maintenance challenges where urban development has occurred on these upper fans. Without maintenance, (culvert and storm drain clearing before and during major storm events), these channels may clog, overflow banks, and migrate from their present form and location.

Periodic Dredging Needs

Reach 17

Local Vegetation Management, Low Priority Channel Incision

Reach 18

Reach 8

Willow and Sediment Management

Reach 7

Filliponi Ecological Reserve Restoration Site

Reach 6

Hazard Trees, Bank Stabilization

Restoration and enhancement opportunity: Diversify willow population, retain debris jams as potiential mitigation, Reaches 2 to 5.

Reach 5

Reach 24

Reach 4

Reach 3

Critical Site Monitoring And Evaluate Need For Bank Stabilization

Reach 2

Reach 1

Figure SMP-3a: Priority Stream Maintenance and Management Needs and Restoration/ Enhancement Opportunities, Lower Watershed

Hazard Trees

Prioritized Bank Erosion Sites

Currently Eroding

Stabilized Phase I

Prioritization Reach Boundaries

Hydraulic Obstructions

Maintenance and Management Zones

Stream Channel

N

W E

S

0.5 0 0.5 Miles

San Luis Obispo Waterways Management Plan

Questa Engineering Corporation

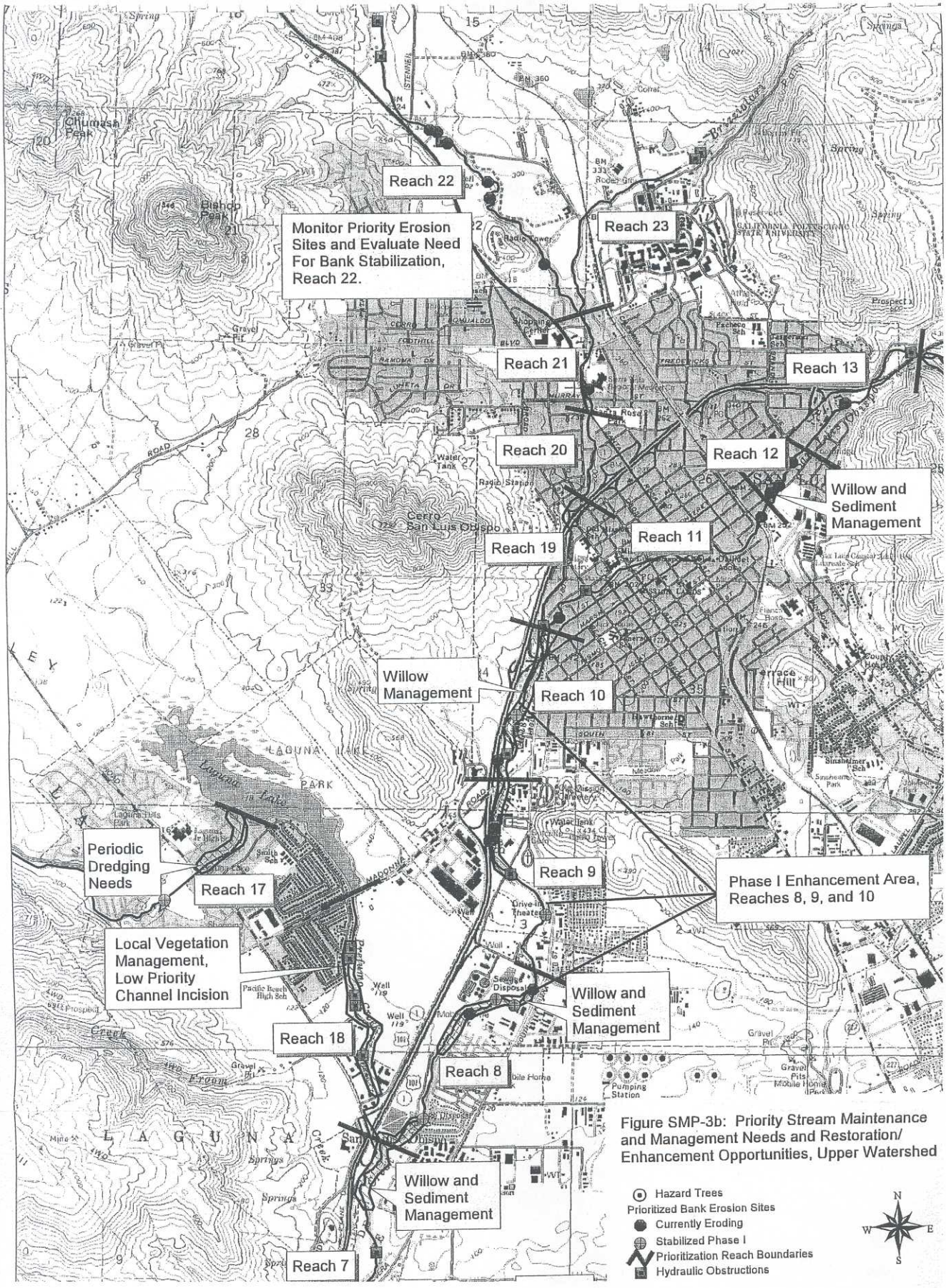



Figure SMP-3b: Priority Stream Maintenance and Management Needs and Restoration/ Enhancement Opportunities, Upper Watershed

## 3.2 MANAGEMENT PROBLEMS AND SOLUTIONS

Management to remove sediment, selectively clear select vegetation and replant with natives can help stabilize and optimize channel conveyance capacity. Preservation of the existing stream corridors, including protecting and enhancing biological habitat along the stream is a cost-effective approach to flood hazard mitigation. Management refers to a pro-active program (often a physical improvement) to overcome a hydrologic or hydraulic problem. Management problems and maintenance activities described in this section include:

- Flood Prone Areas
- Channel Constrictions
- Bank Erosion
- Channel Bed Erosion
- Vegetation Management and Large Woody Debris
- Sediment Accumulation
- Hydraulic Structures

### 3.2.1 Flood Prone Areas

#### *3.2.1.1 Background*

The 1981 FEMA Flood Insurance Rate Map (FIRM) depicts a 300-400 meter (1,000-1,300-feet) band of flooding (100-year average recurrence interval) extending along SLO Creek, with narrower widths along Stenner and Prefumo Creeks. The extent of flood prone areas has been confirmed by hydrologic/hydraulic studies completed as part of the *SLO Phase II Waterway Management Plan*. However, these studies found the depth and frequency of flooding to be somewhat greater than in the FEMA studies. The 1995 flood caused significant damage to private property within the City, and SLO Creek, but provided cleaning and enlargement of the waterway. If this same flood occurred today (2001) it would probably not produce the depth of flooding. Conveyance capacity has been increased at many locations by down cutting and widening the channel through erosion and removal of flow inhibiting vegetation. At other locations the capacity has been reduced by deposition (Marsh Street and Los Osos Valley Road bridges), and at point bars on the inside of channel meanders. The most noticeable area of hardened bars occurs in Reach 8 downstream of the City's Wastewater Treatment Plant below Prado Road.

#### *3.2.1.2 Problem Identification*

Each year channel management is delayed, flood risk is increased. Due to flow constrictions at bridges and other areas of limited channel conveyance, flooding can occur even during the 10 or 20-year recurrence interval flood flows in some areas. Bank denuding and erosion have added plant debris and sediment that is redeposited downstream. Undermined trees have toppled into the channel in some areas, and vegetation can collect debris, reducing channel capacity and deflecting flows against banks. In many areas the sediment bars that were deposited during the 1995 and 1998 high flows have now become overgrown with dense willow thickets, and have become more or less hardened. These willow vegetated bars form significant channel obstructions, and can deflect flow against banks, causing bank erosion.

#### *3.2.1.3 Management and Maintenance Activities*

Careful and sensitive management of channels and banks affords an opportunity to reduce the impact of future floods. Management actions include:

- **Management of hardened bars**. Willow growth should not be allowed to recolonize point bars for more than two consecutive years. If the growth persists, there will be increased flow friction losses and sediment deposition. This will increase the depth of flooding, or cause lateral erosion, particularly at channel bends.

- **Maintain perennial vegetation** in the active part of the channel at a low level, while preserving important habitat. The most critical areas to preserve are shaded pools. The goal will be to maintain larger native plants, (erect, single trunk) generally at spacing of 10-15 feet. For these trees, the limbs in the lower six feet will be removed or thinned. Exotic and hazardous trees will be removed over time and replaced with natives. Thinning and limbing activities will focus on the lower half of the active channel and channel bottom. Planting will be concentrated on the upper bank, bank top, and around existing pools.

- **Replant banks with desirable species** (replacing undesirable exotic vegetation, plugging gaps in canopy cover, or planting areas denuded by the 1995 flood) to help stabilize the bank, direct deposition into toe protecting berms, and reduce sediment supply.

### 3.2.2 Channel Constrictions

#### *3.2.2.1 Background*

Channel constrictions are bottlenecks or channel segments that lack adequate cross-sectional area for flood conveyance. Channel constrictions can occur from channel obstructions, such as bridges, from natural occurrences, such as downed trees or shrubby channel growth, or from man-made obstructions, such as rip-rap or concrete-wall sections. Areas of channel constrictions due to dense willow growth occur in the Mid-Higuera area, from the Marsh Street Bridge to downstream of Madonna Road, (Reaches 9 & 10). Constrictions from built revetment obstructions in the channel occur in the downtown and Mission Plaza area, and upstream to the Santa Rosa Bridge, as well as lower Stenner Creek (Reaches 11 & 12).

#### *3.2.2.2 Problem Identification*

The most common form of channel constriction is the haphazard placement of inappropriate channel protection structures (broken concrete, rock, etc.) on the channel banks that encroach into the stream. In areas with flooding problems, these structures may contribute to reduced hydraulic capacity of the channel. Although many of these private-party attempts at channel protection are old (prior to 1970) or were placed during a flooding emergency, permits for placement have been required by the City, State and Federal agencies since at least 1982.

#### *3.2.2.3 Management and Maintenance Activities*

Proposed projects to address flood causing channel constrictions are presented in **Section 6** of Volume I, *Waterway Management Plan for the San Luis Obispo Creek Watershed*. In addition:

- **Bank protection structures** shall be designed and installed to be hydraulically efficient, without changing floodwater surface elevation or causing channel constriction.
- **Retrofit obstructive revetments**. Revetments that encroach into the channel and block or divert flow will be given priority for replacement or modification, by lowering or reorienting them.
- **Provide routine vegetation management** in constricted sections. See Section 3.2.1.3.

### 3.2.3 Bank Erosion

#### *3.2.3.1 Background*

Stream bank erosion is a natural process. Erosion and bank failure are caused both by hydraulic forces and geotechnical instabilities, and can be accelerated by human intervention and land use changes, often at a watershed scale. SLO Creek bank conditions range from stable and well vegetated to near vertical eroding banks. All reaches of SLO Creek and its tributaries have some bank erosion problems, but widespread, significant problems occur upstream of Prado Road in Reach 8. Bank failure and significant bank erosion occurs throughout the study area. Bank protection has generally been the responsibility of the individual creek-side landowner, except where channel modifications were implemented to protect public facilities, or the City has acquired easements.

#### *3.2.3.2 Problem Identification*

Accelerated bank erosion results from land uses that affect the stream corridor, including overgrazing, agriculture, top of bank construction, and road and utility construction. The Phase II watershed reconnaissance found that channel bank erosion is one of the biggest contributors to sediment load in the system, more than upland erosion.

Bank repair and protection is necessary when erosion

- Causes or **could cause significant damage** to a property or adjacent property,
- Is a **public safety** concern,
- Negatively **impacts recreational use**,
- **Affects water quality**, or
- **Impacts riparian habitat**.

Problems include toe erosion and bank undercutting, over-steepened vertical slopes too high for the natural soils to support due to channel bed incision, and natural downstream migration of meander bends. Bank protection has been used previously, including rock rip-rap or gabion baskets. This can reduce stream shading and displace more desirable riparian vegetation. Some previous bank repair areas are now failing, in many cases from channel bed erosion removing foundation support. Banks are often high, ranging from three to seven meters.

#### *3.2.3.3 Management and Maintenance Activities*

Before new bank stabilization measures are applied to an eroding bank section, it is important to understand the cause of the problems, characteristics of the channel and bank, and the mechanisms of failure. Stabilization designs that are implemented without this analysis could transfer the problem to the other side of the channel, upstream or downstream, or result in added failure and/or costly maintenance. This Program and Phase II hydrologic and geomorphic studies provide such information. Bank repair and protection may include:

- **Repair of stream banks** that are actively eroding,
- **Erosion protection** at critical sites,
- **Hard structures** (e.g., rock, concrete, sack concrete, gabions)
- **Soft structures** (e.g., erosion blankets, willow wattles, willow/brush mattresses, log crib walls, pole planting, etc.).

Vegetative and biotechnical methods will be the preferred method of bank repair and protection, consistent with an engineering analysis of hydraulic, geotechnical and geomorphic constraints. Hard structural approaches will be used sparingly, and only at highly constrained sites. Hard structural approaches must be technically justified through completion of hydraulic, geomorphic, and geotechnical studies as outlined in the *Drainage Design Manual.*

#### *3.2.3.4 Vegetative Approaches*

Vegetative approaches provide soft, flexible channel stabilization. This includes seeded grass, brush plants, or willows, cottonwoods, or other riparian species planted at close spacing. Unlike hard structures, these systems seldom significantly deflect river flow downstream toward the opposite banks, but can absorb energy and decrease stream velocities. Shrubby willow growth and downed trees can deflect some flow. However, vegetative lining alternatives have limitations in resisting channel velocities and shear forces during high-energy flow events. Woody plants' high resistance to channel flow can slow water velocities, and increase water surface elevations and flood depths, particularly where channels are narrow or constricted. Vegetative approaches need "grow-in" time before they become fully effective. Erosion control blankets should be used until vegetation is established. Vegetative solutions are best in areas of lower velocities (<1.5 m/s) where there is adequate room to lay back the bank slopes.

#### *3.2.3.5 Biotechnical Approaches*

A biotechnical repair is one, which uses an integrated approach, combining both vegetative and structural elements. There are many biotechnical approaches, and they represent a "box of

tools" to meet the hydraulic and biologic design needs of each unique set of site conditions. Many projects require more than one technique to resolve the underlying problem(s) leading to bank instability. Some techniques include:

- In reaches with steep gradients and high velocities, an **integrated approach** (combining structural with vegetated techniques) might be to install boulder clusters or grade control structures to flatten the grade. For instance, the structures will need to be keyed into the banks with rock rip rap or other structural element that is vegetated.

- In some areas, high sheer forces require the use of rock rip-rap or gabions to protect the toe slope from bank collapse, but the upper banks can be protected with a softer approach. This would include hard toe protection from the 2-year flow line (one meter $\pm$ above bed) to the 10-year flow line (3 meters $\pm$ above bed), and planted with willows, or other woody vegetation, to reduce velocities and absorb energy.

- These structures need to be designed carefully so there is no significant loss of channel flood flow conveyance or increased water surface elevations. Channel enlargement, or laying the slope back on one or both banks to increase channel capacity and slope stability could be used where there is room to do so at the top of bank. It may be necessary to select the bank with the most area, or the side with the least biological value. Finally, with increased conveyance capacity, the bank slopes could be planted with desirable riparian species.

- Erosion control blankets, willow wattles, or trees and brush can be planted on the upper slopes, where shear forces are lower. Where upper bank slopes experience shear forces higher than the shear resistance of a typical biodegradable erosion blanket, then the design can be strengthened by using a blanket with nylon netting, or cross-wiring the blanket to the slope with rope and stakes.

#### *3.2.3.6 Bank Stabilization Construction Considerations*

Equipment used for bank protection may include construction equipment such as excavators, bulldozers, loaders and dump trucks, and pumps and water trucks. In sensitive areas or areas lacking suitable access, bank protection may also be completed using hand labor. If water must be diverted during repair work, coffer dams may be needed, utilizing water pumps, piping, gravel, sandbag, and hay bales or rubber or other suitable material. If pumps are used in water diversions, they must be screened with an appropriate mesh size (at least 0.25") to prevent the entrance of sensitive species. In some cases, a bypass channel or detention basin is appropriate to isolate a site. Most often, streams and erosion control projects can be implemented in the dry season, with minimal aquatic impacts.

### 3.2.4 Channel Bed Erosion

#### *3.2.4.1 Background*

Channel incision occurs in Reach 14, above Cuesta Park, along lower Prefumo Creek, and Reaches 7, 8, and 9 between Madonna to below South Higuera Road. Historically, channel

incision has occurred upstream of these reaches, through much of the downtown area and above, as well as below Los Osos Valley Road, in reaches 5 and 6.

#### *3.2.4.2 Problem Identification*

Channel incision can pose significant hazards, particularly to rigid structures (retaining walls, bridges) when toe support is removed. Over steepened, unprotected earthen banks affected by channel bed erosion can also fail. Channel incision de-waters stream side alluvial aquifers, affecting riparian communities and wetlands. In some areas summer base flows and channel hydraulic capacity may be increased as the channel cross-sectional area is enlarged through deepening.

#### *3.2.4.3 Management and Maintenance Activities*

Use and placement of grade control structures must be well designed to avoid creating fish passage obstacles. Possible solutions include:

- **Slow velocities, flatten grades, and stabilize the bed** by installing a series of small grade control structures, such as check dams, or boulder clusters. Poorly designed structures can trap sediment, deflect flows, and are potential barriers to fish passage.

- **Grade control structures** consisting of boulder or rock weirs, extending no more than 0.3 meter (1 foot) above the channel invert, can stabilize the bed, allow fish passage, and introduce stream bottom diversity by providing pools and hiding habitat.

### 3.2.5 Vegetation and Woody Debris

#### *3.2.5.1 Background*

Dense vegetation can adversely affect the ability of the channel to contain the volume and velocity of floodwaters necessary to prevent flooding. Vegetation management is also needed to protect levees from plant roots, where structural integrity is a concern; to meet local fire codes requiring the control of combustible weeds and grasses; to provide visual clearance for inspection of structures; and in a few places to provide maintenance road access. Vegetation management includes plant removal, thinning and limbing-up, pruning, weeding, and clearing. Not all areas need willow management.

A common but localized maintenance problem is woody debris caused by large trees falling into waterways. Often, these are large eucalyptus or cypress trees on bank slopes that have been undermined by channel incision or toe erosion. Streamside landowners and maintenance staff have been concerned about the tendency of these large trees to divert flow against the bank, greatly increasing the potential for erosion and bank failure. Fisheries biologists once considered log jams to be obstacles to fish passage, but recent research has shown that these are not normally barriers to movement.

### *3.2.5.2 Problem Identification*

Upstream of the Prado Road Bridge, and through the Mid-Higuera area vegetation management is necessary to maximize capacity, and reduce the frequency of flooding from low recurrence interval storms. Dense shrubby streamside vegetation is rapidly becoming reestablished. Vegetation management to convert growth to a hydraulically efficient and diverse mixed of species with a riparian canopy is a long-term management goal. The overall management goal is to maintain some shrubby willow habitat and emergent vegetation in select, critical areas to provide habitat for wildlife and aquatic species.

Downed trees are a part of the natural system. They provide structure, forming pools as well as providing habitat and cover to a number of aquatic organisms. In addition, there are deep, high quality pools with overhanging and/or emergent vegetation. Clearing and intensively managing vegetation around these pools should be avoided. New management activities will include creating additional shaded pool habitat as part of project design.

### *3.2.5.3 Management and Maintenance Activities*

Frequency of vegetation management typically varies from annually to 3-5 years. A gradual, phased approach may be used to convert shrubby willow vegetation, or areas of large Eucalyptus or other exotic trees, into a more hydraulically efficient stand of native sycamores, tree willows, oaks, or cottonwoods. Activities include:

- **Thinning and removing willow** stands and exotics,
- **Pruning to thin and remove lower limbs** of larger, more desirable forms of individual willows,
- **Replanting with natives**, such as sycamore, cottonwoods, and alders
- **Weed control and irrigation** to increase the survival and establishment of native species.
- **Woody debris** can be cabled or anchored in place with rock. Near sensitive habitat (such as pools), CDFG should be consulted prior to the removal of any large tree (greater than 50 cm.) that has fallen into the creek, except in emergency situations, where bank erosion is occurring and structures are at risk.

Vegetation management is important to control invasive, non-native species. Exotics can spread into areas where they affect channel capacity and compete with native plant populations. In the SLO Creek watershed, this may include selective thinning and removal of Eucalyptus trees, as well as areas of dense castor bean, cape ivy and giant reed (*Arundo Donax*).

### *3.2.5.4 Vegetation Management Methods*

Vegetation management techniques and desired outcomes have changed in recent years. A combination of methods is chosen for each site depending on the desired outcome. Efficiency, habitat goals, economics and the protection of public health and environmental

resources must be considered in the selection of appropriate vegetation management methods. Techniques include:

- Use of **Hand-operated equipment** (chain saws, weed-eaters, hoes, etc.);
- **Mechanical cultivation** (mowing and disking);
- **Chemical control** (herbicides); and
- Managed seasonal **grazing**.

Mowing and herbicide use is limited within the SLO Creek watershed. Mechanical vegetation removal in the uplands, by mowing or disking, is limited to May 15- October 15. When managed with mechanical or hand methods, some woody plants, such as willows, will resprout. These multiple sprouts create a greater flood control problem, due to increased vegetative mass (channel roughness) and require intensive control. The preferred method of willow management is hand removal, occasionally with use of a natural plant hormone on cut sections to reduce regrowth. With selective use of herbicides, annual treatment is often necessary; however, the treatment area is greatly reduced.

Herbicides help control invasive, non-native weedy species. Herbicides spread into the roots of the target plants, to prevent resprouting. Herbicides will only be used according to the label directions and for uses approved by the United States Environmental Protection Agency (USEPA) and the California Department of Pesticide Regulation, under the direction of a registered Pest Control Advisor. Currently, the primary herbicides used include Roundup® Pro and Rodeo®. These herbicides are formulations of the chemical glyphosate, which is a non-selective broad-spectrum herbicide. Rodeo® is approved for use in aquatic areas, whereas Roundup® Pro must be used only where no surface water is present.

The careful, controlled use of small grazing animals to clear unwanted and weedy understory vegetation along stream channels will be explored for applicability within the SLO Creek watershed. For instance, several Park Districts in the San Francisco Bay Area use closely controlled herds of goats to remove understory plants. The goats can be managed within a temporary, fenced enclosure, or tethered to stakes and moved from time to time. Follow-up mechanical control is usually also required.

### 3.2.6 Sediment Management

#### *3.2.6.1 Background*

Over time, development has encroached upon the floodplain. Most streams that once flowed over a wider, meandering area that fluctuated in response to environmental conditions are now confined to narrow channels with homes and businesses built near the edge of the bank. Sediment is deposited as the stream attempts to recreate a meandering low flow within the modified and constrained channel. Sediment accumulation problems occur throughout the system.

#### *3.2.6.2 Problem Identification*

Sediment accumulation reduces channel hydraulic capacity, which can lead to flood break-out points, backwater effects, or with point bars, can deflect flows against banks, causing erosion.

Sediment deposition is generally a natural process that occurs where stream velocity drops and the channel gradient flattens out on the valley floor. This occurs at Marsh Street Bridge, near the City's Wastewater Treatment Plant, upstream of the Los Osos Valley Road Bridge, in lower Prefumo Creek and Laguna Lake. In developed areas, sediment deposition affects flood carrying capacities, especially where modified channels were not designed to self-maintain. One of the elements of the overall *Waterway Management Plan* is to control sediment at its source along stream channels, construction sites, and in the upper watershed.

#### *3.2.6.3 Management and Maintenance Activities*

Mechanical removal of sediment deposited within a stream is intended to restore the flow conveyance of existing streams, and occasionally to restore habitat values. Sediment may be removed when it:

- **Significantly reduces channel conveyance capacity**,
- **Prevents structures from functioning,** (outfalls, culverts and bridges),
- **Impedes fish passage** and access to fish ladders, or
- **Could cause water quality problems** downstream.

Typical equipment used for sediment removal includes excavators, backhoes, draglines, loaders, and dump trucks. Most often, sediment removal projects are implemented in the dry season. Sediment removal activities include:

- **Bypass stream flows** around the site, using screened water pumps and piping, or cofferdams of hand-placed, pre-filled sandbags, hay bales, rubber or other appropriate material
- A **temporary bypass channel** or detention basin is used to isolate a work site.
- **Saturated sediments** may also be temporarily placed adjacent to the work site to dry out before being removed to a suitable disposal or reuse site. Saturated sediments set aside for drying should be inspected for sensitive species before being moved again.
- **BMPs** are also used to ensure that sediment removal projects have the least impact possible.

### 3.2.7 Hydraulic Structures

#### *3.2.7.1 Background*

Hydraulic structures are man-made, hard structures such as culverts, storm drain outfalls, weirs, dams, and grade control structures, and revetments and retaining walls, such as gabions and rock rip-rap or walls. These structures, including their size and condition were included in the Phase II inventory of existing stream conditions. In some reaches of upper SLO and Stenner Creeks, there are extensive areas of hard structures.

#### *3.2.7.2 Problem Identification*

Many older structures were not well designed or constructed. Some structures have footings undermined by channel bed incision, or are in danger of toppling over. In other cases, the revetments encroach into the channel and act as flow obstructions, or deflect flow against unprotected banks. Many storm drain outfalls do not have energy dissipaters.

#### *3.2.7.3 Management and Maintenance Activities*

Design guidelines for bank repair, including the use of biotechnical methods are included in the DDM. Activities include:

- **Institute a program to inspect, repair and replace failing structures** and retrofit hydraulic structures to include habitat elements, such as vegetation components, aquatic shading, scour pools or erosion control elements.
- **Replace failing public hydraulic structures** using designs that incorporate some habitat elements, and reduce geomorphic impacts to the stream channel.
- **Require private structures to be replaced** with more environmentally friendly designs, when failing structures need repair.

## 3.3 BEST MANAGEMENT PRACTICES & TRAINING

**Appendix A**, "Working In The Creek", provides a training manual and field reference guide that creek maintenance workers, including City, County and California Conservation Corps crew and others will utilize performing maintenance work along the creeks in this watershed. They will also refer to the BASMA

## 3.4 MAINTENANCE SCHEDULE

Routine stream maintenance on the bank top and upper bank (Categories 1 and 2) can occur on a year-round basis, but instream work shall be scheduled to avoid or minimize impacts to environmental resources, between April1 and November 1. Typically, routine maintenance that requires the operation of equipment instream will be limited to the dry season, which in San Luis Obispo shall be accomplished July1-October 15. Work on upper banks, and equipment work accomplished from bank top can sometimes be extended until November 15 if USFWS is contacted and with appropriate erosion control measures in place, and no rain is forecast. Thinning of vegetation and limbing up above the flow line is often best accomplished in the spring to prevent regrowth. However, to avoid the sensitive breeding period for California red-legged frog, limbing shall only occur in the instream area between April 1 and November 1. This can be just after leaf break out, as this is when many perennial deciduous woody plants have expended their stored energy reserves, and before they have built up new reserves from summer growth. Removal of exotics can occur during the summer and fall months, and replanting can be done in the early spring or late fall/early winter, if irrigation is not used.

## Section 4
# PROJECT PLANNING AND PERMIT REVIEW

### 4.1 PROJECT PLANNING CATEGORIES

A three (3)-category approach will be used for planning and permitting stream maintenance and management projects within the SLO Creek watershed. Each project will identify the Category of Service, or design objective for flood conveyance, such as 25-year, 50-year, etc., to compare baseline conditions with the identified design objective.

**Category 1** ***projects include CEQA exempt and low-impact projects*** that do not presently require a Corps Nationwide permit prior to implementation. However, some Category 1 projects currently require ESA consultation with USFWS and NMFS, or CDFG. Under this Program, these Category 1 projects will be completed without further ESA consultation. Routine Maintenance activities will be performed under a MOU from the CDFG. Category 1 projects can continue to be completed without additional permitting and environmental review, provided the Policies outlined in Section 2 and the BMPs in **Appendix A** are followed, as verified by the City or County CEQA compliance officer. Category 1 projects will not be included in the AWP.

Category 1 projects include both CEQA-exempt projects, as well as low impact projects that are generally not subject to detailed environmental review, provided environmental protection measures are incorporated.

**CEQA-exempt projects** are based on CEQA Section 15301 (b) Maintenance of existing facilities or Section 15061 (b)(3) No significant effect on the environment. Exempt projects include:

- **Removal of rubbish or other unnatural material from riparian corridors** or estuaries, but only where this work has no impact to any significant resource at the site, downstream, or adjacent to the site.
- **Maintenance activities in existing non-perennial, fully lined stream channels**, but only where there is no impact to any significant down-stream or adjacent resource.
- **Clearing, repair, and replacement of flood control devices** such as check structures, drop structures, rip-rap and other hard revetments, levees, chute structures, culverts, weirs, or stream flow measuring stations, but only where there is no impact to any significant resource at the site, down-stream or along access routes. Generally the repair and maintenance must be within the same footprint and use similar materials.
- **Maintenance activities on access ways outside of riparian corridors**, but only where there is no impact to any significant resource.
- **Maintenance activities on earthen channels** that were developed to convey urban stormwater, agriculture storm water, or agriculture tailwater and have little or no vegetation in them, (limited in the SLO Creek watershed).

Other Category 1 activities currently considered low impact (this may change as CEQA/NEPA laws are modified to reflect regulatory direction and court decisions) are typically exempt from detailed environmental review, provided that appropriate resource protection measures and BMPs are incorporated into the project.

**Category 1 projects include:**

- Trash removal, fence repair, and graffiti removal (not otherwise exempt)
- Access road maintenance and repair
- Tree pruning and limbing (within the context of the guidelines contained in this Program)
- Ongoing maintenance of mitigation and restoration/enhancement sites
- Mowing, disking and herbicide application in upland areas, and rodent control
- Removal of hazardous or downed trees and blockages from streams following the BMPs
- Manual removal and herbicide treatment of exotics and invasive plants in the creek zone
- Native tree planting in the creek zone following these guidelines

Most Category 1 projects will have limited impacts, below the threshold requiring a Corps Nationwide Permit.

**Category 2** ***projects currently (most often) require CEQA review*** such as an Initial Study or EIR ***and require a Section 404 Nationwide Permit.*** The Corps consults with the NMFS, and the USFWS for Endangered Species issues for these projects. A Section 401 Water Quality Certification or waiver is also required from the Central Coast RWQCB. The CDFG can issue either a Section 1601(public projects) or 1603(private projects) Streambed Alteration Agreement or allow work under an approved MOU.

Generally, cumulative impacts from several projects are not dealt with very well in this permitting system, mitigation is not coordinated among projects, and permit review can be time consuming and inefficient. To overcome these problems and improve efficiency, the AWP will be used for Category 2 projects in the SLO Creek watershed.

**Category 2 projects include:**

- **Dredging and sediment removal,** not to exceed 1,000 cubic yards, or 300 lineal feet of stream bed .
- **Sand and gravel bar removal** not to exceed 1,000 cubic yards, or 300 lineal feet of stream bed.
- **Repair of existing, failing bank protection structures,** within the exact same foot print, and using similar materials.These will be retrofitted or planted to native trees and shrubs whenever possible.
- **New Bank Repair** projects (not in-kind, or no existing structure) not to exceed 300 lineal feet of stream bed , or 1 cubic yard per lineal foot of fill, such as rock rip-rap. These would focus on use of biotechnical methods.
- **Upgrade of existing hydraulic structures**, which will be retrofitted where feasible. These include culverts and storm drain outfalls. Culverts will be retrofitted to provide for fish passage wherever feasible, considering flood flow conveyance needs.
- **Installation of in-stream fish habitat enhancement structures**, following the design guidelines contained in the *California Salmonid Stream Habitat Restoration Manual.*

Category 2 projects will specify limits of construction, and include, but are not limited to projects subject to Nationwide Permits.

**Category 3** ***projects currently require an Individual Corps Section 404 permit***, in-depth ***endangered species consultation***, and typically requires a focused or full Environmental Impact Report (EIR) or Environmental Impact Statement (EIS). These projects are not eligible for nationwide permits.

**Category 3 projects include:**

- **Major projects that will require supplemental environmental analysis**, such as extensive bank stabilization projects (over 300 lineal feet, or 1 cubic yard of fill, such as rip-rap, per lineal foot of bank), large channel dredging projects, (over 1,000 cubic yards), bridge replacements, or channel widening or lining for flood protection.
- **Plan-wide enhancements or improvements**; uncertain whether projects will be public or private**.** These projects that have the potential to affect water quality, riparian habitat, and/or public health and safety.
- **Projects exceeding limits specified for Category 2 projects**
- **Projects requiring a Corps Individual Permit**

These kinds of projects will continue to require the same review and permitting process.

## 4.2 ANNUAL WORK PLAN

This Section focuses on the use of an **Annual Work Plan** (AWP) to streamline planning, implementation, reporting protocols and documentation for Category 2 projects. Historically, City (SLO) and County (Zone 9) have issued individual work orders or Plans and Specifications for larger projects (for public bidding) to implement maintenance projects, with Corps permitting required for each project. Work orders and Plans and Specifications provide a description of the project, implementation schedule, cost estimate, and permit requirements or other special conditions. These tools will continue to be the primary vehicle for the implementation of larger maintenance projects. However, to streamline the process for implementing the stream management concepts identified in this Program, and to allow consideration of cumulative effects in a watershed planning context, an AWP will be prepared.

The AWP approach provides several benefits. It serves as a basis for determining need, analyzing alternatives, proposing mitigation and selecting the most effective and least environmentally damaging maintenance practice. It provides the opportunity for public understanding and involvement. It also allows City and County maintenance staff to prioritize maintenance efforts and expenditures.

The AWP will identify the routine stream maintenance work that forms the basis of the annual maintenance budget. The AWP will include location, work area, schedule, project elements, biological and cultural resources, and hydrologic and geomorphic conditions. A jurisdictional delineation will also be attached. The AWP will include all City and County projects, as well as those from other public entities, (Caltrans, Cal Poly, etc.) and private parties along the creek who wish to participate.

Private parties and other public entities will be responsible for the costs associated with design, implementation and monitoring/mitigation of their portion of the AWP. This can be done on a cost recovery basis, including permitting, review and compilation, compliance inspection and related fees. City/Zone 9 will not be responsible for fines and penalties associated with violations by private parties or other entities.

The AWP will identify priorities for stream maintenance for the upcoming year, and include BMPs and mitigation practices, policy statements, technical studies (biology, hydrology, and geomorphology) and planning and project approval documentation. Maintenance needs and activities will be identified either as part of the AWP, or as identified later in the year and implemented in individual work orders issued to internal city or county maintenance personnel.

## 4.3 AWP ENVIRONMENTAL REVIEW

The AWP will be evaluated by the City/Zone 9 CEQA compliance officer to determine if the work is addressed under the Program. If not, the work will follow the appropriate project development and approval process, which may include CEQA review, and individual regulatory permits. The work will also be evaluated to ensure compliance with the Program policies, maintenance guidelines, and pre-established engineering standards.

Once the AWP and preliminary CEQA review are completed, a public meeting at the Zone 9 Advisory Committee will be conducted to discuss specific projects and prioritization in the AWP. A summary will be prepared for submittal to the interested public and regulatory agencies. The summary will include: 1) a list of City/Zone 9's Category 1 projects (if not CEQA/NEPA exempt), 2) projects within the scope of impacts/mitigation measures identified in the Program EIS/R, and 3) projects beyond the scope of the Programmatic EIS/R requiring further environmental documentation. Large-scale projects will continue to require individual permitting and environmental review.

Following City/County and Zone 9 Advisory Committee approval of the AWP, it will be submitted to regulatory agencies for verification and confirmation that the work is included within (this Program's) established existing environmental permits, agreements, or approvals. Any additional applicable permits for routine work not covered (expected to be rare) will be obtained from local, state or federal regulatory agencies prior to implementation of that portion of the AWP.

### 4.3.1 Supplemental Environmental Information

A CEQA/NEPA initial environmental review and check for compliance with Program permits, agreements, and MOU will occur for moderate to major bank repair and sediment management projects, generally exceeding the limits outlined above. The project(s) will be assessed to determine whether it is covered under the long-term regulatory clearances provided in conjunction with this Program. If it is determined that the project is not covered, individual permits or clearances will be sought. For projects that can be completed as part of an AWP, the following supplemental information will be provided:

- All **potential impacts to wetlands** and waters of the U.S., including water quality and biological resources, and historic structures and cultural resources will be identified, with appropriate mitigation.

- The environmental assessment will **cross-reference existing documents** for resource inventory and technical information. Earthwork, hydraulic structures and revegetation elements necessary to meet specific project success criteria will be identified.

- **Specific success criteria will be identified** in project work plans and contract documents. All public projects that are put out to bid will include a mitigation, maintenance and monitoring component.

## 4.4 RESTORATION AND ENHANCEMENT

One element of the AWP will be the identification of enhancement projects to be implemented each year by City/Zone 9 for project mitigation. Private parties will be responsible for identifying and implementing their own mitigation measures, but the City and County will coordinate an overall mitigation proposal whenever possible. For efficiency and to achieve a watershed-based approach to resource management, City/Zone 9 will coordinate this effort with other larger projects by non-profit groups such as the Land Conservancy. However, the City and County reserve the right to independently plan for and implement mitigation measures (enhancement and restoration projects) for their own stream maintenance and management projects. Other agencies, including the Resource Conservation District (RCD), Caltrans, and Cal Poly San Luis Obispo will also be consulted. This element will identify reaches of stream in need of riparian restoration, and aquatic habitat and fisheries enhancement and propose specific projects for implementation that year. City/Zone 9 is committed to working with the Land Conservancy and other non-profits, and will provide funds as available to plan and implement the enhancement components identified in the AWP. The annual commitment of funds will focus on project enhancement opportunities throughout the watershed, as described in the AWP. In addition, City/Zone 9 will coordinate with these groups to obtain grants for restoration and enhancement activities in the watershed, and will provide informal technical consultation for these projects.

Enhancement could be conducted on public lands, if available, adjacent to streams in the watershed. In addition, City/Zone 9 will facilitate the Land Conservancy's and other non-profit efforts to restore and enhance private lands that have both management needs and restoration opportunities.

The Restoration and Enhancement efforts will initially focus on two areas: 1) the lower reaches of SLO Creek between Los Osos Valley Road and See Canyon, and 2) upper reaches, above Cuesta Park and along Cuesta Grade. The lower reaches have bank erosion problems associated with natural adjustment to historic straightening, and a predominance of low diversity shrubby willows. All AWP projects prepared for these areas would preserve the willows and associated fisheries habitat created by debris accumulation, enhance aquatic habitat by installing boulder clusters, root wads and other instream structures, and enhance wildlife habitat value by planting a mix of native species on channel banks. The upper reaches have severe bank erosion problems from channel incision that is undermining old streamside stands of native sycamores. Protection of valuable shaded pools associated with undercut banks is a key management issue that enhancement activities will focus on here. Biotechnical bank protection where mature sycamores are threatened should be considered.

The AWP will include methods and projects to treat eroding banks, establish native vegetation for habitat and streamside shading, and fisheries enhancement. For existing bank stabilization structures, the AWP will provide a range of approaches, from complete removal and replacement, to partial revegetation at the time of repair and maintenance.

Restoration treatments are intended to create a more natural stream corridor within the study reaches. In some reaches, this is not possible because past hard channel modifications must remain for flood conveyance or bank protection, or because there is not enough room at top of bank for more environmentally sensitive repairs. However, within the constraints of urban flood control needs, even highly disturbed areas can often be modified to improve habitat.

Restoration and enhancement elements include:

- **Revegetation of eroded or unvegetated banks**, and failing structural bank protection; these will be phased in on a prioritized basis, or as repairs are necessary;
- **Removal of exotic vegetation** and replacement with riparian species at non-failing sites. These will be completed as mitigation projects, enhancement/restoration projects on public lands, or volunteer project lands, as funds become available;
- **Use of biotechnical bank stabilization** approaches, wherever possible;
- **Selective use of low, grade control structures** to control bed incision; and,
- **Enhancement of aquatic habitat**, and local fish passage improvements. This would include creation of additional pools, incorporated into the design of bank stabilization structures as internal mitigation, whenever technically feasible.

Implementation of these elements requires bank protection and channel stability measures. The preferred treatment at any location is a function of: 1) existing bank conditions and the geomorphic, geotechnical, and hydraulic characteristics of the site 2) proximity of infrastructure and other bank top improvements; 3) cost; 4) maintenance needs, and, 5) environmental impacts. In order to obtain an individual Corps Section 404 Wetlands Fill Permit, the least environmentally damaging solution feasible must be selected, and this requirement will continue to be utilized in planning and project design.

## 4.5 AWP MAINTENANCE AND MANAGEMENT

The maintenance interval for management of culverts, bridge aprons, point bars and willows is typically between three and five years for normal rainfall/runoff years. Sediments (and in-channel willows) can accumulate following periods of drought, when hydraulic forces are insufficient to transport sediments and tear out willows, or after significant flood events when sediments accumulate as point bars or in low gradient reaches. Maintenance will be phased to avoid impacting long segments of streams. For instance, work can be scheduled in alternate years on alternate banks, or in short segments separated by unmanaged segments, to be treated in successive years. Work areas will be surveyed in advance by a biologist, with protocols for sensitive features (particularly pools) and species of concern. Some maintenance activities (both Category 1 and 2) will need to be completed on a periodic/as needed basis, including:

- Inspection, repair and replacement of in-channel boulders, grade control and wing deflectors,
- Inspection and repair of existing gabion baskets, rock rip-rap, and other hard revetments
- Maintenance at culvert outfalls,
- Resetting erosion control blankets, fiber rolls, and fiber rock rolls, and
- Weeding, exotics removal, and replanting with native species

Some of these activities may need to be completed on an emergency basis. Emergency repair will be done in compliance with current agency regulations and the guidelines contained in this Program. Management activities identified in the AWP will focus on the following:

- **Removal and management of accumulated sediment**. Sediment removal is necessary to restore channel hydraulic design inverts to prevent flooding and constriction of the channel. To verify the need for

sediment removal, re-surveying channel cross-sections and hydraulic analysis using the Phase II hydraulic model (HEC-GEORAS) may be needed.

- **Excavation and removal of large channel bars**. Large channel bars that could deflect flows against unprotected channel banks need to be removed until a new sediment load stream dynamic equilibrium is reached. To aid in management recommendations, "large bars" are defined as being over 1 m above the channel bed, and over 10 m long. Where channel toe shear force, and Shield's analyses indicate conditions are suitable, bar materials may be excavated and repositioned locally to reestablish the toe berm. This may require wrapping the cobbles in a biodegradable (coir) blanket and planting them with live willow stakes to stabilize the toe berm (fiber rock roll).

- **Management of in-channel willows**. In some reaches, in-channel, shrubby Arroyo or Sandbar willow thickets need to be physically removed, as they can armor and stabilize unwanted point bars that deflect flows, trap sediment, or reduce hydraulic capacity through frictional losses. Arroyo willows located on lower channel bank side slopes or in-channel flood plain (low) terraces may also need to be thinned.

- **Bank repair and protection.** Bank repair and protection projects will be completed using the DDM and the methods described herein. Maintenance and replanting for a 3-5 year period may be needed at the biotechnical repair sites.

## 4.6 AWP IMPLEMENTATION SCHEDULE

### 4.6.1 Annual Stream Inspection

A reconnaissance-level Annual Stream Inventory will be completed each spring to identify management problems to be repaired the following summer or fall. The stream inspection will focus on:

- City/Zone 9 owned and maintained structures,
- Stream channel bottom and banks in known historic problem areas,
- Areas where citizen input has identified potential problems, and
- Mitigation sites requiring monitoring and management.

The inspection of problem areas and areas with vegetation management needs (by City/Zone 9 or other qualified engineers/biologists) will include documentation of stream conditions, maintenance needs and will focus on stream reaches where prior history or citizen input indicates maintenance problems so that annual work and stream conditions can be tracked over time.

Maintenance needs data collected by private property owners along the creek will also be compiled into the City/Zone 9 data base, provided the information is collected following accepted protocols, and is completed by qualified personnel. The target date for completion of the Annual Stream Inspection is May 15.

Ultimately, the goal is to have portions of the inspection completed using a GPS system, using a form similar to that used in the Phase II Inventory. The results of the inspection may be entered into the GIS database maintenance layer as this system continues to be developed. Hot links can then be provided

to digital ground photography and field data sheets so that problem progression and monitoring repair and restoration activities can be tracked.

This inventory will provide the basis for preparing the AWP and incorporation into Zone 9's budget cycle (completed each year in December), and the City's, (completed every two years, based on a July1-June 30 cycle).

### 4.6.2 Annual Work Plan

The AWP should be completed by July 1 to identify any work that needs to be completed on a priority basis, and funded outside of the City's budgeting cycle. The goal will be to submit the AWP to the regulatory agencies by early July each year, including all of the background and planning information, permit required information, and details on mitigation. The regulatory agencies' goal will be to complete their review of the submittal and request any additional information before August 1, with a final approval/decision targeted for completion before August 15. This would allow construction of approved projects and implementation of most maintenance activities in late summer or early fall.

AWP and inspection worksheets that may be utilized in focus areas are included in **Appendices B** and **C**.

### 4.6.3 Annual Reports

The AWP will include a description of the proposed work, work area limits, and BMPs to minimize potential impacts. The AWP will be submitted to regulatory agencies for verification check of Program compliance and permit conditions. The details of any additional project mitigation, including off-site mitigation for larger projects, will be determined with the applicable permitting agencies and through CEQA review.

Section 5

# MITIGATION OF CUMULATIVE IMPACTS

## 5.1 INTRODUCTION

Many of the design/planning components and BMPs in the Program are considered ***Mitigation Measures*** under CEQA and NEPA guidelines. The avoidance and minimization measures described in this document are considered sufficient to reduce most, but not necessarily all, potential impacts of the Program to a less-than-significant level. This Section describes measures to mitigate cumulative impacts. Discussion of specific Program impacts, including sensitive species and compensatory mitigation, will be presented in the EIS/R prepared for the *Waterway Management Plan*.

Significant cumulative environmental impacts are those that remain even after implementation of the policies, design components, and BMP's described in this Program. Stream activities can impact:

- **Biological resources:** wetlands, riparian vegetation, fisheries, aquatic vertebrates and invertebrates, and sensitive species
- **Earth resources:** geomorphic and geologic or geotechnical effects on channel bank and stream stability
- **Water resources**: changed flood hazard and adverse water quality effects.

Mitigation includes:1) implementing policies, procedures and BMPs to reduce on-site impacts, 2) compensatory mitigation (through off-site restoration, enhancement, and preservation) for impacts that cannot be fully mitigated on-site, and (3) mitigation for *potential* impacts to sensitive species.

Off site mitigation is intended to compensate for temporary disturbance impacts (not permanent wetlands fill) and temporal impacts, or the short-term loss of habitat quality while the enhanced habitat is maturing.

## 5.2 MITIGATION PRINCIPLES

Successful mitigation balances opportunity, feasibility, and cost to enhance habitat. The following principles will guide mitigation efforts:

- **Larger, naturally sustainable ecosystems are preferred**, rather than restoration or creation of smaller, fragmented, artificially supported systems.
- **Consider adjacent land uses**, such as lands in public ownership or other mitigation sites, when evaluating site size and sustainability.
- **Conservation, protection, and enhancement of existing habitats are preferable** to the creation of artificially supported systems.
- A **watershed-wide, programmatic approach is preferable** to a project-by-project approach.
- **Stream reaches with the highest natural resource potential** (which may have low current value) will be the focus of mitigation efforts.

## 5.3 ON-SITE MITIGATION

Projects will be designed to be self mitigating, by preserving and increasing pool aquatic habitat, and cover, species richness, diversity and value in upper bank and bank top riparian zones. Native riparian vegetation will be integrated into the design of stabilization structures and the surrounding area. Where stabilization design requires the toe of the proposed structure to extend into the channel (pool habitat), the project will be designed to provide new pools or hiding habitat. This can be done by using boulder clusters, root wads, or wing deflectors to direct flow energy onto the channel bottom to form scour holes. The *California Salmonid Stream Habitat Restoration Manual* will be used for guidance. On-site mitigation includes:

- **All in-stream construction work will be scheduled to minimize aquatic and fisheries impacts**, in late summer or early fall (August-October).
- **Native vegetation** to be incorporated in the stabilization design of all structures.
- An **extended revegetation/restoration zone**, above the structures to the top of bank will be planted, where feasible. Any laid back slope will also be planted to native riparian species.
- **New wetlands of the U.S. will be created** to compensate for the loss of wetlands where toe support or backfill extends into the channel,(See my comment about including ratios). By excavating a riparian bench at some locations, at the approximate two-year flow level and laying the slope back above this new bench, new habitat will be created. On-site enhancement and protection of existing riparian resources may count for up to ½ of the mitigation.
- To **provide a complex and diverse riparian corridor**, mitigation and restoration components will typically specify 400-600 native woody trees/shrubs per hectare, with 1.5-2.5 meters spacing. They will include a typical mix of 70% deciduous and 30% evergreen species native to the SLO area. The goal is to achieve 70% survival, with a 70% canopy cover (focused on upper bank) after 5 years. A list of plant species appropriate for restoration planting is included in the **Appendix D**.

## 5.4 OFF-SITE MITIGATION

When projects are implemented, there should be no net loss in the total acreage of aquatic wetland and riparian habitat. Properly designed restoration and enhancement projects can usually count toward meeting mitigation obligations. Although most projects will be mitigated on-site by design, restoration, enhancement, and use of BMPs, some off-site mitigation may be required. Watershed-wide mitigation elements include:

- **Restoration** entails **returning a wetland or natural area from a disturbed condition**, to an approximation of historic conditions. This includes fill areas no longer classified as wetlands. Typically, there is a need to alter the hydrologic environment for successful restoration. Mitigation may include removing fill material, or allowing abandoned watercourses to flow once again. Eradication of exotics such as giant reed and German ivy will be accompanied by planting of native riparian vegetation. This will continue to be accomplished in collaboration with the Land Conservancy.

- **Enhancement** means **to increase one or more biological functions or values** of an existing habitat that provides some value, such as shaded pool aquatic habitat. Like restoration this could include removal of exotic plants and replanting with native species appropriate to site conditions, or addition of habitat enhancement features such as channel boulders, root wads or cabled logs. Habitat functions and values can be enhanced at disturbed sites when properly designed, since appropriate physical conditions, such as soil moisture regime, and soils already exist.

- City/Zone 9 will cooperate with the Land Conservancy on its fisheries enhancement program. This may include grant preparation, technical support, personnel, and/or financial contributions to the Land Conservancy's program to remove flow obstructions (dams and weirs) and installation of aquatic habitat structures such as root-wads, boulder clusters, and lunker structures.

- **Protection** means **management and preservation** of areas of existing high quality or critically important habitat. This usually involves acquisition or easements, and fencing or other means to protect the habitat.

- Upper watershed and habitat protection will be coordinated with the on-going programs with the Land Conservancy and RCD so that multiple functions of the natural systems are provided or enhanced in an overall watershed scale (including on-going TMDL and Phase II stormwater planning and implementation programs). In most cases, this will result in a concentration of mitigation actions on certain sections of a stream or streams to gain the maximum habitat function and value.

- **Creation** of a wetland involves the **conversion of a persistent upland** (usually grassland) area into a wetland or riparian area, through grading and alteration of the hydrologic regime. This presumes that the area has not recently been a wetland; otherwise, such actions would be considered restoration.

- Most of the restoration and enhancement work to be completed by City/Zone 9 and the Land Conservancy and other nonprofits will focus on private lands in Reaches 3 to 6, in the County portion below Los Osos Valley Road to See Canyon, and in upper reaches, Reach 14, above Cuesta Park. The lower reaches have bank erosion problems associated with natural adjustment to historic straightening, and a predominance of low diversity shrubby willows. The upper reaches have bank erosion problems from channel incision that are undermining old streamside stands of native sycamores, causing them to fall into the stream. Protection of valuable shaded pools associated with undercut banks, and preservation of native mature sycamores, are key elements.

## 5.5 MONITORING AND COMPLIANCE REPORTING

Monitoring is a key component of mitigation efforts. This is true when deflectors or grade stabilization structures are used to guide and direct flow, and where there is dense streamside vegetation that requires thinning and limbing up above the floodway. The stream may not respond exactly as expected, especially the first year, or following a major flood event. Biotechnical stabilization efforts also typically require two to three or more years for the vegetation to become well established and provide the degree of protection ultimately required. Under-protected banks may be vulnerable to high-energy erosive events during this interim period, unless temporary protection is also provided (erosion control blankets or other devices).

Periodic monitoring and observation will be important to determine that the structures are intact, functioning properly, or if they require repair, adaptation or modification. Integrated stabilization structures that rely on vegetation for added integrity also require frequent inspection and care of the plant materials. Thinning and limbing willows, and inter-planting with a diverse and desirable grove of single-trunk trees (sycamores, bays, alders, cottonwoods) may also be required. Monitoring and observations following heavy rains or high flow events followed by timely development and implementation of a remedial repair or maintenance plan is critical to the success of most biotechnical bank stabilization projects.

Monitoring will also be required for any created wetlands, under the provisions of a Corps Section 404 Wetlands Fill permit. This will include observations of the hydrologic function of a mitigation site, and an inventory of the species composition, cover, growth and vigor of the target wetland plants. An annual monitoring report may be required. It describes the status of the site with respect to meeting specific success criteria for plant establishment (e.g., 70% survival of planted native woody plants, with a cover of 70% after 5 years), and needed remedial measures. Bi-weekly to monthly maintenance visits for weeding, watering, plant replacement and pest control are usually required the first several years to insure success.

At the end of the maintenance season (prior to December 15$^{th}$ for uplands, November 1 for instream work), an annual report (including any necessary compliance certification and mitigation monitoring results) will be prepared that reviews the work completed. It will be submitted to the agencies, including as-built descriptions of the work, location, size and mitigation measures incorporated into the project, and remedial recommendations. Violations of the permit terms and agreements will be immediately reported to the applicable agencies.

## Section 6
# REFERENCES


BASMAA Operational Permits Committee, June 2000. *Flood Control Facility Maintenance Best Management Practices.* EOA, Inc., Oakland, California.

Chang, Howard, 1988. *Fluvial Processes in River Engineering*. John Wiley & Sons, New York.

Cleveland, Paul A. 1996. *San Luis Obispo Creek Habitat Inventory and Investigation*. California Regional Water Quality Control Board. Contract No. 4-106-253-0. 26 pages.

Dunne, T., L. Leopold, 1978. *Water in Environmental Planning*. W. H. Freeman Co., New York.

Federal Emergency Management Agency (FEMA), (1978), *Flood Insurance Study for the City of San Luis Obispo*. FEMA, Washington D.C.

Federal Interagency Stream Restoration Working Group, Oct. 1998, *Stream Corridor Restoration; Principles, Processes, and Practices*.

Flosi, G., S. Downie, J. Hupelain, M. Bird, R. Cowy, and B. Collins. (February, 1998), *California Salmonid Stream Habitat Restoration Manual,* California Department of Fish & Game, Inland Fisheries Division, Sacramento, CA. 227 pages.

Fugro West, Inc. 1995. *Biological Resource Assessment and Impact Analysis for the SLO Creek Water Reuse Project. (*PN 94-48-8018.) Ventura, California. Prepared for City of San Luis Obispo, Utilities Department. San Luis Obispo, California. October, 1995.

Gray, D. H. and A. T. Leiser, 1982. *Biotechnical Slope Protection and Erosion Control*. Van Nostrand Reinhold, New York.

Gray, D. H. and R. B. Sotir, 1996. *Biotechnical and Soil Bioengineering Slope Stabilization.* John Wiley & Sons, Inc., New York.

Hall, C. A. and others, 1979. *Geologic Map of the San Luis Obispo-San Simeon Region*. SLO, California; U.S. Geological Survey Miscellaneous Field Studies Map I-1097.

Hall, C. A. and S.W. Prior, 1975. *Geologic Map of the Cayucos-San Luis Obispo Region*. SLO County, California; U.S. Geological Survey Miscellaneous Field Studies Map MF-686.

Halleck, Brent G., Leslie S. Bowker, Walter D. Bremer, and Dianne N. Long. 1994. *Nutrient Objectives and Best Management Practices for SLO Creek.* Coastal Resources Institute, California Polytechnic State University, San Luis Obispo. Prepared for California Regional Water Quality Control Board Central Coast Region. San Luis Obispo, California.

Johnson, A. W. and J. M. Stypula, 1993. *Guidelines for Bank Stabilization Projects*. King County Department of Public Works, Seattle, Washington.

King Co. Department of Public Works, (June, 1993), *Guidelines for Bank Stabilization Projects in the Riverine Environments of King County*, Seattle, WA.

Knighton, David, 1984. *Fluvial Forms and Processes*, Hodder & Stoughton, New York.

Lane, E.W., 1953. *Design of Stable Channel*. Proceedings of the American Society of Civil Engineers 79, 280-1-280-31.

Land Conservancy of San Luis Obispo. 1988. *San Luis Obispo Creek Restoration Plan*.

Land Conservancy of San Luis Obispo. 1996. *San Luis Obispo Creek Watershed Hydrologic Survey*. Prepared for the California Water Quality Control Board.

Land Conservancy of San Luis Obispo, 1997. *Draft Restoration Actions within the SLO Watershed*.

Land Conservancy of San Luis Obispo County, March 2002, *San Luis Obispo Creek Watershed Enhancement Plan*.

Leopold, Luna, Wolman, Gordon, and Miller, John, 1964. *Fluvial Processes in Geomorphology*,

Gray, Donald and Sotir, Robbin, 1996 Biotechnical and Soil Bioengineer Slope Stabilization. John Wiley & Sons, New York. Obispo, California.

Nolte and Associates, 1977. *Flood Control and Drainage Master Plan for the San Luis Obispo Creek Watershed*, Zone 9 / San Luis Obispo County Flood Control and Water Conservation District, Appendix D - Geologic Reports, prepared by Central Coast Laboratories.

Nolte, George & Associates, 1977. *Flood Control and Drainage Master Plan for the San Luis Obispo Creek Watershed,* prepared for the SLO County Water Conservation District.

Questa Engineering Corporation, April 4, 1997, *Stream Corridor Management Plan for San Luis Obispo Creek Phase I Study Area*, Consultants report prepared for the City of San Luis Obispo.

Questa Engineering Corporation, June 2002, *Drainage Design Manual* for the San Luis Obispo Creek Watershed; prepared for the City of San Luis Obispo and San Luis Obispo Flood Control and Water Conservation District, Zone 9.

Riley, A. (1998). *Restoring streams in Cities; A Guide for Planners, Policymakers, and Citizens*. Island Press, Covello, CA 423 pages.

Schiechtl, H.M. and Stern, R. (1996), *Water Bio Engineering Techniques for Watercourse, Bank, and Shoreline Protection,* 186 p., Blackwell Science, Cambridge, MA.

US Department of Transportation, (1995), *Streambank Stabilization Measures for Highway Engineers,* National Technical Information Service PB-187986, Springfield, Virginia.

U.S. Army Corps of Engineers (Corps). 1974. *Flood Plain Information for SLO Creek and Tributaries, Vicinity of San Luis Obispo, San Luis Obispo County, California*. Los Angeles District. Los Angeles, California.

U.S. Army Corps of Engineers, April, 1997. *Bioengineering for Streambank Erosion Control*, 90p., Waterways Exp. Station, Vicksburg, MS.

U.S. Army Corps of Engineers, 1984. *Streambank Protection Guidelines for Landowners and Local Governments*. Waterways Exp. Station, Vicksburg, Mississippi.

U.S.D.A. Natural Resources Conservation Service (NRCS). 1992. *Soil Bioengineering for Upland Slope Protection and Erosion Reduction*. National Engineering Field Handbook. Chapter 18.

U.S.D.A. NRCS. 1996. *Streambank and Shoreline Protection*. National Engineering Field Handbook. Ch. 16.

U.S. Fish & Wildlife Service, Endangered Species Program. *Habitat Conservation Plans and the Incidental Take Permitting Process*. http://endangered.fws.gov/hcp/. February 2001

## Section 7
# GLOSSARY

***Abrasion.*** Removal of streambank soil as a result of sediment-laden water, ice, or debris rubbling against the bank.

***Aggradation***. The geologic process by which streambeds and floodplains are raised in elevation by the deposition of material.

***Acre Foot***. The amount of water that will cover one acre to a depth of one foot. (Equals 43,560 cubic feet).

***Act of God***. Rainfall, innundation, flooding, and general storm runoff damage arising from natural causes without the intervention of mankind, and which human prudence could not foresee or prevent.

***Alluvial***. Deposited by running water.

***Anadramous***. Fish that leave freshwater and migrate to the ocean to grow and mature. They return to freshwater to spawn.

***Appurtenances to Storm Drains.*** Structures, devices, and appliances, other than pipe or conduit, which are an integral part of a drainage system, such as manholes, storm water inlets, detention storage facilities, etc.

***Apron.*** A floor or lining of concrete, timber, or other suitable material at the toe of a dam, discharge side of a spillway, a chute, or other discharge structure, to protect the waterway from erosion from falling water or turbulent flow.

***Armoring***. (a) The natural process of forming an erosion resistant layer of relatively large particles on the surface of the streambed. (b) The artificial application of various materials to strengthen streambanks against erosion.

***Axil.*** The angle between the upper side of a leaf and its supporting branch or stem.

***Backfill.*** (1) The operation of filling an excavation after it has once been made, usually after some structure has been placed therein. (2) The material placed in an excavation in the process of backfiling.

***Backwater.*** The water retarded above a dam or backed up into a tributary by a channel obstruction, confinement of flow or abrupt change in channel section, slope, roughness or alignment.

***Backwater Curve.*** The term applied to the longitudinal profile of the water surface in an open channel when flow is steady, but non-uniform.

***Backwater Effect***. Increase in upstream depth above normal depth due to channel obstruction, confinement of flow or abrupt change in channel section, slope roughness or alignment.

***Baffles.*** Deflector vanes, guides, grids, gratings, or similar devices constructed or placed in flowing water to: (1) check or effect a more uniform distribution of velocities, (2) absorb energy, (3) divert, guide, or agitate the liquids and (4) check eddy currents.

***Bank.*** The lateral boundary of a stream or channel confining water flow.

***Bankfull Discharge***. The discharge corresponding to the stage at which the natural channel is full. This flow has a recurrence interval of 1.5 to 4 years depending on the channel gradient and bank materials.

***Bar***. (a) Accumulation of alluvial material along the banks, midstream, or at the mouth of a stream or in the wakes of objects where a decrease in velocity induces deposition. (b) An alluvial deposit composed of sand, gravel, and other material that obstructs flow and induces deposition or transport.

***Base Flood.*** The flood having a one percent chance of being exceeded in any given year. The Abase flood is commonly used as the Astandard flood in federal flood insurance studies.

***Base Floodplain.*** The area subject to flooding by the base flood.

***Base flow***. Volume of flow in a stream channel that is not derived from surface run-off. Base flow is characterized by low-flow regime (frequency, magnitude, and duration daily, seasonally, and yearly), by minimum low-flow events and in context of the size and complexity of the stream and its channel.

***Bed load***. Sediment moving along or near the streambed and frequently in contact with it.

***Bed slope***. The inclination of the channel bottom.

***Bedding.*** The foundation under a drainage structure.

***Bend***. A change in the direction of a stream channel.

***Benthic***. Of or pertaining to animals and plants living on or within the substrate of a water body.

***Berm***. A levee, shelf, or bench along a streambank that may extend laterally in the channel to partially obstruct flow, or parallel to the flow to contain the flow within its streambank. May be natural or constructed.

***Best Management Practice***. A practice used to reduce impacts from a particular land use.

***Biotechnical approach.*** An applied science that combines structural, biological and ecological concepts to construct living structures for erosion, sediment and flood control.

***Blanket***. Material placed on a streambank to cover eroding soil.

***Boulder***. Sediment particle having a diameter greater than 256 mm (10 inches).
***Bridge.*** A structure for carrying traffic over a watercourse, depression, or other obstacle.
***Brush layer***. Live branch cuttings crisscrossed on trenches between successive benches of soil.
***Brush mattress***. A mattress-like covering that is placed on top of the soil. The covering material is living wood plant cuttings that are capable of rooting.
***Buffer***. A vegetated area of grass, shrubs or trees to capture and filter runoff from surrounding land uses.
***Caltrans.*** California Department of Transportation.
***Canopy***. Overhead branches and leaves of riparian vegetation.
***Canopy cover***. Vegetation projecting over a stream, including crown cover (generally more than 3 feet above the water surface) and overhand (less than 3 feet above the water surface).
***Capacity.*** The effective carrying ability of a drainage structure or facility. May also refer to storage capacity.
***Carry Over.*** The quantity of water which continues past an inlet.
***Catch Basin.*** A basin combined with a storm drain inlet to trap solids.
***Catchment Area.*** (1) The contributing area to a single drainage basin, expressed in acres, square miles, or other unit of area. Also called Drainage Area or Watershed. (2) The area served by a drainage system receiving storm and surface water; or by a water-course.
***Caving:*** The collapse of a streambank by undercutting due to wearing away of the ote or an erodible soil layer above the toe.
***Cellular Confinement.*** A design element that consists of a honeycomb-like structural material, placed to allow access across wet areas to distribute load and minimize environmental damage, such as ruts.
***Channel***. A natural or man-made waterway that continuously or periodically passes water.
***Channel roughness***. The irregularity of streambed materials sizes and channel form in plan and cross-section that causes resistance to flow.
***Channel scour and fill***. Erosion and sedimentation that occurs during relatively short periods of time; *degradation* and *aggradation* apply to similar processes that occur over a longer period of time.
***Channel stability***. A relative measure of the resistance of a stream or river to erosion. Stable reaches do not change markedly in appearance from year to year.
***Channel Storage.*** The volume of water stored in a channel. Generally considered in the attenuation of the peak of a flood hydrograph moving downstream.
***Check.*** A barrier placed in a ditch, canal or channel to decrease the velocity of the flow of water so as to minimize erosion of the bottom and banks or to raise the level of the water. Also used for diverting water from one channel to another, as in irrigation usage.
***Check dam***. A structure placed bank to bank downstream from a headcut.
***Clay***. Cohesive soil whose individual particles are not visible to the unaided human eye. Soil can be molded into a ball that will not crumble.
***Cobble***. Sediment particles larger than pebbles and smaller than boulders. Usually 64 - 256 mm (3 to 8 inches) in diameter.
***Cohesive soil.*** Microscopic soil particles that have natural resistance to being pulled apart at their point of contact.
***Coir***. A woven mat consisting of coconut fibers. Generally used for various soil erosion control practices such as surface slope protection and the construction of geogrids.
***Concentrated Flow***. Flow which is altered from its natural surface runoff and has accumulated into a single narrow ditch, channel or pipe.
***Conduit.*** Any pipe, arch or box through which water is conveyed.
***Confluence.*** A junction of streams or channels.
***Control.*** A section or reach of an open conduit or channel which maintains a stable relationship between stage or discharge.
***Conveyance.*** A measure of the water carrying capacity of a stream or channel.
***Cost/Benefit Ratio.*** A comparison of the cost of a project with the good accruing from it.
***Cover***. Anything that provides protection for fish and/or wildlife from predators or ameliorates adverse conditions of stream flow and/or seasonal changes in metabolic costs. May be instream structures such as rocks or logs, turbulence, and/or overhead vegetation. Anything that provides areas for escape, feeding, hiding, or resting.
***Cribwall***. A hollow structural wall used for bank and slope stabilization formed by mutually perpendicular and interlocking members (usually timber) into which live cuttings are inserted along with soil to stabilize roots.
***CRLF.*** Calfornia Red legged frog
***Cross section***. A vertical section of a stream channel or structure that provides a side view of the structure; a transect taken at right angles to flow direction.
***Cross-Street Flow.*** Flow across the traffic lanes of a street from external sources, as distinguished from sheet flow of water falling on the pavement surface.
***Culvert***. A sewer or drain crossing under a road or embankment.

***Culvert, Box.*** Generally a rectangular or square concrete structure for carrying large amounts of water under a roadway. This term is sometimes applied to long underground conduits.
***Current***. The flow of water through a stream channel.
***Cut Off.*** A channel cut across the neck of a bend.
***Cutbank***. The outside bank of a bend, often eroding and across the stream from a point bar.
***$D_{30}$, $D_{50}$, $D_{100}$.*** The particle size for which 30, 50, and 100 percent of the sample is finer.
***Dam.*** A barrier constructed across a watercourse for the purpose of (1) creating a reservoir, (2) diverting water therefrom into a conduit or channel.
***Datum.*** A plane, level, or line from which heights and depths are calculated.
***Deadman.*** A log or block of concrete buried in a streambank that is used to tie in a revetment with cable or chain.
***Debris***. Any material, organic or inorganic, floating or submerged, moved by a flowing stream.
Debris Basin. A basin formed behind a low dam, or an excavation in a stream channel, to trap debris or bed load carried by a stream. The balue of a basin depends on cleaning-out of
***Deflectors***. Structures used to deflect stream flow to a different location, usually away from an eroding bank.
***Degradation***. The long-term hydraulic process by which stream and river beds lower in elevation. It is the opposite of aggradation.
***Dentention.*** Temporary ponding of stormwater to attenuate or reduce peak runoff rates.
***Dentention, Upstream.*** Normally used for the detention of water close to the point of reainfall occurrence, usally applied to rooftop ponding, parking lot ponding, and small storage basins.
***Development.*** Any man-made change to imporved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations.
***Deposition***. The settlement of material out of the water column and onto the streambed or floodplain. Occurs when the flowing water is unable to transport the sediment load.
***Development***. Any man-made change to improved or unimproved real estate. This includes, but is not limited to buildings and other structures, mining, dredging, filling, grading, paving, excavation, and drilling operations.
***Dike (groin, spur, jetty, deflector)***. A structure designed (1) to reduce the water velocity as streamflow passes through the dike so that sediment deposition occurs instead of erosion (permeable dike) or (2) to deflect erosive currents away from the streambank (impermeable dike).
***Discharge.*** A volume of water flowing past a given point per unit time. In its simplest concept, discharge means outflow; therefore, the use of this term is not restricted as to course or location, and it can be applied to describe the flow of water from a pipe or from a drainage basin. If the discharge occurs in some course or channel, it is correct to speak of the discharge of a canal or of a river. It is also correct to speak of the discharge of a canal or stream into a lake, stream, or ocean.
***Diversion.*** The change in character, location, direction, or quantity of flow of a natural drainage course.
***Drains.*** A pipe, ditch, or channel for collecting and conveying water. Sometimes used in AStorm Drains@ when describing an urban storm drainage system to carry the initial runoff.
***Drainage.*** (1) A general term applied to the removal of surface or sub-surface water from a given area either by gravity or by pumping. The term is commonly applied herein to surface water. (2) The area from which water occurring at a given point or location on a stream originates. In such case, the term is synonymous with Drainage Area and Watershed. (3) The term is also used in a general sense to apply to the flow of all liquids under the force of gravity.
***Drainage Area.*** See Catchment Area.
***Drainage Way.*** Those natural depressions in the earth=s surface, such as swales, ravines, draws and hollows, in which surface waters ten to collect, but which do not constitute a watercourse in the defined sense.
***Drawdown.*** The vertical distance the free water elevation is lowered or the reduction of the pressure head due to the removal of free water.
***Dredge material***. Soil that is excavated from a stream channel.
***Drop.*** A vertical structure in a conduit or canal installed for the purpose of dropping water to a lower level.
***Drop Inlet Culvert.*** A culvert installed with a drop inlet on one end and daylighted at the other end.
***Eddy current.*** A circular water movement that develops when the main flow becomes separated from the bank. The eddy current my then be set up between the main flow and the bank.
***Encroachment.*** The advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development into a floodplain which may impede or alter the flow capacity of a floodplain.
***Energy Dissipater.*** A structure for the purpose of slowing the flow of water and reducing the erosive forces present in any rapidly flowing body of water.

***Enhancement***. Improvements to the existing conditions of the aquatic, terrestrial, and recreational resources.
***Erosion***. In the general sense, the wearing away of the land by wind and water. As used in this pamphlet, the removal of soil particles from a bank slope primarily due to water action.
***ESA.*** Endangered Species Act
***Failure***. Collapse or slippage of a large mass of bank material into a stream.
***Fascines***. Sausage-like bundles of plant cuttings used to stabilize streambanks and other slopes. Also known as wattlings.
***FEMA***. Federal Emergency Management Agency. The agency which administers the NFIP at the federal level.
***Fill material***. Soil that is placed at a specified location to bring the ground surface up to a desired elevation.
***Filter***. Layer of fabric, sand, gravel, or graded rock placed between the bank revetment or channel lining and soil to prevent the soil from moving through the revetment; to prevent the revetment from sinking into the soil; and to permit natural seepage from the streambank, thus preventing buildup of excessive groundwater pressure. If a filter is used by a landowner or local government, technical assistance should be obtained to properly match the filter with the soil.
***Fine particles (or Fines)***. Silt and clay particles.
***Fish habitat***. The aquatic environment and the immediately surrounding terrestrial environment that meet the necessary biological and physical requirements of fish species during various life stages.
***Flanking.*** Streamflow between a structure and the bank, possibly occurring because the structure was not property tied into the bank.
***Flood***. A general and temporary condition of partial or complete inundation of normally dry land areas.
***Flood Control.*** The elimination or reduction of flood losses by the construction of flood storage reservoirs, channel improvements, dikes, and levees, by-pass channels, or other engineering works.
***Flood Insurance Rate Map (FIRM).*** The official Flood Insurance Administration map which shows special hazard zones and risk areas of a community. This map is used for insurance rating purposes.
***Flood Storage.*** Storage of water during floods to reduce downstream peak flows.
***Floodplain***. An area of land that would be covered with water during a flood. In connection with the Flood Insurance Program, usually refers to the 100-year floodplain. The term is identical to Aflood hazard area@.
***Flood Plain Fringe.*** That portion of the flood plain that lies outside the regulatory area. Its hazard should be recognized although it is not great enough to make public regulations desirable.
***Flood Plain Management.*** Control of use of land subject to flooding.
***Flood Proofing.*** A combination of structural changes and adjustments to properties subject to flooding primarily for the reduction of flood damages.
Flood Waters.
**Flood Storage Area.** Flood storage area is that portion of the regulatory area that may serve as a temporary storage area for flood waters from the 100-year flood and that lies landward of the floodway.
***Floodway***. The river channel and overbank areas of riverine floodplains through which the base flood is discharged. This portion of the floodplain is where the highest flood velocities and greatest flood depths usually occur. Floodways are shown on the Flood Boundary and Floodway Maps (FBFM) prepared by FEMA for regular program communities. Upon the adoption of these maps by a community, the floodway(s) shown become Aregulatory floodways@ within which encroachment or obstructions must be prohibited.
***Flow.*** A term used to define the movement of water, silt, sand, etc.; discharge; total quantity carried by a stream.
***Flow Line.*** (1) The position of the water surface in a flowing stream or conduit for a normal or specified rate of discharge. (2) The hydraulic grade line in an open channel.
***Fluvial***. Produced by moving water.
***Fluvial geomorphology***. The study of surface forms produced by the action of flowing water.
***Freeboard***. The vertical distance between the design water surface elevation and the elevation of the bank, levee or revetment that contains the water.
***Frequency Curve.*** A curve that expresses the relation between the frequency of occurrence and the magnitude of the variables. The theoretical frequency curve is a derivative of the probability curve.
***Gabion***. A galvanized wire basket with a hinged top, intended to be filled with stones and used to stabilize banks or channel beds, to control erosion, and to prevent bed material from shifting. Generally not recommended for placement in gravel bed streams.
***Geomorphology***. The geologic study of the evolution and configuration of land forms.
***Grade.*** (1) The inclination or slope of a channel, canal, conduit, etc., or natural ground surface, usually expressed in terms of the precentage of number of units of vertical rise (or fall) per unit of horizontal distance. (2) The elevation of the invert of the bottom of a conduit, canal, culvert, sewer, etc. (3) The

finished surface of a canal bed, road bed, top of an embankment, or bottom of an excavation.
***Gradient***. Slope calculated as the amount of vertical rise over horizontal run.
***Gravel***. Soil particles ranging from 1/5 inch to 3 inches in diameter.
***Groundwater flow.*** Water that moves through the subsurface soil and rocks.
***Groundwater table***. The depth below the surface where the soil is saturated; that is the open spaces between the individual soil particles are filled with water. Above the groundwater table and below the ground surface the soil either has no water between the particles or is partially saturated.
***Gutter.*** See Street Nomenclature.
***Gutter Flow.*** Flow in a gutter.
***Habitat***. The area or environment in which an organism lives.
***Habitable Structure.*** Any building or structure which would suffer significant damage to inundation of flood waters.
***Headcutting***. The action of an upstream moving waterfall or locally steep channel bottom with rapidly flowing water through an otherwise placid stream. These conditions often indicate that a readjustment of a stream's discharge and sediment load characteristics is taking place.
***Headwater***. The uppermost reaches of a stream or river.
***Hydraulic Gradient.*** A hydraulic profile of the piezometric level of the water, representing the sum of the depth of flow and the pressure. In open channel flow, it is the water surface.
***Hydraulic Jump.*** The hydraulic jump is an abrupt rise in the water surface which occurs in an open channel when water flowing at supercritical velocity is retarded by water flowing at subcritical velocity. The transition through the jump results in a marked loss of energy, evidenced by turbulence of the flow within the area of the jump. The hydraulic jump is often used as a means of energy dissipation.
***Hydraulics***. Water or other liquids in motion and their actions.
***Hydric soils***. Soils found in saturated, anaerobic environments usually characterized by a gray or mottled appearance, often found in wetlands.
***Hydrogrpah.*** A graph showing stage, flow, velocity, or other property of water with respect to time.
***Hydrology***. The study of the properties, distribution and effects of water on the Earth=s surface, soil, and atmosphere.
***Impermeable material***. A soil that has properties which prevent movement of water through the material.
***Impervious***. A term applied to a material through which water cann
***Incised channel***. A stream that has cut its channel into the bed of the valley.
***Infiltration***. (1) The entering of water through the interstices or pores of a soil or other porous medium. (2) The quantity of groundwater which leaks into a sanitary or combined sewer or drain through defective joints. (3) The entrance of water from the ground into a sewer or drain through breaks, defective joints. (4) The absorption of liquid water by the soil, either as it falls as precipitation, or from a stream flowing over the surface. Se Surface Infiltration.
***Inlet.*** (1) An opening into a storm sewer system for the entrance of surface storm runoff, more completely described as a storm sewer inlet. (2) A structure at the diversion end of a conduit. (3) The upstream connection between the surface of the ground and a drain or sewer, for he admission of surface or storm water.
***Intensity.*** As applied to rainfall, is a rate usually expressed in inches per hour.
***Interception.*** As applied to hydrology, refers to the process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs and buildings, never reaching the suface of the ground, and is lost by evaporation.
***Instream.*** The instream channel includes the channel bottom up to 10 feet minimum above the Ordinary High Water (OHW) mark, or the 2-year peak flow line.
***Instream cover***. (a) Areas of shelter in a stream channel that provide aquatic organisms protection from predators. (b) A place in which to rest and conserve energy due to a localized reduction in the force of the current.
***Integrated Approach.*** Design that combines structural with vegetated techniques to minimize impacts and add strength to bank restoration techniques.
***Intermittent stream***. A stream that has interrupted flow or does not flow continuously.
***Invert.*** The bottom of a drainage facility along which the lowest flows would pass.
***Isohyetal Line.*** A line drawn on a map or chart joining point which receive the same amount of precipitation.
***Isohyetal Map.*** A map containing isohyetal lines and showing rainfall intensities.
***Joint planting***. The process of placing live woody plant cuttings in the spaces between pieces of rock rip-rap. When placed properly, the cuttings are capable of rooting and growing.
***Large woody debris***. Any large piece of woody material that intrudes or is embedded in the stream channel. Also called large organic debris.

***Launching.*** Process where stone stockpiles along top bank is undercut and slides downslope thus protection the bank against future erosion.
***Left Bank.*** The left-hand bank of stream or dam when the observer is facing downstream.
***Level of Service.*** Design objective for managing a stream reach for flood conveyance, expressed in recurrence interval such as 25-year, 50 year, etc.
***Lining.*** Material such as concrete, rock, cobbles, grass, geotextiles, etc., placed on the sides and bottom of a ditch, channel, and reservoir to prevent or reduce seepage of water through the sides and bottom and/or to prevent erosion.
***Lip.*** A small wall on the downstream end of an apron, to break the flow from the apron.
***Live Stakes***. Cuttings from living branches that are inserted into the soil to stabilize slopes and streambanks when the cuttings root and grow.
***Lower bank.*** That portion of the streambank below the elevation of the average water level of the stream.
***Maintenance.*** The ***repair, care and upkeep*** of a channel at a pre-existing or approved design condition, within a designated flow conveyance capacity.
***Management. Modification, alteration and change***, where necessary, of physical and biological site conditions in response to evolving goals, objectives and changing environmental conditions.
***Manhole.*** A structure through which a person may gain access to an underground or enclosed conduit or facility.
***Manning=s An@***. The resistance coefficient in the Manning formula used in calculating water velocity and stream discharge. It is a proportionality coefficient that varies inversely as a function of flow.
***Meander***. A circuitous winding or bend in the river.
***Mean sea level (MSL)***. The average height of the sea at all stages of the tide. Mean Sea Level is also ANational Geodetic Vertical Datum@ (NGVD).
***NOAA.*** National Oceanic and Atmospheric Administration.
***NWS.*** National Weather Service.
***Non-cohesive soil***. Soil particles that have no natural resistance to being pulled apart at their point of contact, for example, silt, sand, and gravel.
***Obstruction***. Any structure or assembly of materials including fill above or below the surface of land or water, and any activity which might impede, retard or change flood flows.
***OHW.*** Ordinary high water mark. See below.
***One-hundred year flood***. Another name for the base flood, the flood having a one-percent of occurring in any single year.
***Ordinary high water mark.*** The mark along a streambank where the waters are common and usual. This mark is generally recognized by the difference in the character of the vegetation above and below the mark or the absence of vegetation below the mark.
***Orifice.*** (1) An opening with closed perimeter, and of regular form in a plate, wall, or partition, through wihc water may flow. (2) The end of a small tube, such as a Pitot tube, piezometer, etc.
***Overbank flow***. Water flowing over the top of bank.
***Peak Rate of Runoff.*** The maximum rate of runoff during a given runoff event.
***Perennial stream***. A stream that flow continually.
***Permeability.*** The quality of a soil horizon which permits movement of water through it when saturated and actuated by hydrostatic pressure.
***Pervious.*** Applied to material through which water passes relatively freely.
***Point bar***. A gravel or sand deposit on the inside of a river bend; an actively mobile river feature.
***Point of Concentration.*** That point at which water flowing from a given drainage area concentrates.
***Pool***. Deeper areas of a stream with slow-moving water, often used by larger fish for cover.
***Pool-riffle ratio***. The ratio of pool and riffle areas, or pool and riffle length in a given stream reach.
***Pollution.*** A state of physical impurity or uncleanliness, usually brought about by the addition of sanitary sewage, harmful industrial waste, or other harmful materials to water which make it unfit for use.
***Precepitation.*** Any moisture that falls from the atmospher, including snow, sleet, rain and hail.
***Program.*** San Luis Obispo Creek Stream Management and Maintenance Program
***Reach***. A relatively homogeneous length of stream having a similar sequence of characteristics.
***Regime.*** The sytem of order characteristic of a stream; its behavior with respect to velocity and volume, form of and changes in channel, apacity to transport sediment, amount of material supplied for transportation, etc.
***Retention***. Containment of runoff by ponding to be discharged by infiltration and evaporation or by release after the sotrm has ended.
***Riffle***. A shallow section in a stream where water is breaking over rocks or other partially submerged organic debris and producing surface agitation.
***Right Bank.*** The right-hand bank of a stream or dam when the observer is facing downstream.
***Rip-rap***. A layer, facing, or protective mound of stones placed to prevent erosion, scour, or sloughing of a structure or embankment. Also refers to the stone used.
***Riparian.*** Pertaining to the banks and other adjacent, terrestrial evirons of freshwater bodies, watercourses, and surface emergent aquifers, whose imported water

provide soil moisture significanly in excess of that available through local precipitation.

***Riparian area***. The area between a body of water and adjacent upland areas that is identified by distinctive soil and vegetative characteristics.

***Riparian buffer***. Trees and shrubs growing parallel to a stream that reduce the intrusion into the top bank area by humans, animals, and machinery. This vegetation also retards surface runoff down the bank slope and provides a root system which binds soil particles together.

***Riparian vegetation***. Vegetation growing along the banks of streams and rivers or other bodies of water tolerant to or more dependent on water than plants further upslope.

***Riparian zone***. The vegetated zone adjacent to a stream or any other water body (from the Latin work ripa, pertaining to the bank of a river, pond or lake).

***Risk.*** The potential adverse consequences measured in terms of inconvenience, damage, safety or professional liability or political retribution. (WEF/ASCE, 1992).

***Risk Analysis.*** The quantification of exposure, vulnerability and probability (WEF/ASCE, 1992).

***Roughness element***. Any obstacles in a channel that deflect flow and change its velocity.

***Routing, Hydraulic.*** (1) The derivation of an outflow hydrograph of a channel or stream from known values of upstream inflow. (2) The process of determining progressively the timing and shape of a flood wave at successive points along a stream or channel.

***Run***. The straight fast-moving section of a stream between riffles.

***Runoff***. That part of the precipitation which reaches a stream, drain, sewer, etc., directly or indirectly.

a. *Direct Runoff*: The total amount of surface runoff and subsurface storm runoff which reaches stream channels.
b. O*verland Runoff:* Water flowing over the land surface before it reaches a definite stream channel or body of water.

***Salmonids***. Fish of the family Salmonidae, including salmon, trout, char, whitefish, ciscoe, and grayling.

***Sand***. Mineral particles ranging from 0.0625 to 2 mm (0.0025 to 0.08 inch) diameter; 0.03 inch is the normal lower limit at which the unaided human eye can distinguish an individual particle.

***Sanitary Sewer.*** A closed conduit carrying sewage and other waste liquids, but not including intentionally added surface and stormwater.

***Scoop and Lift.*** Sediment removal technique, where excavated material is loaded directly into trucks, or out of channel, and not moved in the channel.

***Scour.*** Concentrated erosive action of flowing water in streams that removes material from the beds and banks.

***Sediment.*** Material of soil and rock origin transported, carried, or deposited by water.

***Sediment discharge***. Mass of sediment passing a stream cross-section at a defined unit of time.

***Sediment load***. The sediment transported through a channel by streamflow.

***Sediment***. Soil particles that have been transported and/or deposited by wind or water action.

***Shear strength***. The internal resistance of a body to shear stress. Typically includes frictional and cohesive components. Expresses the ability of soil to resist sliding.

***Shear stress***. The force per unit area tending to deform a material in the direction of flow.

***Sheet erosion***. The removal by surface runoff of a fairly uniform layer of soil from a bank slope.

***Sheet flow.*** Any flow spread out and not confined, i.e., flow across a flat open field.

***Silt***. Slightly cohesive to noncohesive soil composed of particles that are finer than sand but coarser than clay, commonly in the range of 0.004 to 0.0625 mm. Silt will crumble when rolled into a ball.

***Silt Basin***. A basin or reservoir installed in a storm drainage system to retard velocity, causing sedimentation and providing storage for deposited solids.

***Sinuosity***. A measure of the amount of a river=s meandering; the ration of the river length to the valley length. A straight channel has a sinuosity of 1.0; a fully meandering river has a sinuosity of 2.0 or greater.

***Slope***. The amount of vertical rise divided by horizontal run.

***Sloughing (or sloughing off)***. Movement of a mass of soil down a bank into the channel (also called slumping). Sloughing is similar to a landslide.

***Slumping***. The collapse of slopes caused by undercutting.

***Specifications***. A detailed description of particulars, such as size of stone, quantity and quality of materials, contractor performance, terms, quality control, and equipment.

***Spillway.*** A waterway in or about a dam or other hydraulic structure, for the escape of excess water. Also referred to as: By-Channel, By-Wash, and Diversion Cut.

***Stage.*** The elevation of a water surface above its minimum; also above or below an established “low water” plane; hence above or below any datum of reference; gage height.

***Storm.*** A disturbance of the ordinary, average conditions of the atmospher which, unless specifically qualified, may include all meterological

distrubances such as wind, rain, snow, hail, or thunder.

***Storm Sewer.*** A closed conduit for conducting sotrm water that has been collected by inlets or collected by other means.

***Stream***. A body of running water moving over the Earth=s surface in a channel or bed (also river).

a. *Effluent:* A stream or stretch of stream which receives water from groundwater rin the zone of saturation. The water surface of such a stream stands at a lower level thn the water table or piezometric surface of the groundwater body from which it receives water.
b. *Ephemeral:* (10 One that flows only in direct response to preceiptation. Such a stream receive no water from springs and no long-continued supply from melting snow or other surface source. Its channel is at all time above the water table. (2) The term may be arbitarily restricted to streams or stretches of streams that do not flow continuously during periods of as much as one month.
c. *Influent:* A stream or stretch of stream which contributes water to the zone of saturarion. The water surface of such a stream stands at a higher level than the water table or piezometric suface of the gorundwater body to which it contributes water.
d. *Intermittent:* A stream which flows during protracted periods, but not continually, when it receives water from springs or surface runoff.
e. *Perennial.* A stream which flows continuosly at all seasons of a year and during dry as well as wet years. Such strems are usally fed by groundwater, and their water surface generally stands at a lower level than that of the water table in the locality.

***Stream Flow.*** A term used to designate the water which is flowing in a stream channel, canal, ditch, etc.

***Stream Response.*** Changes in the dynamic equilibrium of a stream by any one, or combination of various causes.

***Streambank***. The portion of the channel cross section that restricts lateral movement of water at normal water levels

***Streambank erosion***. Removal of soil particles from a bank slope primarily due to water action. Climatic conditions, ice and debris, chemical reactions, and changes in land and stream use may also lead to bank erosion.

***Streambank failure***. Collapse or slippage of a large mass of bank material into the channel.

***Streambed***. The substrate plane bounded by the stream banks over which water moves. Also called stream bottom. It is the area kept mostly or completely bare of vegetation by the wash of waters in the stream.

***Streamflow***. The movement of water through a stream channel.

***Structural***. Reducing flood hazards through physical means, such as dams, dikes, levees, or channelization of rivers or streams.

***Structure***. (a) Any object in the channel that affects water and sediment movement. (b) The diversity of physical habitat within a channel.

***Subdrain.*** An underground conduit designed to permit infiltration for the purpose of collecting groundwater.

***Subgrade.*** (1) The bottom of a trench, or other execavation, that is somewhat below the predetermined elevation of the bottom of the final excavation or structure wihch is to be placed therein, the intervening spacke being backfilled with some special material such as sand, gravel, broken stone, or tamped earth, or impervious lining, or occupied by the structure for which the excavation was made. The term is also applied to the elvation of such bottom. (2) The natural soil area beneath a street or road.

***Subsoil.*** The portion of a nomral soil profile underlying the surface or A-horizon. Its depth and physical properties control to a considerable degree the movement of soil moisture.

***Substrate***. The mineral or organic material that forms the bed of the stream.

***Sump.*** Low point in natural or improved surface topography where surface flows will pond if drain is not provided.

***Surface detention.*** The storm runoff detained on the surface of the ground at or near where the rainfall occurred, and which will run off later.

***Surface Flow or Sheet Flow.*** The surface flow from rainfall on pavements, ground surfaces, and other exposed surfaces until such flow reaches a gutter, ditch, water course, inlet, or other point of concentration.

***Surface Infiltration.*** That rainfall which percolates into the ground surface and which therefore does not contribute directly to the storm runoff flow.

***Surface runoff***. That portion of precipitation that moves over the ground toward a lower elevation and does not infiltrate the soil.

***Suspended Load.*** Sediment that is supported by the upward components of turbulent currents in astream and that stays in suspension for an appreciable amount of time.

***Swale.*** A shallow, gentle depression in the earth's surface. This tends to collect the waters tos ome

extent as a drainage course, although waters in a swale are not considered stream waters.

***Thalweg***. A line following the deepest part of the bed or channel of a stream.

***Toe***. The break in slope at the foot of a bank where the bank meets the bed.

***Top of bank***. The break in slope between the streambank and the surrounding upland terrain.

***Transect***. (a) A predetermined line along which vegetation occurrence or other characteristics such as canopy density are counted for monitoring purposes. (b) A channel cross-section.

***Trash Rack.*** A grid, screen, or other barrier constructed to catch debris and exclude it from a downstream conduit.

***Trench.*** An excavation made for installing pipes, masonry walls, and other purposes. A trench is distinguished from a ditch in that the opening is temporary and is eventually backfilled.

***Tributary Basin.*** An area tributary to a specific point under study.

***Turbidity***. Relative water quality conditions; measure of light passing through water affected by suspended material.

***Upper bank***. That portion of the streambank above the elevation of the average water level of the stream.

***Vegetated geogrid***. Soil wrapped with a geotextile fabric and with live woody plant cuttings placed in between each soil/geotextile wrap.

***Velocity (of water in a stream)***. The distance that water can travel in a given direction during an interval of time.

***Watercourse.*** A running steam of water, a natural stream, or storm water channel, including rivers, creeks, runs, and rivulets. Streams flow ina particualr direction though it need not flow continually. They may sometimes be dry, and they usally flow in a definite channel having a bed, sides, or banks. It does not inlcude the water flowing in the hollows or ravines in land, which is the surface water from rain or melting snow and is discharged through them for a higher to a lower level, but which at other times are destitute of water. Also known as Drainage Way and Waterway.

***Waters of the United States***. Includes all dry land and water-covered areas below the ordinary high water marks on navigable and non-navigable streams.

***Watershed***. An area of land that drains into a particular river or body of water. Usually divided by topography.

***Wattling***. See fascines.

***Wetland***. AWetland@ means lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands have one or more of the following three attributes: (a) At least periodically, the land supports predominantly hydrophytes; (b) The substrate is predominantly undrained hydric soil; and, (c) the substrate is nonsoils and is saturated with water or covered by shallow water at some time during the growing season of each year.

***Woody debris***. Coarse wood material such as twigs, branches, logs, trees, and roots that fall into streams.

# APPENDIX A

Best Management Practices
(Working In The Creek)

# Working in the Creek

## Stream Management and Maintenance Program for the San Luis Obispo Creek Watershed

City of San Luis Obispo
Engineering Department
555 Morro Street
San Luis Obispo, CA

and

San Luis Obispo County
Flood Control and Water
Conservation District, Zone 9

October14, 2002

# Contents

# A Pre-Construction Activities

**Before work in the creek begins, make sure all applicable permit conditions have been met. Here is a list of standard conditions and activities that must be completed prior to working in SLO's creeks.**

## TYPICAL PERMIT CONDITIONS

- Five days prior to initiation of construction, the permittee shall notify the ACOE in writing indicating the actual start and end dates of construction, and must provide written certification to the ACOE that the permittee, project foreman, contractors, and equipment operators have read the permit and will comply with all general and special conditions of the permit. The notification shall also provide the names of the environmental and biological monitor(s). (ACOE)

- Prior to initiation of construction, the permittee shall temporarily isolate the workspace utilizing a method pre-approved by the ACOE. (ACOE)

- The applicant shall photograph the action area during and before and after construction activities are completed for the purpose of developing a reference library of instream and riparian habitat characteristics. (NMFS)

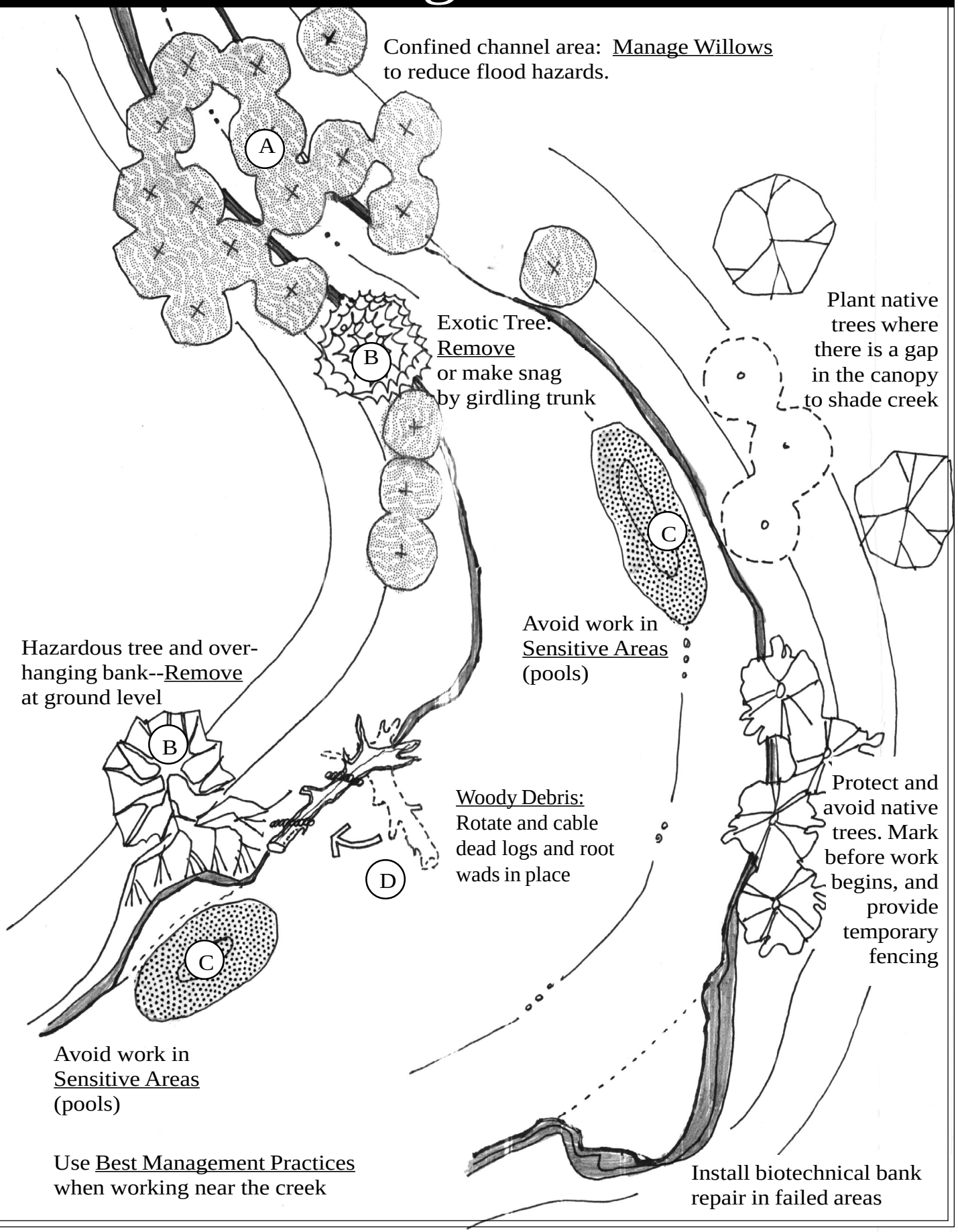
- A USFWS protocol-level, preconstruction survey shall be conducted to determine the presence of California red-legged frogs, southwestern pond turtles, and two-striped garter snakes. If CRLF are found, all construction shall cease and the operator shall consult with the CDFG and the USFWS, and the agreement will need to be amended and potential environmental review conducted before the project proceeds. If southwestern pond turtles or two-striped garter snakes are found, all construction shall cease, and the Operator shall contact the CDFG. The Agreement may need to be amended before the project proceeds. (CDFG)

- Prior to construction, a qualified biologist shall conduct training sessions to familiarize all construction personnel with identification of CRLF, and other sensitive species, their habitat, general provisions and protections afforded by the ESA, measures implemented to project the CRLF and a review of project boundaries. (CDFG)

- Preconstruction surveys shall be conducted by a qualified biologist to determine the presence of nesting birds in the riparian zone. If nests are found to be present, all construction shall be delayed until the qualified biologist determined that the young have fledged. (CDFG)

- Swallow nests are presumed to be active between February 15th and September 1st. If construction begins prior to September 1st, preconstruction surveys shall be conducted to determine the presence of swallows in the culvert. If nests are found to be present, exclusionary fencing shall be placed immediately upstream from the culvert to prevent

# B Creek Management



# C Managing Willows

Native willows found in San Luis Obispo creeks include the shrubby arroyo and sandbar willows (*Salix lasiolepis* and *S. hindsiana)*, and the tree-like red-tree and yellow willow (*S. laevigata* and *S. lasiandra*). Willows are short-lived, with suckering and sprouting. Most willows have weak wood that is subject to decay and insect damage. Willows may need to be removed from a channel bed if they are obstructing flow or diverting water against a bank.

## ACTIVITIES:

**1. Learn to identify** Red and yellow tree willows, Arroyo willows, and Sandbar willows.

**2. Select plants with single-trunk**, tree-like growth habits over multi-trunked or shrubby forms.

**3. Remove shrubby trees** to create approximately 15-20 ft. spacing.

**4. Never top live willows**; this encourages shrubby growth.

**5. Limb trees up to 5-7 ft.** by removing lower branches (except one or two to provide shading).

**6. Remove diseased or hazardous trees that could be undermined** and topple into the water-way on middle and lower banks.

**7. Cable downed or leaning trees** using deadman anchors or cable links.

**8. Keep and protect plants that provide shade to creek**, on the upper bank.

**9. Use cuttings** from existing tree-like species to replant open areas.

**10. Remove non-native species** like weeping willows and replant with native willows and other native trees, if feasible. Do not disturb roosting or nesting habitat.

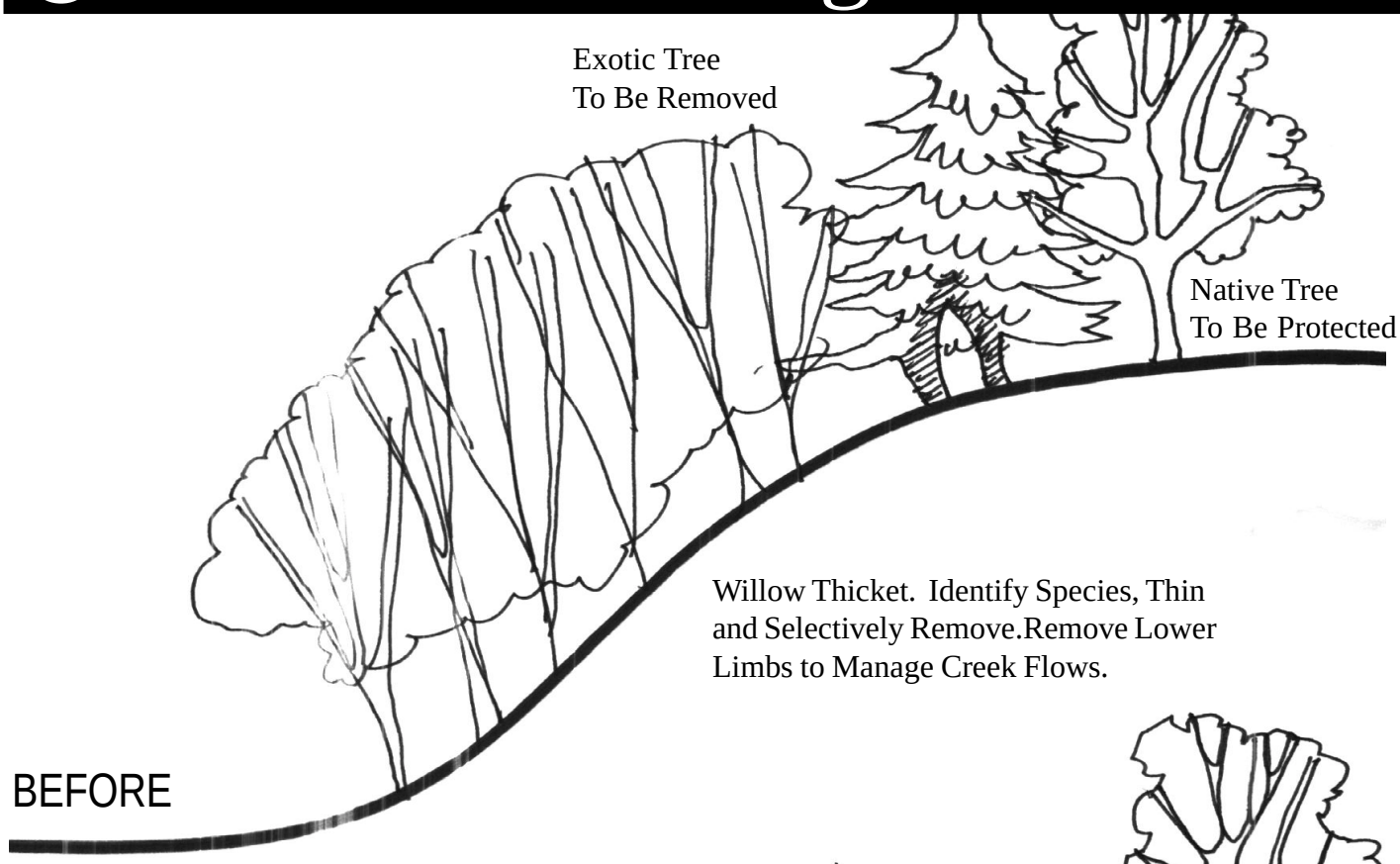
**11. Stockpile willow cuttings** to be used in planting areas. (Cuttings only remain viable for a limited time and must be kept wet. Select single trunk trees over those with a shrubby growth form) Use the elevation at which trees are growing to decide where to plant stakes.

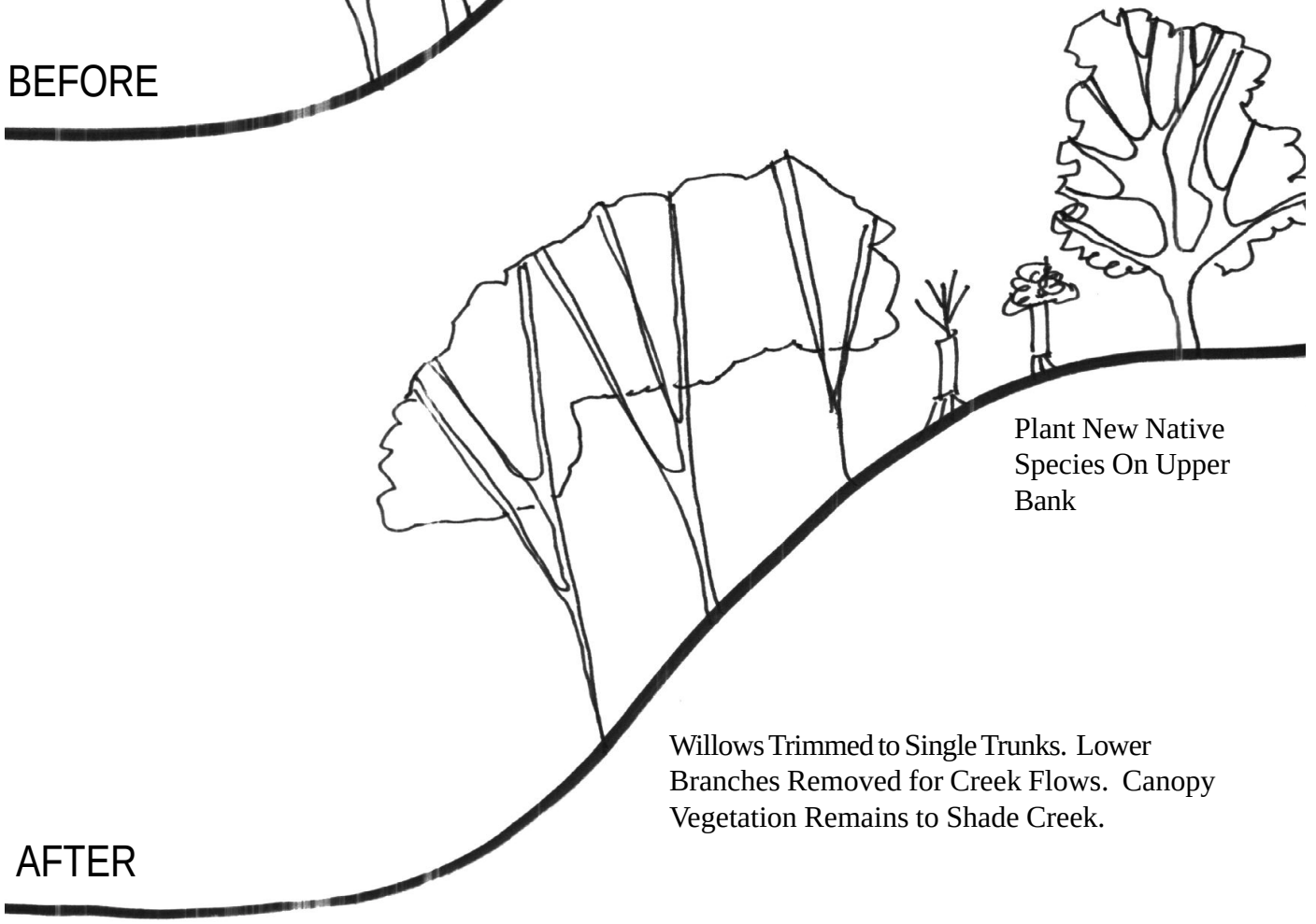
**12. Pruning cuts** should conform to ISA Pruning Standards (1992).

**13. Prune willows** in in May and June, after bird nesting activity.

**14. Remove sprouts** by rubbing-off new sprouts before they become woody. Sprouts may need to be removed two to three times during the summer. Napthalene Acetic Acid (NAA) compound (Tre-hold) can also be used by painting a mixture of NAA onto the pruning cut.

# D Willow Thinning



# E Controlling Willow Sprouts

## Willow Pruning Tips

1. Tree willows are more desirable than shrub forms for repair work where channel capacity is limited.

2. Maintenance crews can trim willows where necessary and stockpile those cuttings to be used in planting areas. However, cuttings only remain viable for a limited time and must be kept wet. Select single trunk trees over those with a shrubby growth form for staking purposes. Use the height at which trees are growing to decide where to plant stakes.

3. It can take 5-7 years to establish a canopy dense enough to shade out cattails.

4. Pruning cuts should conform to ISA Pruning Standards (1992).

5. Willows may need to be removed from a channel bed if they are obstructing flow or diverting water against a bank.

6. Standing dead trees can be topped and left for wildlife.

7. Prune willows in the summer, after nesting season.

8. Never top live willows; this encourages shrubby growth. Limb trees up when possible, remove lower branches (except one or two to provide shading to 5-7 ft.)

9. Sprout removal can be accomplished by rubbing-off new sprouts before they form a woody connection to the stem. Sprouts may need to be removed two to three times during the summer.

Willows tend to resprout after pruning. Sprouts can originate from both ad ventitious (from callus tissue that develops around pruning wounds) and dor mant buds. Most buds originate in the axil of leaves on the current season's shoots. Some grow into new shoots the succeeding year, but many remain dormant under the bark. When the physiological balance is upset by cutting, disease or injury, the buds produce sprouts.

***Timing:*** The best time to prune tree willows is late May or early June, after nesting bird activity is completed. In addition, sprouting is least abundant from stumps cut in late spring or early summer when trees have just fully leafed out and carbohydrate reserves are at their lowest. Sprouting is greatest from stumps cut during the dormant season when carbohydrate reserves are high. Therefore, the most effective way to control the quantity and vigor of sprouting is to prune willows just after their first flush of leaves have matured.

Arroyo willow starts its spring growth before other native willow species, with leaves and flowers appearing simultaneously. The best time to prune this species is in late April or May when the male flowers (catkins) begin to fall, providing it does not conflict with nesting. The tree willows leaf-out later and have catkins that appear after the leaves have emerged.

***Shading:*** Sprouting can be reduced by selecting certain branches to shade other portions of the plant that have been heavily pruned. Thinning out major stems requires making pruning cuts near the root collar. This area will have the most vigorous sprouting. Retain stems that are well positioned to shade the lower portions of the trunk. This method sometimes conflicts with limbing up to minimize flood obstruction. In addition, retain vegetation shading deep pools.

***Thinning*** includes pruning cuts that remove a branch at its point of attachment or shorten it to a lateral large enough to assume the terminal role. Thinning will be done mainly to reduce the number and spacing of stems to create a more tree-like form that offers less obstruction to flow and facilitates the passage of large floating debris.

***Clearing*** means the removal of all stems and treatment of the root collar (stump) to kill the plant. Clearing will be done to increase channel capacity, to remove willows that are obstructing flow in an adverse way, and to increase spacing between plants to facilitate the passage of large debris.

***Sprout removal*** entails the removal of sprouts that occur from prior pruning and/or other injury. Sprout removal is necessary to manage growth. Two factors affect sprouting: timing of pruning, and increased shading. Overpruning also encourages heavier sprouting. Application of natural plant hormone (Napthalene Acetic Acid or [NAA]) can also be used to reduce sprouting. NAA is not currently regulated as a pesticide. An NAA-based compound (trade name Tre-hold) has been developed commercially for use in orchards to reduce water sprouts and suckering following fruit tree pruning. This compound can also be used (experimentally) to control willow sprouting by painting a mixture of NAA onto the pruning cut.

# F Thinning and Training Trees

**1. Remove all dead, dying or diseased wood.**

**2. Stand back** and examine its form and location on the bank.

**3. Determine which branches should be saved** as major limbs and which should be removed.

**4. Select branches that are attached to the trunk at wide angles** and smaller in diameter than the trunk. In many young trees the lower branches outgrow the trunk and upper branches.

**5. Remove part or all of a lower branch** if it is outgrowing the leader or helps flow resistance for trees growing in the channel.

**6. Prune for vertical spacing of the limbs** to establish a dominant leader, eliminate crossing limbs, structural strength and improve tree appearance.

**8. Prune young trees as little as needed during the first two growing seasons,** to a single trunk with most limbs off the ground for flood water passage.

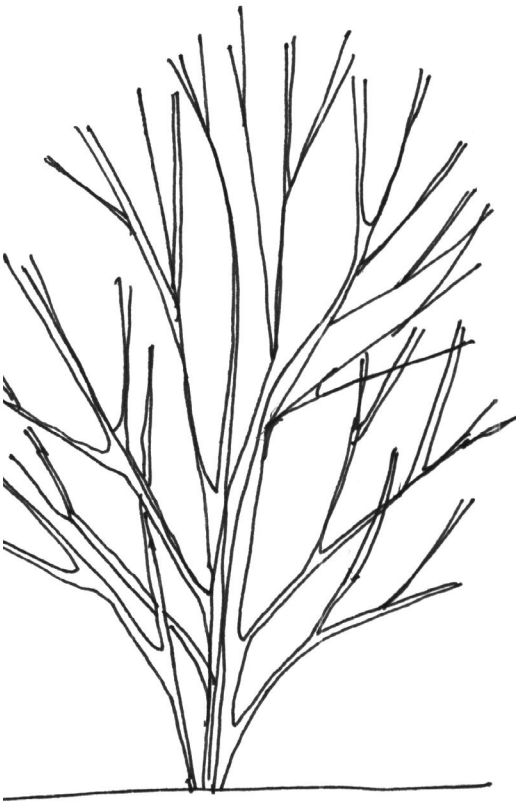
**9. Leave one or two limbs that can overhang the water and provide shade and habitat.** This allows the trees to use all available foliar resources to establish their root systems.

**7. The vertical space between major branches should be >8", preferably 18 to 24".** Mature trees have branches 4-12 feet apart. Radial spacing should avoid one limb over another. Radial branch distribution should allow 5-7 limbs to fill the circle around the trunk (1-2 rotations).

**10. Allow laterals to remain as temporary branches to shade and protect the trunk** to reduce sun scald.

**11. Pinch the tips of vigorous temporary branches to reduce competition** with the leader. When the trunks of small trees are three or four inches in caliper or those of larger trees are six to eight inches in caliper, reduce the number of temporary branches.

**12. Problems** such as kinked J roots, disease, insects, sun scald, & poor drainage may stunt growth. Revitalize the tree by pruning. New growth will come from buds below the cut. When the new shoots are 5-6", choose the one in the best position & remove others to form a new leader.



BEFORE

AFTER

# G Pruning, Thinning & Clearing Woody Species

Pruning decisions should reflect the hydraulic and vegetation management goals for a channel. SLO/Zone 9 will conduct a training program for field maintenance crews on vegetation management techniques. Vegetation management techniques will be implemented in a demonstration area. In sensitive habitat areas, a hydrologist and botanist should work together in the field to mark stems and plants that need to be removed with paint or flagging. A good time to do this is during the dormant season when plant stems can be easily viewed. Observations made during winter high flow periods and following storms may indicate which trees cause obstructions to flows, deflect flows or trap sediments.

Plant/creek interface is critical to maintaining healthy creek life, to shade the creek and cool water temperatures. Whenever possible, leave overhanging vegetation and emergent wetland vegetation that colonizes depositional bars. Crews should be trained to identify native wetland plant species.

Cattails can also be left at the edges of low flow channels if the deposition they encourage helps stabilize the toe of an eroded or armored bank. If working in an area that has a large active floodplain, leave a 5' buffer at the water's edge and maintain the banks above this buffer. Some low growing vegetation in the channel will not greatly increase resistance to storm flows and should be left. Crews should always avoid disrupting pools that support aquatic species.

Mixed riparian forests are valuable. Most have some exotic species, such as Eucalyptus. There may also be a lack of native saplings due to competition with the exotics. A goal of vegetation management should be to phase out the exotics and replant native shrub and tree species where feasible, recoginizing that some mature trees have value as nesting habitat for raptors. Environmental, aesthetic, public access and impacts on local neighborhoods also need to be factored into management decisions. Vegetative management activities should include:

- Selectively thinning to remove exotic or weedy species as the forest matures in order to meet hydraulic roughness, shade tolerance/canopy cover or basal areas goals
- Inspecting and managing hazardous trees and downed wood for stability
- Pruning and brushing out to mitigate structural weaknesses or disease problems
- Limbing-up for flood conveyance or traffic along public access and maintenance pathways
- Interplanting to close the canopy, increase diversity and the structure, and provide improved wildlife habitat
- Special management in sensitive habitats
- Pest, disease and weed control

## Management Practices

**Vines:** Hand crews should cut non-native vines, like berry and ivy away from native trees and shrubs.

**Woody Debris:** Only remove downed wood from creek when it is loose and can be washed downstream or if it is an obstruction to flow or diverting flow into a bank. First, determine whether it can be realigned and stabilized. If the debris is wedged into roots of an existing tree, especially at a meander with a deep pool, leave it alone, or stake it by driving pipe anchors through it.

**Stumps:** Leave stumps in place where possible. If root wad is still intact, the trunk can be buried into the creek bank. Overhanging and exposed roots can provide habitat and help stabilize bank.

**Pruning Tools:** All pruning tools should be kept sharp and clean. When making thinning cuts, it is recommended that hand shears and loppers be used on stem diameters one inch or less, and that a fine toothed pruning saw be used for larger stems. Stems greater than four inches in diameter can be cut with a chain saw when it is certain that the saw will not injure adjacent stems. When clearing, a chain saw may be used to make all the cuts. All pruning cuts other than clearing cuts should conform to techniques established by the Western Chapter of International Society of Aboriculture (ISA Pruning Standards dated 1992).

**Sprouting:** Sprouting will occur soon after pruning. If it is not possible to get to the site while the sprouts are still young, pruning shears and loppers should be used to remove woody sprouts.

# H Pruning Mature Trees

Mature trees with low, broken, crossing, dead or diseased limbs require pruning to eliminate hazards. Trees that are too large may need to be pruned to eliminate conflicts with power lines. To keep trees healthy, and manage understory vegetation, thin the top of the tree so interior leaves and branches receive more direct sunlight. Topping should be avoided. A mature tree can be opened up by removing limbs one to two inches in diameter. Remove limbs from the top and around the sides of the tree. Remove branches that are too close to each other. Never leave long stubs.

Heading, pollarding, topping, stubbing or dehorning are terms used to describe a form of severe pruning that removes practically all branches and leaves from a tree. Regrowth is vigorous and upright from the stubs, and destroys the form. The new branches form a compact head, cast dense shade and are weakly attached to older limbs, becoming susceptible to wind damage as they age. Avoid this type of pruning.

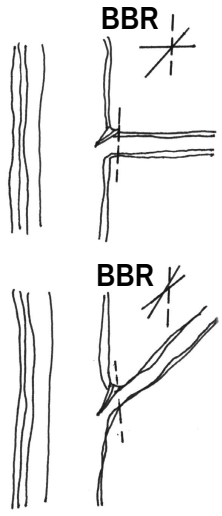
## ACTIVITIES:

**1. Make cuts in healthy wood** 18 to 24 inches below the infection.

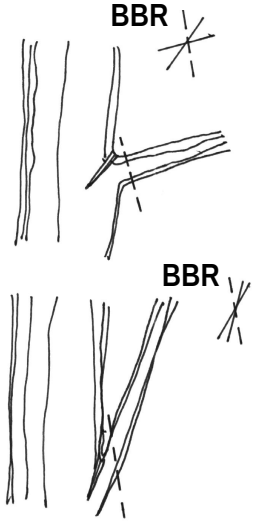
**2. Shears should be disinfected after each cut** with alcohol, bleach or Lysol spray. Rinse and oil after each use.

**3. To renew shrubs,** remove the older, weaker, larger, woody branches, leaving the young, pliant branches intact.

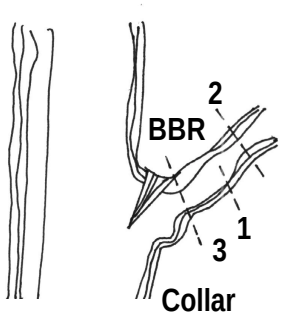
**4. Thinning and renewal should be conducted in the spring** after leafing, to avoid problems with excessive sprouting.




*The angle of the cut (dotted line) should be equal and opposite the angle of the **BBR** (Branch Bark Ridge). When cutting large branches, the final cut should be outside the BBR.*




**5. Do not leave large stubs.** Remove limbs all the way to the main trunk or to a new leader or remaining limb. When cutting limbs back to the parent stem or trunk, do not cut so close as to damage the bark or significantly enlarge the wound. Make the cut just outside the bark ridge and "branch collar." This zone of tissue at the base of every branch inhibits the spread of decay into the trunk. Preserving the branch collar promotes rapid wound closure. If the collar is cut off or injured, the chances of infection by damaging microorganisms are greatly increased.




**6.The three-cut method recommended for larger limbs is recommended.** Make the first cut eight to ten inches from the crotch or branch angle and on the underside of the limb. Cut 1/3 to ½ way through the limb. Make the second cut from one to three inches further out from the first cut. Start this cut from the top and cut through the limb. As the limb falls, any bark rip or break is stopped at the first cut. Make the final cuts just outside of the branch collar. Avoid treating cut surfaces with paint or sealant as this may seal in any infections. Instead, allow the cut surfaces to heal naturally.

# I Tree and Shrub Removal

Mixed riparian forests are valuable. Most have some exotic species, such as Eucalyptus. There may be a lack of native saplings due to competition with the exotics. Remove or phase out the exotics and replant native shrub and tree species over time. Inspect hazardous trees and downed wood for stability before starting work.

## ACTIVITIES:

**1. Keep all pruning tools sharp and clean.**

**2. Use hand shears and loppers** when making thinning cuts, on stems lees than one inch.

**3. Use a fine toothed pruning saw for larger stems.**

**4. Cut stems larger than four inches with a chain saw** (do not injure adjacent stems). Use a chain saw to make all the cuts when the area is to be cleared.

**5. Pruning cuts** should conform to ISA Pruning Standards (1992).

**6. Sprouting will occur soon after pruning.** If it is not possible to get to the site while the sprouts are still young, pruning shears and loppers should be used to remove woody sprouts.

**7. Leave stumps in place** where possible. If root wad is still intact, the trunk can be buried into the creek bank. Overhanging and exposed roots can provide habitat and help stabilize bank.

**8. Hand cut non-native vines**, like berry and ivy away from native trees and shrubs.

**9. Retain trees on the east side** of north-south flowing streams (south side of east- west flowing streams) to increase shading.

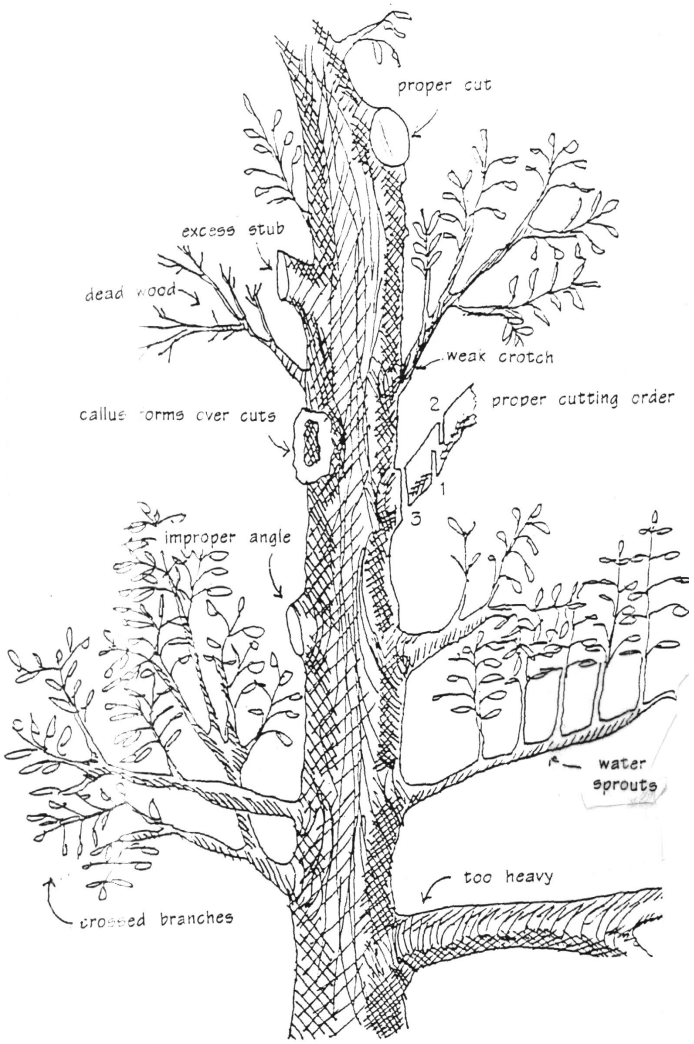
# J Hazardous Tree Management

## Look for:

•Narrow angle branch attachments (weak structure), cracking, split limbs
•Too narrow spacing, too much weight on one side)
•Sprouting from below topping cuts
•Downward growth of large branches
•Unnatural or lopsided growth
•Location of tree in relation to other trees (whether the tree was previously part of a grove and is now exposed or on the edge of the remaining group)

## Health Issues:

•Stress, branch dieback or dead tops
•Deep cracks in trunks, branches, or branch crotches
•Cankers or rots n trunk, branches, crown, or roots
•Mushrooms or fungal fruit bodies
•Physical injury




The term **"hazardous tree"** refers to trees with a high risk of toppling, dropping large limbs, deflecting bank flows, damaging drainage structures, or endangering property or users.

Riparian trees, such as box elder, cottonwood and willows, mature at 40 or 50 years, then develop disease problems and decline. Wood may be brittle, prone to breakage and decay, especially during storms. The species' survival strategy is to grow rapidly and propagate through dissemination of natural cuttings or trunk shoots. In contrast, upland oaks and sycamores tend to be slower growing and depend upon corns and seeds for multiplication.These trees must be managed for hazard reduction along stream corridors. This is important where they occur along public access ways, or might fall and block a culvert or bridge crossing. The tree should be assessed to determine if it is possible to lessen the hazard by removing damaged limbs, balancing weight distribution, or thinning the crown to lessen the "sail effect" of the canopy, or staking and cabling. Where valuable mature native trees are being undermined at the bank edge by erosion, then a bank stabilization treatment should be implemented.

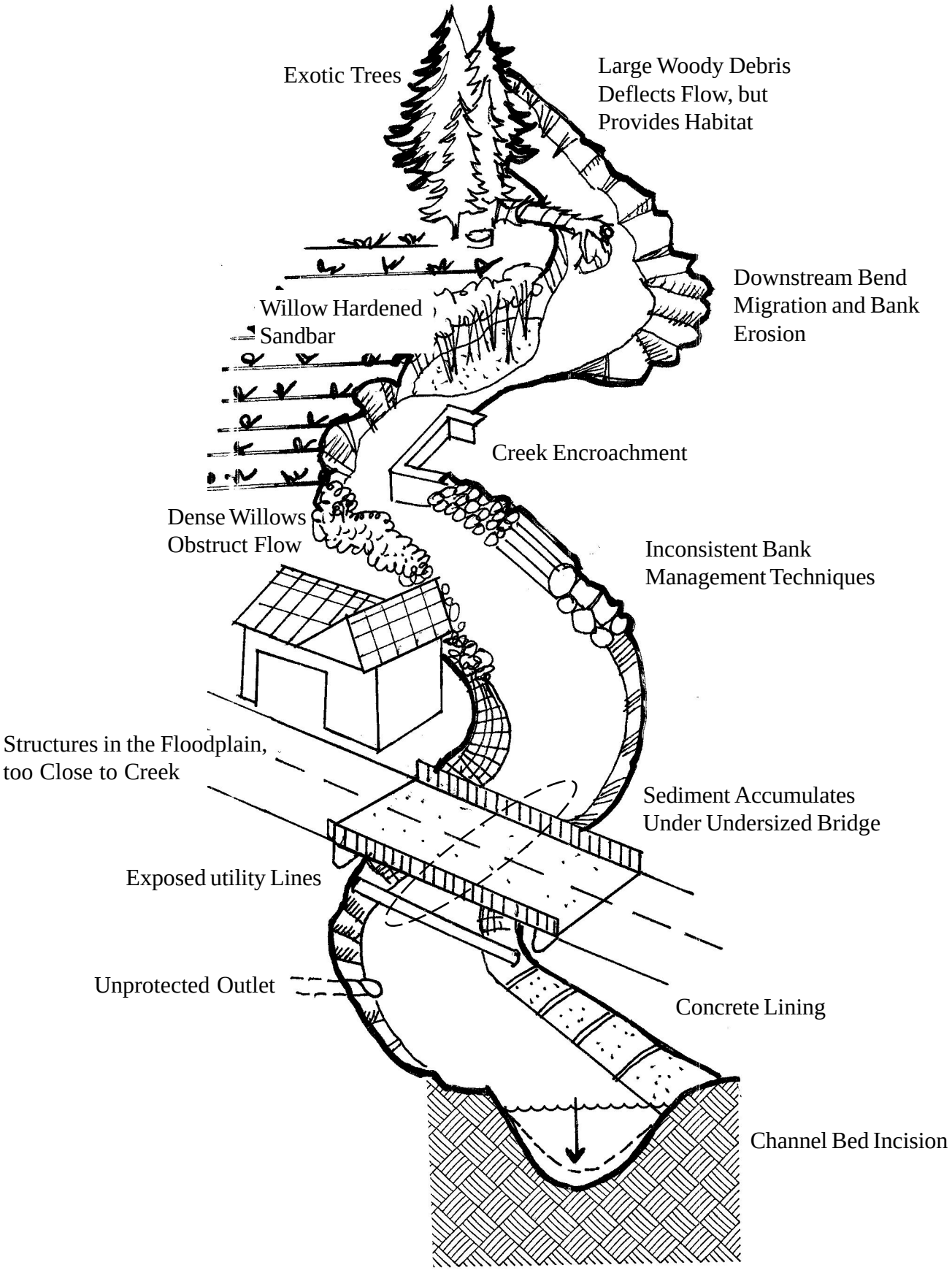
Dead or decayed trees can be important wildlife habitat, providing raptor perching sites, insects, and nesting hollows for birds and other animals. The objective for managing these trees should be to assess the risk related to flooding, bank erosion, property, and access path users.

Non-native trees common to the SLO area include Eucalyptus and Monterey Cypress, and can be shallow rooted. Removal may be desirable. An inspection should determine if the tree or limbs will fall into the watercourse where they may become obstructions, or if the downed tree can be anchored and cabled in place, and used as a root-wad.

For wildlife habitat, it is desirable to retain at least one large (greater than 10 inches dbh) snag per acre. As a rough guide, (assuming a 200 ft. corridor), one snag should be left for about every 200 lineal feet along the corridor. For a 100 to 150-foot right-of-way this would be about one snag for every 400 to 500 feet.

Determining the potential for tree hazards requires careful evaluation of the tree in question. Primary areas of concern include a review of the tree's existing structure, health, condition and location of the tree in relation to people, property and drainage structures.

# K Identifying Creek Problems



# L Sediment Management

## TYPICAL PERMIT CONDITIONS

• The applicant shall isolate the workspace from flowing water for the purpose of avoiding off-site sedimentation and turbidity, and of minimizing direct effects to steelhead. (NMFS)
• Implement effective sediment and turbidity control measures. (NMFS)
• Effective erosion control and sediment detention devices shall be used at the time of construction. These devices shall be in place during all construction activities, and after if necessary, for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and of detaining sediment-laden water on site. The devices shall be placed at all locations where the likelihood of sediment input exists. (NMFS)
• Placement of any soil/sediment berm for isolating any workspace from flowing water is prohibited. (NMFS)
• Erosion control and sediment detention devices will be used to minimize off-site sedimentation run-off and turbidity in the creek. (USFWS)
• A biologist will monitor construction activities, instream habitat improvements, functionality of sediment control/detention devices and revegetation/willow planting success. (USFWS)

## Equipment Access

A few carefully selected permanent stabilized access points are preferable to more frequent access across vegetated bank slopes. If crossings are needed, use temporary culverts or flexible cellular structures. This avoids damaging riparian vegetation down to bank. Equipment crossings shall be limited to one crossing every 500 feet.

Providing stream bottom access may reduce the need for banktop maintenance roads. Roads may be reused for public access trails or planted terraces. Consider habitat impacts, equipment needs, and dump truck loading considerations when selecting access points.

All heavy equipment working in wetlands must use mats or take other measures to minimize soil disturbance.

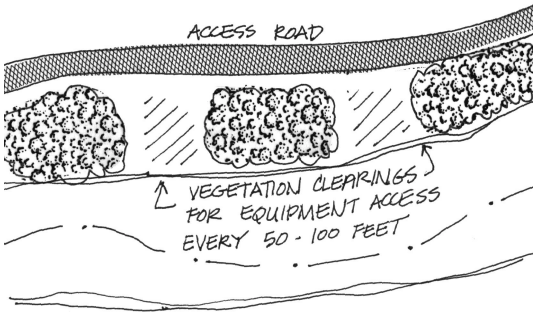
Installing instream sediment detention basins can trap sediment for periodic removal. The location should be based on channel hydraulics, biological factors and ease of access. Construction or operation of sediment basins must not destroy habitat for species such as California Red Legged Frog (CRLF).

If the stream channel must be dredged from bank top maintenance roads, work from only one side of the channel. Where maintenance roads are on both sides, consider removing the road on the side that will provide the most shade (south, west, northwest). If channel hydraulics allow, replant the bank slopes and bank top.

Where a continuous road is needed, plant in zones to provide selected access to the stream. Typically, 40 to 50-foot planting zones with 20-foot openings will allow sufficient excavation arm reach to the channel.

After sediment is removed, reinstall channel bed elements to diversify aquatic habitat. This includes stockpiling and replacing coarse cobbles, small stones, boulders and anchored logs.

For ephemeral streams, remove sediment by front-end loader via direct access to the stream bottom during dry periods, subject to CDFG approval.




**DESIGN CRITERIA FOR INSTREAM SEDIMENT DETENTION STRUCTURES IN LOW GRADIENT CHANNELS:**

1.Sediment trap bottom width should be twice the bottom width of the low-flow channel.

2.Sediment trap depth should be selected based on an estimate of the sediment input and the desired maintenance frequency (three to five years).

3.Sediment trap volume should be sufficient to provide sediment storage and to reduce velocities sufficiently to cause sedimentation. (Velocities should be cut to one-third and less than 2 fps.)

4.Where access and physical conditions constrain sediment trap designs, sediment removal should occur on a more frequent basis (annually) to minimize maintenance of biologically sensitive downstream channels with hydraulic constraints.

5. Hazardous materials shall be properly handled and water quality protected when removing sediments from the streams.

# M Aquatic and Fisheries Resources

## Shading

Stream side riparian vegetation not only provides critical terrestrial wildlife habitat and travel corridors for a wide variety of species, it also directly benefits aquatic habitat conditions. Stream side plants shade the creek or channel bottom, maintaining favorable water temperatures, while exposed roots and overhanging banks create hiding cover for fish and other aquatic organisms. Leaves and insects dropping from overhanging branches of trees and shrubs also provide an important food source.

For most streams, shading of about 50 percent or more of the streambed during the height of the afternoon summer sun is required to maintain cool stream temperatures.

More shading is required when velocity or depth is reduced. When selecting trees for removal to meet hydraulic capacity objectives, it may be more beneficial for water temperature management to retain large shade trees set well back from the channel on the east side of north-south flowing streams and on the south side of east-west flowing streams, than shrubby willow stream side specimens.

Where stream temperature is an important factor in management, consider using pruning techniques to create tree masses for shading, and phasing out undesirable exotic trees as planted natives mature.

Where fallen logs and debris are directing flow into a bank, creating logjams or trapping high amounts of sediment and pose a clear and imminent threat of flooding, removal should be considered. Consult with a CDFG biologist before removing any large woody debris.

## Natural Debris

Woody debris in the stream channel (such as fallen logs and stumps) provides an important source of cover, food and shelter for fish and other aquatic organisms. A moderate amount of woody debris can provide natural bank protection and "root wads," and when placed in combination with boulders can be used to stabilize banks.

Avoid removing natural woody debris from channels unless it poses a clear threat. Some root wads and woody debris may be secured in place to protect stable undercut banks.

Stable undercut banks (those maintained by roots or boulders) should remain. Use of larger boulders for rip-rap that have 4-12"gaps may provide cavities as escape cover that are not provided by sacked concrete or small rip-rap.

To manage the woody debris, first determine whether it can be realigned with a portable winch, thinned, shortened or strapped down by wedging with rocks, cables or driven rebar to lessen the hazard. If a directed flow problem exists, determine whether these actions, in combination with remedial bank support by willow stakes, rocks, erosion blankets, or other biotechnical bank protection methods can provide the necessary bank armoring.

## Gravels and Pools

Add gravels at end of construction to potential salmonid breeding reaches. Use gravels either from work site or off-site, at a size and depth appropriate to the species (5-75 mm in diameter). In supplementing spawning gravels, imported gravels must be of the appropriate size to be beneficial.

## Aquatic Species

If fish or native aquatic vertebrates are present, a fish and native aquatic vertebrate relocation plan will be implemented when cofferdams, water bypass structures, and silt barriers are installed to ensure that fish and native aquatic vertebrates are not stranded.

Potential impacts to steelhead will be avoided by timing stream maintenance projects in streams where there are, or could be, steelhead so that work is conducted outside of the migration and spawning season. Steelhead migration and spawning season is generally between December 15 to June 1.

Avoid work in reaches that contain deep pools. Maintain these pools as refuges by constructing temporary barriers so as to avoid pool destruction.

## TYPICAL PERMIT CONDITION

**If southwestern pond turtles, or two-striped garter snakes, or other special-status species are found after construction activities have begun, all construction shall cease, and the Operator shall contact the CDFG. The CDFG may amend the Agreement conditions if these two species are found. (CDFG)**

# N CRLF Protocols

## TYPICAL PERMIT CONDITIONS

- A Service-approved biologist will survey the work site two weeks before the onset of activities. If CRLF, tadpoles, or eggs are found, the approved biologist will contact the Service to determine if moving any of these life-stages is appropriate. In making this determination, the Service will consider if an appropriate relocation site exists. If the Service approves moving animals, the approved biologist will be allowed sufficient time fo move CRLF from the work site before work activities begin. Only Service-approved biologists will participate in activities associated with the capture, breeding, handling and monitoring of CRLF.

- Before any construction activities begin on a project, a Service Approved biologist will conduct a training session for all construction personnel. At a minimum, the training will include a description of CRLF and its habitat, the importance of CRLF and its habitat, general measures to conserve the CRLF and the boundaries within which the project may be accomplished. The training shall also include provisions of the Endangered Species Act, necessity for adhering to the ESA, and penalites for violations. Brochures, books and briefings may be used, provided that a qualified person is on hand to answer questions.

- The ACOE permit does not authorize the take of an endangered species, in particular the California red-legged frog. In order to legally take a listed species, you must have separate authorization under the ESA. (ACOE)

- A Service-approved biologist will be present at the work site until such time as all removal of CRLF, instruction of workers, and habitat disturbance have been completed. After this time, the contractor or permittee will designate a person to monitor on-site compliance with all minimization measures. The Service-approved biologist will ensure that this individual receives training in the identification of CRLF. The monitor and the Service-approved biologist will have the authority to halt any action that might result in impacts that exceed the levels anticipated by the ACOE and Service during review of the proposed action. If work is stopped, the ACOE and Service will be notified immediately by the Service-approved biologist or the on-site biological monitor. (USFWS)

- Only biologists authorized by the Service shall survey for and capture CRLF. (USFWS)

- Take of CRLF shall be reduced by following well defined procedures during surveys for, and capture and handling of individuals prior to and during project activities and during restoration activities. (USFWS)

- Worker education programs and well-defined operational procedures shall be implemented, with oversight by authorized biologists, to avoid or minimize the take of CRLF during project activities. (USFWS)

- All CRLF found during surveys shall be captured by the authorized biologist by using nets and bare hands. Authorized biologists handling CRLF shall not use soaps, oils, creams, lotions, repellants, or solvents of any sort on their hands before and during periods when they are capturing and translocation CRLF. (USFWS)

- The authorized biologist shall limit the duration of handling and captivity of CRLF to the minimum necessary to efficiently complete this task. While in captivity, CRLF shall be kept in a cool, moist environment, such as a bucket containing a damp sponge. (USFWS)

- CRLFs found during surveys shall be captured by the authorized biologist and translocated within 8 hours to appropriate habitat following contact with the USFWS to determine agreed upon release sites. However, the USFWS will cooperate with the authorized biologist in identifying potential release sites prior to project implementation. Release sites shall be within the same drainage but at least 150 feet from dewatering activities. If more than one CRLF is to be released at the same time, individuals shall be released at least 35 feet apart from each other in suitable habitat. (USFWS)

- If tadpoles of the CRLF are found in an area that will be affected by project activities, the USFWS will be contacted to determine the appropriate course of action. This may include moving tadpoles to nearby suitable habitat or holding them in captivity until project completion. (USFWS)

- Authorized biologists shall conduct a daily, visual survey of the entire length of access roads to a distance of 35 feet from the creek or any wetlands for CRLF prior to the start of any vehicle traffic. Authorized biologists shall also conduct a daily, visual survey of the length of the creek bed and any other CRLF habitat that is within the work are each morning before work begins. The surveys shall be conducted for five consecutive days. If no CRLF are found for five consecutive days, the surveys shall be conducted at least twice a week prior to the start of work. In CRLF are found at any time, or if rainfall is predicted or occurs, the daily surveys shall be reinitiated until CRLF are not found for five consecutive days. CRLF observed in these areas shall be translocated. (USFWS)

- Members of the work crew shall be designated to monitor all construction activities to ensure compliance with the terms and conditions of the permit. The designated monitors shall be trained by the authorized biologist to identify CRLF. The designated monitors shall immediately notify the authorized biologist if CRLF are discovered by members of the construction crew in the work area. The designated monitors are not authorized to capture or handle CRLF. The designated monitors shall have the authority to temporarily halt work activities that may injure or kill CRLF until they have been translocated by the authorized biologist. (USFWS)

- If CRLF are found after construction activities have begun, the Operator shall cease all construction activities and shall notify the USFWS and the CDFG immediately. The CDFG may amend permit conditions if CRLF are found, or other sensitive species are found. (CDFG)

# N Steelhead Protocols

## TYPICAL PERMIT CONDITIONS

- The ACOE permit does not authorize you to take an endangered species or designated critical habitat, in particular the steelhead trout. In order to legally take a listed species, you must have separate authorization under the Endangered Species Act (ESA). (ACOE)

- The applicant shall retain a biologist for the purpose of monitoring construction activities, instream habitat, and performance of sediment control/detention devices for the purpose of identifying and reconciling any condition that could adversely affect steelhead or their habitat. The biologist shall be empowered to halt work activity and to recommend measures for avoiding adverse effects to steelhead and their habitat. (NMFS)

- The applicant's biologist shall monitor dewatering of the channel for the purpose of capturing any steelhead that becomes stranded. Captured steelhead shall be relocated to a suitable instream area immediately upstream or downstream of the dewatered area. Only the following NMFS approved methods shall be used to capture steelhead: dip net, seine, trap, and hand. Electrofishing is prohibited from use. (NMFS)

- The applicant's biologist shall contact NMFS (Anthony Spina, 562-980-4045) immediately if one or more steelhead are found dead or injured. The purpose of the contact shall be to review the activities resulting in take and to determine if additional protective measures are required. (NMFS)

- Minimize the amount and extent of negative temporary and permanent changes to the quality and quantity of instream and riparian habitat. (NMFS)

- Improve habitat complexity in the action area. (NMFS)

- Employ a biologist for the purpose of monitoring the action area. (NMFS)

- The applicant shall minimize disturbance to riparian and upland vegetation. (NMFS)

- A Service-approved biologist will permanently remove, from within the project area, any individuals of exotic species, such as bullfrogs, crayfish, and centrarchid fishes, to the maximum extent possible. The permittee will have the responsibility to ensure that their activities are in compliance with the California Fish and Game Code. (USFWS)

- The Operator shall hire a biologist, with all necessary State and Federally permits, to rescue all fish/amphibians within the work site prior to dewatering. Rescued fish/amphibians shall be moved to the nearest appropriate site on the stream. A record shall be maintained of all fish, amphibians rescued and moved, and the record shall be provided to the CDFG (c/o 1600 Program, Post Office Box 47, Yountville, California 94599) with appropriate Streambed Alteration Agreement number. (CDFG)

# P Protecting Cultural Resources

Work in areas where remains or artifacts are found shall be restricted or stopped until proper protocols are met.

In the event that unexpected archeological traces are encountered, all construction within a one hundred and fifty foot radius shall be stopped, and an archeologist called in. This allows evaluation to determine if remains are important.

In the event of discovery or recognition of any human remains in any location other than a dedicated cemetery, there shall be no further excavation or disturbance of the site until the San Luis Obispo County Coroner has been informed and a determination has been made that no investigation of the cause of death is required.

## TYPICAL PERMIT CONDITION

If you discover any previously unknown historic or archaeological remains while accomplishing the activity authorized by this permit, you must immediately notify the ACOE of what you have found. The ACOE will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing the National Register of Historic Places. (ACOE)

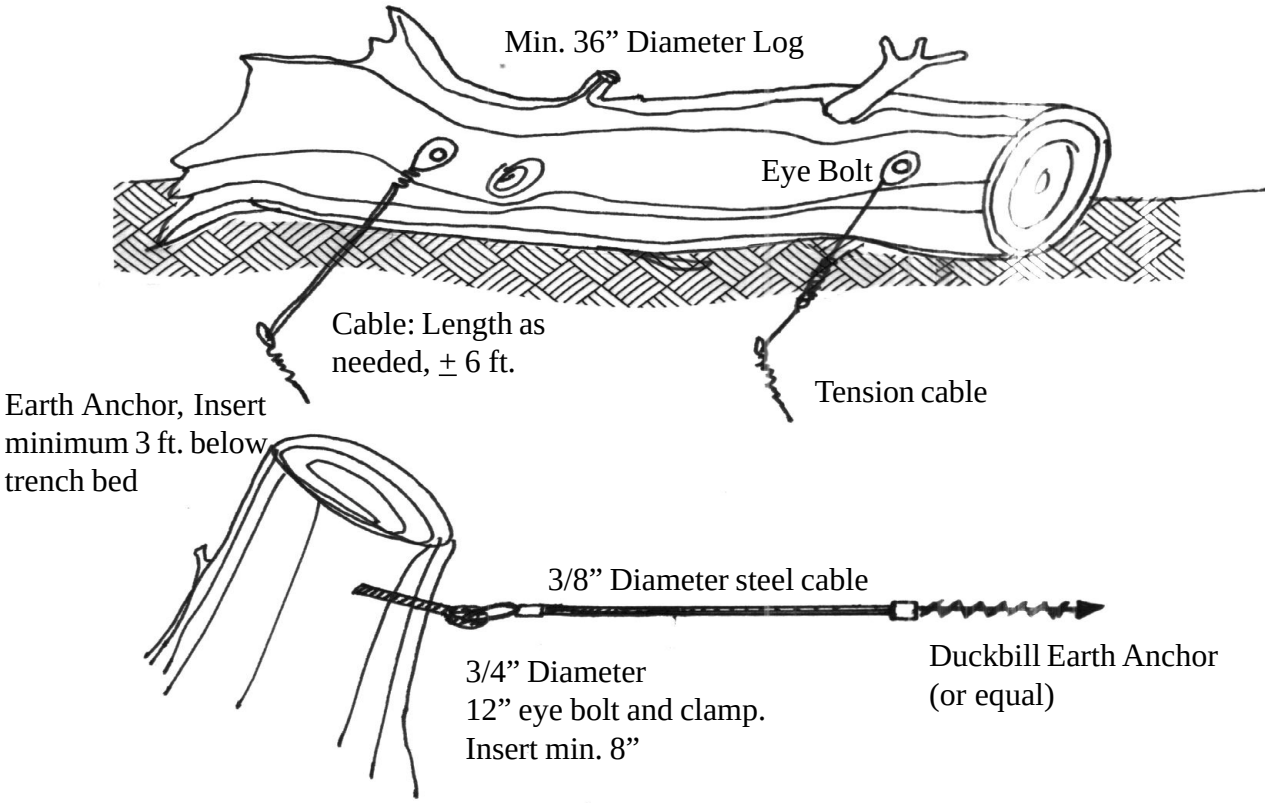
# Q Woody Debris

## ACTIVITIES:

**1. Only remove downed wood from creek when it is loose** and can be washed downstream or if it is an obstruction to flow or diverting flow into a bank. First, determine whether it can be realigned and stabilized. If the debris is wedged into roots of an existing tree, especially at a meander with a deep pool, leave it alone, or stake it by driving pipe anchors through it.

**2. Leave stumps in place** where possible. If root wad is still intact, the trunk can be buried into the creek bank. Overhanging and exposed roots can provide habitat and help stabilize bank.

**3. Move log in line with bank and cable in place**, where downed logs obstruct flows in creek.




**CABLED LOG**

# Protecting Sensitive Habitats

There are special niches within the riparian forest or channel, such as pools, seeps or wet spots, that provide habitat for wildlife. Openings in the riparian forest where grass-shrub mixes occur and the borders between habitat types are very important for wildlife. Edges between riparian forests and grasslands or riparian forests and urban landscaping are very common along stream corridors. These represent both special opportunities for management, and risks of conflicts between potentially incompatible uses. These special environments may also be more vulnerable to invasion from adjacent areas by aggressive weedy or exotic species that can take advantage of unusually wet or dry sites.

## TYPICAL PERMIT CONDITIONS:

- At least 15 days prior to the onset of activities, the applicant or project proponent will submit the name(s) and credentials of biologists who will conduct activities specified in the following measures. No project activities will begin until proponents have received written approval from the Service that the biologist(s) is qualified to conduct the work. (USFWS)

- To minimize the possibility of injuring CRLF and other wildlife, herbaceous and small shrubby vegetation within the project boundaries that would be disturbed by subsequent project activities shall be removed by hand prior to the use of heavy equipment or machinery. All trash shall be removed from the site daily to avoid attracting potential predators to the site. No pets shall be permitted to be at the site during construction. (CDFG)

- The ACOE shall develop a list of qualified biologists by submitting the credentials of biologists it wishes to participate in the capture, handling, relocation, and surveying to the USFWS for review and approval at least 15 days prior to the onset of any such activities. (USFWS)

## ACTIVITIES:

1. **Do not remove overhanging vegetation and emergent wetland vegetation** that colonizes depositional bars.
2. **Learn to identify native wetland plant species.**
3. **Do not remove cattails and tules at the edges of low flow channels** to stabilize the toe of an eroded bank.
4. **Leave a 5' vegetated buffer at the water's edge to protect the bank.**
5. **Allow low growing vegetation** in the channel to remain, unless invasive.
6. **Avoid pools** that support aquatic species.
7. **Work areas shall be fenced** to prevent access to sensitive areas.
8. **Work shall not be done during the breeding season** of special staus species.
9. **Workers shall be trained by a biologist** to avoid and minimize activities that might affect wildlife.
10. **No pets** shall be permitted at a work site.
11. **Do not use hazardous materials, store machinery or leave trash** in or near sensitive areas.

# S Protocols for Sensitive Habitat

-

***The following measures will be taken during the course of all creek maintenance work to minimize incidental take of species of special concern identified within a project site:***

***1) Worker education*** and well defined operational procedures should be implemented, with the cooperation of the biologist, to avoid and minimize the take of species of special concern during creek improvements.

***2) Clearly defined and fenced work areas*** shall be established to reduce incidental take of species of special concern, through injury, damage or death due to the straying of construction equipment and personnel.

***3) A qualified biologist shall visit each site***, conducting appropriate surveys (following CDFG/USFWS protocol) prior to construction activities, and will re-survey at least once a week throughout the work process.

***4) Avoid work during breeding season*** of Special Status Species.

***5) Clean up and immediately report*** all project-related spills of hazardous materials within or adjacent to project sites.

***6) The biologist shall be contacted immediately*** if any species of special concern are located in or near the work zone.

***7) No pets*** should be allowed on any project site.

***8) Work shall be consistent with protocols*** established by the USFWS, NMFS, CDFG or other regulatory agency for evaluating nesting migratory Bird occurrence within stream maintenance work areas that may affect the breeding or nesting period of migratory birds.

***9) A qualified biologist shall coordinate scheduling*** among State and Federal agencies, County and City engineers, regarding compliance with biological mitigation measures. The biologist shall walk maintenance sites that contain potential habitat to ensure that listed species and species of concern are not present on-site.

# T Construction Conditions

## TYPICAL PERMIT CONDITIONS

- An environmental monitor shall be retained to oversee construction and implementation of the mitigation plan to ensure compliance with this permit. The monitor shall have authority to halt work in the event of non-compliance with the provisions of the ACOE permit. (ACOE)

- The number of access routes, number and size of staging areas, and the total area of the activity shall be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated, and these areas will be outside of riparian and wetland areas. Where impacts occur in these staging areas and access routes, restoration will occur as identified in USFWS post construction measures. (USFWS)

- All invasive exotic plant species shall be removed from the project site. Any Vinca, cape or German ivy, castor bean, arundo, or other exotic plant species shall be bagged and appropriately disposed of in a landfill. Exotic species shall not be used in composting or left otherwise exposed in or around the project site. (CDFG)

- Heavy equipment and other machinery shall be inspected for the presence of undesirable species prior to on-site use and cleaned to reduce the risk of introducing exotic plant species into the project area. (CDFG)

- Project sites will be revegetated with an appropriate assemblage of native riparian wetland and upland vegetation suitable for the area. A species list and restoration and monitoring plan will be included with the project proposal for review and approval by the Service and the ACOE. Such a plan must include, but not be limited to, location of the restoration, species to be used, restoration techniques, time of year the work will be done, identifiable success criteria for completion, and remedial actions if the success criteria are not achieved. (USFWS)

- Stream contours will be returned to their original condition at the end of project activities, unless consultation with the Service has determined that it is not beneficial to the species or feasible. (USFWS)

# U Instream Hydraulic Structures

**ROCK RIP-RAP**

Most loose rock slope protection projects fail because of settlement or undermining. Even well designed and placed rip-rap requires maintenance about every ten years to reconstruct settlement and sediment accumulation problems. Common causes of failure are improper stone size or the lack of a well designed gravel or filter blanket. Where significant sediment has accumulated weed growth may be a problem requiring control.

Damage to the rock toe can be repaired by adding rock or replacing lost or displaced rock. Additional rock can be individually placed with specialized equipment. In high energy areas, large rock (D100) should be considered for replacement. If the filter layer has been damaged, or the grade significantly changed by slumping or settlement, the slope should be reconstructed with a new filter. Scour areas at the toe may also need to be filled with large rock.

**CONCRETE-LINED CHANNELS AND GROUTED ROCK**

Hard channel linings must be inspected periodically for undermining, settlement, cracking, chipping and plugging of weep holes. Undermining, settlement or hydrostatic failure may require removal, design analysis and reconstruction of an upgraded structure.

**SEDIMENT DETENTION BASINS**

In-channel sediment detention basins will require periodic clean-out, depending on the design basis. Typically, when channel hydraulics can be maintained, displacement of up to 50 percent of the capacity can be tolerated before clean out is required.

**LOOSE ROCK GRADE STABILIZATION STRUCTURES**

Properly designed and installed loose rock grade stabilization structures should require minimal maintenance. Inspect after major storm events. Check toe for piping, or scour, and loss of rock. Repair or replace failing structures immediately to arrest head cutting. Restack rock and chink voids with smaller stones. Consider lying down filter fabric at the extended toe, bury and weigh down new apron with rock. Drive in 3/4-inch rebar downstream of rock flush with rock surface to stabilize. Where rock appears undersized, consider importing larger rocks.

**ACCESS ROADS AND PATHWAYS**

Inspect roads and pull-out areas periodically for condition of surface, ditches, culverts and road cuts. Top dress with new gravel as needed. Check ditches for sediment accumulation and remove where conveyance is blocked. Clean out culverts and any drop inlets. Trim back cut-bank slumps and rills, apply erosion control netting, and seed and mulch where significant soil loss is occurring.

## Biotechnical Bank Stabilization Structures

***Wattles***

Regular inspection and maintenance of installed wattling should be conducted the first two years following construction, particularly after heavy flows. Loose, live stakes should be reset or replaced and any settled fill areas or accumulated sediment returned to grade by hand shovel work, where feasible.

***Wired Brush Matting***

Inspect existing matting. Tighten wire and replace broken wire and stakes where needed. If brush sprouting has failed, consider inserting live willow stakes into the brush.

***Erosion Control Netting***

Erosion control netting (jute or coir) have life expectancies ranging from two to seven years. They are typically used with other measures, such as hydroseeding, plug planting or live staking. Erosion control netting provides only limited support to combat mass wasting, and depending upon the blanket design and staking pattern, may fail by sagging or shearing at velocities ranging from 4 to 12 feet per second. Installed erosion control blankets should be inspected after the first storm event and each successive larger storm to determine if restaking or seam stapling is required.

# V Temporary Water Diversion

## TYPICAL PERMIT CONDITIONS

- Prior to the start of construction, the stream shall be diverted around or though the work area and the work area shall be isolated from the flowing stream using a pre-approved method. The stream diversion system shall be inspected daily and shall remain in place and functional throughout the construction period. If, for any reason, the stream diversion fails, they shall be repaired immediately. (CDFG)

- When dewatering the work area, either a pump shall remove water to an upland disposal site, or a filtering system shall be used to collect then return clear water to the creek for the purpose of avoiding input of sediment/water slurry to flowing water. The pump intake shall be fitted with fish exclusion netting or similar device that accomplishes the same purpose. An alternate dewatering scheme may preclude the use of a pump. (NMFS)

- If a work site is to be temporarily dewatered by pumping, intakes will be completely screened with wire mesh not larger than 5 millimeters (mm) to prevent CRLF from entering the pump system. Water will be released or pumped downstream at an appropriate rate to maintain downstream flows during construction. Upon completion of construction activities, any barriers to flow will be removed in a manner that would allow flow to resume with the least disturbance to the substrate.(USFWS)

- The workspace will be isolated from flowing water using a combination of sandbags, visqueen, and/or a culvert. (USFWS)

- The creek diversion will remain in place during the project and removed immediately after work is completed. (USFWS)

- During creek diversion, the ACOE will ensure maintenance of a corridor for unimpeded passage of steelhead during project construction. (USFWS)

- Dewatering devices will be fitted with netting to ensure exclusion of fish (USFWS).

- Ingress or egress points at the top of the creek banks will be used to avoid work and heavy equipment from entering flowing water and from disturbing instream and riparian habitat. (USFWS)

- If the site must be dewatered during construction, any muddy or otherwise contaminated water shall be pumped to a settling pond located outside the stream channel or to a stable upland site where the water can clear prior to re-entering the stream. (CDFG)

## Bypass Protocols:

***Bypass water*** around work areas so work can be done in dry conditions. Working in dry conditions prevents turbidity.

***Individually*** place barriers in the streambed to isolate water.

***Pumps must be screened*** (if used in water diversion) with an appropriate sized mesh (at maximum 0.25 inch), to prevent the entrance of sensitive species.

***Temporary barriers*** shall be established upstream and downstream of a project site to isolate the site. These include bladder dams, which can be used in streams that have up to 10 cubic feet per second (cfs).

***Sandbags must be hand placed and pre-filled.*** They can be used in flows that have up to 5 cfs. Stream bypass systems shall be part of each temporary barrier system, and consist of pipes or hoses that allow flows (and aquatic life) to continue around a maintenance site.

***Removal of temporary barriers*** should not cause flows to exceed more than 2 times the current flow in the construction area.

***Remove sandbags as soon as practicable.*** It is permissible to leave sand in areas where removal is impractical due to deterioration of the sandbag, or where access is no longer safe.

***Safely stockpile sediments*** at or near the removal site, outside the riparian zone, to dry before disposal. Saturated sediments set aside for drying shold be inspected for sensitive species before being moved again.

***Wet sediments shall be stockpiled away from the creek channel.*** No runoff from wet sediments shall flow back into the channel. Where possible, stockpile in areas so that they are not visible to adjacent landowners or to trail users.

***Dewater temporary stockpiles*** before transfer and disposal.

***Properly size bypass pipes,*** if used, to prevent increases in temperature and decreases in dissolved oxygen (DO). Larger diameter pipes pass the flows better. Bypass pipes may be avoided by creating a low-flow channel or using other methods to isolate work area.

***When bypassed flows are reintroduced*** to dewatered areas, they will be reintroduced in a non-erosive manner. For example, bypassed flows could be slowly reintroduced into the dewatered area by leaving a silt barrier in place to allow water to slow and drop sediment to the extent possible.

***Diversion and reintroduction of water*** shall be done at appropriate distances upstream and downstream of the work site to minimize habitat disruption.

***A relocation plan*** will be implemented to ensure that fish and native aquatic vertebrates are not stranded.

# Construction BMP's

## TYPICAL PERMIT CONDITIONS

- Prior to construction, heavy equipment and other machinery shall be inspected for the presence of undesirable species prior to on-site use and cleaned to reduce the risk of introducing exotic plant species into the project site. (CDFG)

- The project shall be completed with equipment positioned on the parking lot or by lowering equipment into the channel or positioning equipment on planks. No heavy equipment shall enter flowing water. (ACOE)

- Staging, storing, fueling/maintenance of equipment and materials shall be located outside the ACOE jurisdiction. (ACOE)

- No debris, soil, silt, sand, oil, or petroleum products, cement or concrete washings thereof, unless specifically authorized herein, shall be allowed to enter into or placed where it may be washed by rainfall or runoff into the creek. (ACOE)

- Avoid work in flowing water. Excavation of a channel for the purpose of isolating the workspace from flowing water is prohibited.(NMFS)

- Use existing ingress or egress points, or perform work from the top of the creek banks, for the purposes of avoiding work and heavy equipment in flowing water and disturbing instream and riparian habitat. Lowering heavy equipment into the channel (but not flowing water) and positioning equipment on planks is acceptable, however. (NMFS)

- All trash that may attract predators will be properly contained, removed from the work site, and disposed of regularly. Following construction, all trash and construction debris will be removed from the work areas. (USFWS)

- All fueling and maintenance of vehicles and other equipment and staging areas will occur at least 20 meters from any riparian habitat or water body. The ACOE and permittee will ensure that contamination of habitat does not occur during such operations. Prior to the onset of work, the ACOE will ensure that the permittee has prepared a plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur. (USFWS)

- Access to work area shall be via pre-existing access routes to the greatest extent possible. The boundaries of all roads shall be marked clearly. Vehicle traffic on these roads shall be limited to only those vehicles necessary to perform the proposed work. The areas of disturbance from all work activities shall be confined to the smallest practical area. (USFWS)

- Vehicles and all construction activities shall remain within well-defined construction areas and designated access roads. No vehicular traffic shall be allowed outside of these areas. (USFWS)

- No heavy equipment shall operate in the live stream. (USFWS)

- Staging/storage areas for equipment, materials, fuels, lubricants and solvents, shall be located outside of the stream's high water channel and associated riparian area. Stationary equipment such as motors, pumps, generators, compressors, and welders, located within the dry portion of the stream channel or adjacent to the stream shall be positioned over drip-pans. Vehicles and equipment shall be moved out of the normal high water area of the stream prior to refueling and lubricating. No litter or construction debris shall be deposited, or allowed to remain, in the riparian/stream zone. All such material shall be picked up daily. Spoil sites shall not be located within the stream channel, where spoil may be washed back into the stream, or where it will cover wetland or riparian vegetation. Building materials and construction equipment shall not be stored where materials could be washed into the water or where it will cover wetland or riparian habitat. (USFWS)

- Building materials and/or construction equipment shall not be stockpiled or stored where they could be washed into the water or where they will cover aquatic or riparian vegetation. (USFWS)

- 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 which could be hazardous to aquatic life, resulting from project related activities, shall 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, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately. (USFWS)

- During construction, the contractor shall not dump any litter or construction debris within the riparian/stream zone. All such debris and waste shall be picked up daily and properly disposed of at an appropriate site. (USFWS)

- Construction activities shall occur during the dry season when the channel is at low flow. Equipment shall not enter flowing water. Fueling or maintenance of equipment shall not occur within the channel. Water from equipment washing or concrete wash water shall not enter the channel. Stockpiled materials shall not enter the creek. Appropriate setbacks must be maintained. Water shall be diverted around work areas to prevent increased turbidity or contamination. (RWQCB)

***Work in Dry Conditions.*** Stream maintenance activities will occur in dry conditions. If flowing water is within the area, cofferdams, berms, or bypass systems will be used to isolate the area.

***Concrete.*** Concrete work shall occur in dry conditions to prevent uncured concrete from releasing hydroxides into water. Concrete can take up to 3 weeks to cure.

***Concrete Rubble Removal.*** Concrete rubble will be removed in association with erosion repair projects when the rubble is adjacent to a bank repair project.

***Hazardous Waste.*** The discharge of any hazardous or non-hazardous waste as defined in Division 2, Subdivision 1, Chapter 2 of the California Code of Regulations shall be conducted in accordance with applicable State and federal regulations.

***Construction Road Stabilization.*** Use erosion control measures such as 90% soil compaction and installation of geotextile mats on side slopes.

***Slow runoff in Construction Sites.*** Initial flows from the removal of temporary barriers shall not exceed more than 2 times the current flow in the construction area.

***Stabilize Stockpiles.*** Inactive areas shall be sprayed with soil stabilizer or hydroseeded. Stockpiles shall be watered, enclosed, covered, or sprayed with soil stabilizers. Traffic speeds shall be limited to 15 mph. Sandbags or other bank protections shall be installed to prevent silt runoff to roadways. Vegetation in disturbed areas shall be replanted as quickly as possible.

***Dust Control.*** The construction site shall be watered at least twice per day or as needed. All haul trucks carrying soil, sand, and other loose materials shall be covered or left with two feet of freeboard. All access roads, parking areas, staging areas at the construction site, and adjacent public streets shall be swept if visible material is carried onto them.

***Stabilized Construction Entrance.*** Provide point of access to project site as close to the area as possible. Use existing ramps where possible. Methods used to prevent mud from being tracked out of work sites onto roadways include installing a ground layer of geotextile mat, followed by 4" of 1" gravel.

***Erosion Control Measures.*** The following erosion control methods should be used during the construction phase:

- Silt Fences
- Straw Bale Barriers
- Brush or Rock Filters
- Storm Drain Inlet Protection
- Sediment Trap
- Sediment Basin

# X Spill Prevention and Containment

## TYPICAL PERMIT CONDITIONS

- Prior to the onset of work, the ACOE will ensure that the permittee has prepared a plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur. (USFWS)
- An emergency response plan shall be prepared and submitted to the CDFG prior to the start of construction. The plan shall identify the actions which will be taken in the event of spill of petroleum products, or other material which will be kept at the site to allow the rapid containment and clean-up of any spilled material. (CDFG)
- In the event dewatering is necessary in the workspace, dewatering shall be carried out consistent with the dewatering plan described in the program and approved by the ACOE. (ACOE)

***Chemicals.*** Prohibit the release of chemicals, fuels, lubricants, non-storm drainage water instream and outstream of the channel.

***Vehicle Maintenance.*** No fueling, repair or vehicle washing shall be performed in the creek channel or in areas at the top of the channel bank that may flow into the creek channel. Vehicles shall be washed only at the approved area in the corporation yard. No washing of vehicles will occur at the job sites. No fueling or equipment servicing will be done within 50 feet of the edge of the riparian zone.

***Sanitation.*** Temporary sanitary facilities shall be located on jobs that last multiple days.

***Training.*** All employees should receive annual environmental training by health and safety personnel. Contractors should receive training before any job is started, including protocols when toxic materials are discovered.

***Spill Kits.*** Field personnel will be appropriately trained in hazardous material control, and clean-up of accidental spills. Spill prevention and containment kits shall always be in close proximity when using hazardous materials (crew trucks). All field personnel will be trained in their appropriate use.

# Y Post Construction Management

## TYPICAL PERMIT CONDITIONS

- Immediately upon completion of the project, the permittee shall completely remove any planks used for access to the creek, as well as any and all sandbags, visqueen and culvert used to divert creek flow during construction.(ACOE)
- Within 20 days of completion of the project, the environmental monitor shall submit a report and color photographs taken of the project site before, during, and after construction to document compliance with the terms and conditions of the ACOE permit. (ACOE)
- Within 15 days of implementation of the mitigation task, the environmental monitor shall submit a report documenting compliance with the ACOE approved mitigation plan. (ACOE)
- Report to NMFS activities associated with minimizing and monitoring proposed action effects on steelhead and critical habitat. (NMFS)
- The applicant shall revegetate soil exposed as a result of the proposed action using seed casting, hydroseeding, or live planting methods no later than 15 days following the completion of the proposed action. Only native plant species shall be used. (NMFS)
- The applicant shall inspect the revegetated area during spring and fall to qualitatively assessing growth of the plantings or seedlings and the presence of exposed soil. The applicant shall note the presence of native and non-native vegetation and extent (percent area) of exposed soil and photograph the revegetated areas during each inspection. (NMFS)
- The applicant shall revegetate all soil exposed as a result of the proposed action using hydroseeding, seed casting, or live planting methods. Only native plant species shall be used. (NMFS)
- The applicant shall provide a written monitoring report to NMFS within 15 working days following completion of the proposed action. The report shall include the number of steelhead killed or injured during the proposed action and biological monitoring; the number of steelhead relocated; a description of the effectiveness of the sediment control measures; any effect of the proposed action on steelhead that was not previously; and photographs taken during and before and after work activity. (NMFS)
- The applicant shall provide a written report describing results of the revegetation and vegetation monitoring within 15 working days following completion of the overall revegetation task. The report shall include a description of the locations planted or seeded, the area ($ft^2$) revegetated, a plant palette, planting or seeding methods, proposed methods to monitor and maintain the revegetated area, performance or success criteria, and pre- and post-planting color photographs of the revegetated area. (NMFS)
- The ACOE will ensure that a monitoring report is submitted to NMFS, which assesses the success of the revegetation and willow planting activities. (USFWS)
- Soil exposed during the proposed action will be revegetated with native trees, shrubs, and herbaceous plant species. (USFWS)
- Upon completion of construction, the streambed shall be left smooth with no pot holes or depressions. Natural features will not be backfilled. Large woody debris or trees within the stream channel or on the lower bans of the stream shall not be removed. (CDFG)
- The Operator shall notify the CDFG at least 5 days prior to the completion of work. Notification may be made by phone to the Yountville office at (707) 944-5520. (CDFG)
- Seed and hydromulch exposed soil areas as soon as possible after completion of construction. (RWQCB)
- Commence permanent revegetation as soon as possible after completion of construction. (RWQCB)

# APPENDIX B

Annual Work Plan Worksheet

**Annual Work Plan Worksheet**

**(Attach Plans, Stream Inventory, Environmental Characteristics, Delineation, etc.)**

---

**Project Location:**

**Size of Work Area:**

**Dates of Work:**

**Environmental Review** (attach description of biology, hydrology and geomorphic conditions):

**Prior Approvals:**

---

**Level 1 Exempt Activity:**

- ☐ Trash removal, fence repair, or graffiti removal
- ☐ Access road maintenance and repair
- ☐ Repair of existing hydraulic structures, including revetments, with the same or environmentally superior materials
- ☐ Repair of existing bank stabilization
- ☐ Channel clearing not exceeding 500 lineal feet of stream bed
- ☐ Minor sediment removal, <1,000 cubic yards
- ☐ Tree pruning and limbing
- ☐ Ongoing maintenance of restoration site
- ☐ Upland Mowing and discing
- ☐ Upland herbicide application or rodent control
- ☐ Removal of hazardous/downed trees in stream
- ☐ Manual removal/herbicide treatment of exotics

---

**Work Description:**

**Repair and Replace Existing Structures:**

- ☐ In-channel boulder clusters
- ☐ Grade control structures
- ☐ Wing deflectors
- ☐ Gabion baskets
- ☐ Rock rip-rap
- ☐ Culvert outfall
- ☐ Reset erosion control blankets
- ☐ Reset fiber rolls
- ☐ Weeding exotics removal
- ☐ Replant with native species (list)
- ☐ Other hard revetment (describe)

---

**Sediment Removal (attach channel cross sections and HEC-GEORAS data)**

Volume: Removal Method:

---

**Excavate and Remove Large Channel Bars**.(over 1 m above the channel bed, and over 10 m long)

- ☐ Place toe berm
- ☐ Erosion blankets
- ☐ Planting (list species):

**In-Channel Vegetation Removal**

☐ Species to be removed: ☐ Thinning (spacing of trees): ☐ Limbing

**Biotechnical Bank Repair and Protection**

| | | | |
|---|---|---|---|
| ☐ | Erosion Blanket | ☐ | Toe berm |
| ☐ | Willow wattles or pole planting | ☐ | Rootwad |
| ☐ | Brush mattress | ☐ | Planted Rip Rap |
| ☐ | Vegetated geogrid | ☐ | Other (describe) |

**Restoration and Enhancement Components to be included (describe):**

☐ Revegetation

☐ Fish Habitat Enhancement

**Design Level of Service:** 5 yr 10yr 25yr 50 yr other:

# APPENDIX C

Annual Stream Inspection

# ANNUAL STREAM INSPECTION

Inspections should include photographic documentation during low water, following storm events, physical measurement, and jurisdictional delineation.

---

**LAND USE**

Upland Land Use:

Land Management:

- ☐ Saturated or ponded
- ☐ Upland/well-drained
- ☐ Upland/sloped
- ☐ Upland terrace
- ☐ Riparian vegetation

Soil Types:

Topography:

Describe sinuosity, width, bars, riffles, pools, boulders, logs:

---

**BASELINE DATA**

- ❒ Plan view
- ❒ Longitudinal profile
- ❒ Cross section

Stream Type:

- ❒ Perennial
- ❒ Intermittent
- ❒ Seasonal

Bank repose angle:

Depth bankfull:
Width:
Width/depth ratio:
Bed particle size distribution:

**EROSION**

- ❒ Exposed soil surfaces
- ❒ Cracks in slope surfaces
- ❒ Mass failures or sloughing
- ❒ Undermined vegetation
- ❒ Changes in channel bed elevation
- ❒ Debris, sandbars or other obstructions
- ❒ Horizontal displacement of rock toe
- ❒ Toe scour

**AQUATIC INVENTORY**

- ❒ Temperature
- ❒ Turbidity
- ❒ Dissolved oxygen
- ❒ PH
- ❒ Nutrients bed material load
- ❒ Alkalinity/Acidity
- ❒ Hardness
- ❒ Pool/riffle ratio
- ❒ Springs and groundwater seeps
- ❒ Dissolved and suspended solids
- ❒ Channel characteristics
- ❒ Toxics
- ❒ Woody debris
- ❒ Organic loading (BOD, TOC, etc.)
- ❒ Flow
- ❒ Spawning gravel
- ❒ Instream cover
- ❒ Shade

**RIPARIAN ASSESSMENT**

***Tress***
Species present:

Percent canopy cover, absolute and relative:
Basal diameter:
Stem density:
Crown height:
Vigor:
Exotics: species, percent cover, increase and control recommendations:

**SHRUBS**
Species present:

Percent cover, absolute and relative:
Frequency:
Vigor:
Exotics:  species, percent cover, increase and control recommendations:

---

**HERBACEOUS SPECIES**
Species present:

Percent cover:
Frequency:
Exotics:  species, percent cover, increase and control recommendations:

---

**HABITAT ASSESSMENT**

Birds:

Mammals:

Reptiles and Amphibians:

Fish Habitat:

Benthic Macroinvertebrates:

Cultural Resources:

# APPENDIX D

Plants Suitable for Riparian Restoration

# TABLE A: TREES FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| NAME | SIZE (FEET) | | LIFE EXP. | EST | D/E | FORM | TOLERANCE | | | | BANK LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Height | Spread | | | | | SUN | SHADE | DRY | INUN | |
| **California Buckeye** *Aesculus californica* | 5-40 | 30-80 | 20-100 yrs | A | D | S | X | X | X | | U |
| **Bigleaf Maple** *Acer macrophyllum* | 50-80 | 25-60 | >100 yrs | E | D | A | X | X | | | M |
| **California Box Elder** *Acer negundo* ssp. *californicum* | 30-60 | 15-30 | 20-100 yrs | E | D | W | X | X | | | M |
| **White Alder** *Alnus rhombifolia* | 50-80 | 30-40 | 20-100 yrs | E | D | W | X | X | X | | M |
| **Madrone** *Arbutus menziesii* | 30-60 | 15-30 | >100 yrs | D | E | S | | X | | | U |
| **California Black Walnut** *Juglans hindsii* | 30-60 | 20-40 | >100 yrs | E | D | S | X | | X | | U |
| **Fremont Cottonwood** *Populus fremontii* | 40-90 | 30-50 | 20-100 yrs | E | D | W | X | X | X | X | L |
| **Coast Live Oak** *Quercus agrifolia* | 20-70 | 60-70 | >100 yrs | E | E | S | X | X | X | | U |
| **California Black Oak** *Quercus kelloggii* | 30-80 | 20-50 | >100 yrs | A | D | S | X | X | X | | U |
| **Scrub Oak** *Quercus dumosa* | 3-10 | 4-12 | >100 yrs | A | E | S | X | | X | | U |
| **Valley Oak** *Quercus lobata* | 50-90 | 50-70 | >100 yrs | E | D | S | X | X | X | | U |
| **Red Tree Willow** *Salix laevigata* | 5-15 | 10-30 | 20-50 yrs | E | D | W | X | X | X | X | M |

# TABLE A: TREES FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| NAME | SIZE (FEET) | | LIFE EXP. | EST | D/E | FORM | TOLERANCE | | | | BANK LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Height | Spread | | | | | SUN | SHADE | DRY | INUN | |
| **Pacific Willow** *Salix lasiandra* | 30-60 | 15-30 | 20-50 yrs | E | D | W | X | X | | X | L |
| **Arroyo Willow** *Salix lasiolepis* | 6-30 | 6-20 | 20-50 yrs | E | D | W | X | X | | X | L |
| **Blue Elderberry** *Sambucus mexicana* | 8-18 | 8-18 | 20-50 yrs | A | D | A | X | X | X | | M |
| **California Bay** *Umbellularia californica* | 40-90 | 30-50 | >100 yrs | E | E | A | X | X | | X | M |

# TABLE B: WOODY SHRUBS FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| NAME | SIZE (FEET) | | LIFE EXP. | EST | D/E | FORM | TOLERANCE | | | | BANK LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Height | Spread | | | | | SUN | SHADE | DRY | INUN | |
| **Coyote Brush**<br>*Baccharis pilularis* var. *consanguinea* | 3-12 | 3-10 | <20 yrs | E | E | A | X | X | X | | U |
| **California Hazelnut**<br>*Corylus cornuta* var. *californica* | 5-12 | 5-12 | >50 yrs | D | D | A | X | | | | M |
| **Coast Silk Tassel**<br>*Garry elliptica* | 8-30 | 5-30 | >50 yrs | A | E | A | X | X | X | | U |
| **Toyon**<br>*Heteromeles arbutifolia* | 6-18 | 5-15 | 20-50 yrs | A | E | A | X | X | X | | U |
| **Oceanspray**<br>*Holodiscus discolor* | 5-8 | 5-8 | <20 yrs | E | D | A | X | X | X | | U |
| **California Rose**<br>*Rosa californica* | 3-10 | 3-10 | 20-50 yrs | E | D | A | X | | X | | M |
| **California Coffeeberry**<br>*Rhamnus californica* | 3-12 | 8-15 | 20-50 yrs | E | E | S | X | | X | | M |
| **Poison Oak**<br>*Rhus diversiloba* | 5-8 | 5-8 | 20-50 yrs | E | D | A | X | X | X | | M |
| **Fuchsia-Flowered Gooseberry**<br>*Ribes speciosum* | 1-5 | 5-12 | 20-50 yrs | E | D | A | X | X | X | | M |
| **California Blackberry**<br>*Rubus vitifolius* | 3-6 | 5-20+ | 20-50 yrs | E | D | A | X | X | X | X | L |
| **Common Snowberry**<br>*Symphoricarpos rivularis* | 2-6 | 3-5 | 20-50 yrs | E | D | A | X | X | | | M |

# TABLE C: PERENNIAL SUBSHRUBS AND VINES FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| NAME | SIZE (FEET) | | LIFE EXP. | EST | D/E | FORM | TOLERANCE | | | | BANK LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Height | Spread | | | | | SUN | SHADE | DRY | INUN | |
| **California Sagebrush** *Artemisia californica* | 3-4 | 3-5 | <20 yrs | E | E | W | X | X | | | U |
| **Mugwort** *Artemisia douglasiana* | 2-3 | 2-3 | <20 yrs | A | E | W | X | X | X | | M |
| **Bush Monkey Flower** *Diplacus aurantiacus* | 2-3 | 2-3 | <20 yrs | A | E | W | X | | X | | U |
| **Hairy Honeysuckle** *Lonicera hispidula* | 6-8 | 4-6 | 20-30 yrs | A | D | W | X | | X | | U |
| **Bee Balm** *Scrophularia californica* | 3-6 | 2-5 | <20 yrs | A | E | A | X | X | | | U |
| **Creeping Snowberry** *Symphoricarpos mollis* | 1-2 | 2-4 | 20-50 yrs | A | D | A | X | X | | | M |
| **California Fuchsia** *Zauschneria californica* | 1-2 | 1-4 | <20 yrs | A | E | W | X | | X | | U |

Possible Plants to add:

*Pickeringia montana*
*Prunus illicifolia*
*Prunus lyonii*
*P. virginians var. demissa*
*Phamnus crocea*
*Ribes aureum*
*Ribes sanguineum var glutinosum*
*Ribes viburnifolium*
*Salvia mellifera*
*Vaccinium ovatum*
*Cercis occidentalis*
*Crataegus douglasii*
*Arctostaphylos—*
*Atriplex lentiformus*
*Ceanothus thrysiflorus*
*Cercocarpus betuloides*
*Fremontodendron californica*
*Garrya fremontii*
*Myrica californica*
*Arctostaphylos edmundsii*
*Arctostaphylos uva-ursi*
*Baccharis pilularis*
*Eriogonum fasciculatum*
*Fragaria chiloensis*
*Clematis lasiantha*
*Apropyron trachycaulam*
*Aristida hamulosa*
*Deschampsia caespitosa*
*Festuca rubra*
*Mulenbergia rigens*
*Festuca megalura*

# TABLE D: GRASSES AND HERBS
# FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| NAME | SIZE (FEET) | | LIFE EXP. | EST | D/E | TOLERANCE | | | | BANK LOC |
|---|---|---|---|---|---|---|---|---|---|---|
| | Height | Spread | | | | SUN | SHADE | DRY | INUN | |
| California Brome<br>*Bromus carinatus* | 2-4 | | <20 yrs | E | E | X | | | | U |
| California Oat Grass<br>*Danthonia californica* | 1-3 | | <20 yrs | A | E | X | | X | | U |
| Blue Wildrye<br>*Elymus glaucus* | 2-4 | | <20 yrs | A | E | X | | X | | M |
| California Fescue<br>*Festuca californica* | 2-3 | 2-3 | <20 yrs | A | E | X | X | X | | U |
| Creeping Wild Rye<br>*Leymus triticoides* | 1-4 | 3-8 | <20 yrs | A | E | X | X | X | | M |
| Purple Needle Grass<br>*Stipa pulchra* | 1-2 | 1-2 | <20 yrs | A | E | X | | X | | U |
| Milkweed<br>*Asclepias fasicularis* | 1-3 | 1-2 | <20 yrs | A | E | X | | X | | M |
| Farewell to Spring<br>*Clarkia amoena* | 1-2 | 1-2 | <20yrs | A | E | X | X | | | U |
| California Poppy<br>*Eschscholzia californica* | 1-2 | 1-2 | <20yrs | A | E | X | | | | U |
| Dove Lupine<br>*Lupinus bicolor* | 1-2 | 1-2 | <20yrs | A | E | X | | | | U |
| Gilia<br>*Gilia capitata* | 1-2 | 1-2 | <20yrs | A | E | X | | | | U |

# TABLE D: GRASSES AND HERBS
# FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sneezeweed<br>*Helenium puberulum* | 2-3 | 1-2 | <20yrs | A | E | X | | X | | M |
| Meadow Barley<br>*Hordeum brachiantherum* | 1-2 | 1-2 | <20yrs | A | E | X | | X | X | L |
| Goldfields<br>*Lasthenia glabrata* | 1 | 1 | <20yrs | A | E | X | | | | U |
| Tidy Tips<br>*Layia platyglossa* | 1-2 | 1-2 | <20yrs | A | E | X | | | | U |
| Giant Wild Rye<br>*Leymus condensatus* | 1-4 | 1-4 | <20yrs | A | E | X | | | | U |
| Creeping Wild Rye<br>*Leymus triticoides* | 1-4 | 1-4 | <20yrs | A | E | X | | | | U |
| Dwarf Lupine<br>*Lupinus nanus* | 1 | 1 | <20yrs | A | E | X | | | | U |
| Succulent Lupine<br>*Lupinus succulentus* | 1-3 | 1-2 | <20yrs | A | E | X | | | | U |
| Baby Blue-Eye<br>*Nemophila menziesii* | 1 | 1 | <20yrs | A | E | X | | | | U |
| Butter and Eggs<br>*Orthocapus eriantus* | 1-2 | 1-2 | <20yrs | A | E | X | | | | U |
| Blue-Eyed Grass<br>*Sysyrinchium bellum* | 1 | 1 | <20yrs | A | E | X | | | | U |

# TABLE E: MARSH PLANTS FOR SAN LUIS OBISPO RIPARIAN RESTORATION

| NAME | SIZE (FEET) | | LIFE EXP. | EST | D/E | TOLERANCE | | | | BANK LOC |
|---|---|---|---|---|---|---|---|---|---|---|
| | Height | Spread | | | | SUN | SHADE | DRY | INUN | |
| Water Plaintain<br>*Alisma plantago-aquatica* | 1-4 | 1-4 | <20 yrs | E | E | X | | | X | L |
| Umbrella Sedge<br>*Cyperus eragrostis* | 1-3 | | <20 yrs | E | E | X | | | X | L |
| Needle Spike Rush<br>*Eleocharis acicularis* | 1 | | <20 yrs | E | E | X | | | X | L |
| Baltic Rush<br>*Juncus balticus* | 1-3 | | <20 yrs | E | E | X | | | X | L |
| Rush<br>*Juncus bolanderi* | 1-3 | | <20 yrs | E | E | X | | | X | L |
| Soft Rush<br>*Juncus effusus* | 2-3 | | <20 yrs | E | E | X | | | X | L |
| Monkey Flower<br>*Mimulus guttatus* | 1-2 | | <20 yrs | A | E | X | | | X | L |
| Plaintain<br>*Plantago subnuda* | 1 | 1-2 | <20 yrs | A | E | X | X | | X | L |
| Water Smartweed<br>*Polygonum punctatum* | 1-3 | 1-3 | <20 yrs | A | E | X | | | X | L |
| Common Tule<br>*Scirpus acutus* | 1-15 | 1 | <20 yrs | A | E | X | | | X | L |
| California Bulrush<br>*Scirpus californica* | 8-12 | | <20 yrs | A | E | X | | | X | L |
| Olney Bulrush<br>*Scirpus olneyi* | 1-7 | | <20 yrs | A | E | X | | | X | L |
| Alkali Bulrush<br>*Scirpus robustus* | 1-4 | | <20 yrs | A | E | X | | | X | L |

# APPENDIX E

Typical Permit Conditions

## Typical Permit Conditions

Typical permit conditions that have been required for creek work in the SLO Creek watershed are listed below. They are categorized as Pre- Construction, During Construction, and Post-Construction, by which agencies required them.

### I. Pre-Construction

#### *A. ACOE*

Condition 1:
Five days prior to initiation of construction, the permittee shall notify the ACOE in writing indicating the actual start and end dates of construction, and must provide written certification to the ACOE that the permittee, project foreman, contractors, and equipment operators have read the permit and will comply with all general and special conditions of the permit. The notification shall also provide the names of the environmental and biological monitor(s).

Condition 2:
Prior to initiation of construction, the permittee shall temporarily isolate the workspace utilizing a method pre-approved by the ACOE.

#### *B. NMFS*

Condition 1:
The applicant shall isolate the workspace from flowing water for the purpose of avoiding off-site sedimentation and turbidity, and of minimizing direct effects to steelhead.

Condition 2:
The applicant shall photograph the action area during and before and after construction activities are completed for the purpose of developing a reference library of instream and riparian habitat characteristics.

#### *C. USFWS*

Condition 1:
At least 15 days prior to the onset of activities, the applicant or project proponent will submit the name(s) and credentials of biologists who will conduct activities specified in the following measures. No project activities will begin until proponents have received written approval from the Service that the biologist(s) is qualified to conduct the work.

Condition 2:
A Service-approved biologist will survey the work site two weeks before the onset of activities. If CRLF, tadpoles, or eggs are found, the approved biologist will contact the Service to determine if moving any of these life-stages is appropriate. In making this determination, the Service will consider if an appropriate relocation site exists. If the Service approves moving animals, the approved biologist will be allowed sufficient time to move CRLF from the work site before work activities begin. Only Service-approved biologists will participate in activities associated with the capture, handling, and monitoring of CRLF.

Condition 3:
Before any construction activities begin on a project, a Service-approved biologist will conduct a training session for all construction personnel. At a minimum, the training session will include a description of the California red-legged frog (CRLF) and its habitat, the importance of the CRLF and its habitat, the general measures that are being implemented to conserve the CRLF as they relate to the project, and the boundaries within which the project may be accomplished. Brochures, books, and briefings may be used in the training session, provided that a qualified person is on hand to answer any questions.

Condition 4:
Prior to the onset of work, the ACOE will ensure that the permittee has prepared a plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

Condition 5:
The ACOE shall develop a list of qualified biologists by submitting the credentials of biologists it wishes to participate in the capture, handling, relocation, and surveying to the USFWS for review and approval at least 15 days prior to the onset of any such activities.

Condition 6:
An authorized biologist shall survey habitat 100 feet upstream and downstream of all dewatering and construction activities. Two daytime visual surveys shall be conducted on two different days from the banks or within the creek within one week prior to the onset of dewatering and construction activities. Nighttime surveys by spotlighting shall be conducted on two separate nights with the final night scheduled for the night before the initiation of dewatering activities. Vegetation that will be disturbed by subsequent construction may be removed by hand during these surveys to facilitate finding and capturing CRLF.

Condition 7:
The authorized biologist shall conduct a training session for all construction personnel prior to any work being conducted. At a minimum, the training shall include a description of CRLF and their habitat; the general provisions of the Endangered Species Act (ESA); the necessity for adhering to the provisions of the ESA; the penalties associated with violating the provisions of the ESA; the specific measures that are being implemented to conserve the CRLF as they relate to the project; and the boundaries of the project within which it must be accomplished.

***D. CDFG***

Condition 1:
A USFWS protocol-level, preconstruction survey shall be conducted to determine the presence of California red-legged frogs, southwestern pond turtles, and two-striped garter snakes. If CRLF are found, all construction shall cease and the operator shall consult with the CDFG and the USFWS, and the agreement will need to be amended and potential environmental review conducted before the project proceeds. If southwestern pond turtles or two-striped garter snakes are found, all construction shall cease, and the Operator shall contact the CDFG. The Agreement may need to be amended before the project proceeds.

Condition 2:
Prior to construction, a qualified biologist shall conduct training sessions to familiarize all construction personnel with identification of CRLF, and other sensitive species, their habitat, general provisions and protections afforded by the ESA, measures implemented to project the CRLF and a review of project boundaries.

Condition 3:
Preconstruction surveys shall be conducted by a qualified biologist to determine the presence of nesting birds in the riparian zone. If nests are found to be present, all construction shall be delayed until the qualified biologist determined that the young have fledged.

Condition 4:
Swallow nests are presumed to be active between February 15$^{th}$ and September 1$^{st}$. If construction begins prior to September 1$^{st}$, preconstruction surveys shall be conducted to determine the presence of swallows in the culvert. If nests are found to be present, exclusionary fencing shall be placed immediately upstream from the culvert to prevent access by equipment or construction workers.

Condition 5:

Prior to the start of construction, the stream shall be diverted around or though the work area and the work area shall be isolated from the flowing stream using a pre-approved method. The stream diversion system shall be inspected daily and shall remain in place and functional throughout the construction period. If, for any reason, the stream diversion fails, they shall be repaired immediately.

Condition 6:
An emergency response plan shall be prepared and submitted to the CDFG prior to the start of construction. The plan shall identify the actions which will be taken in the event of spill of petroleum products, or other material which will be kept at the site to allow the rapid containment and clean-up of any spilled material.

Condition 7:
Prior to construction, heavy equipment and other machinery shall be inspected for the presence of undesirable species prior to on-site use and cleaned to reduce the risk of introducing exotic plant species into the project site.

Condition 8:
The Operator shall notify the CDFG at least 5 days prior to project commencement. Notification may be made by phone to the Yountville office at (704) 944-5520.

## II. During Construction

### *A. ACOE*

Condition 1:
If you discover any previously unknown historic or archaeological remains while accomplishing the activity authorized by this permit, you must immediately notify the ACOE of what you have found. The ACOE will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing the National Register of Historic Places.

Condition 2:
The ACOE permit does not authorize you to take an endangered species or designated critical habitat, in particular the steelhead trout. In order to legally take a listed species, you must have separate authorization under the Endangered Species Act (ESA).

Condition 3:
The ACOE permit does not authorize you to take an endangered species, in particular the California red-legged frog. In order to legally take a listed species, you must have separate authorization under the ESA.

Condition 4:
The permittee shall retain an environmental monitor to oversee construction and implementation of the mitigation plan to ensure compliance with this permit. The monitor shall have authority to halt work in the event of non-compliance with the provisions of the ACOE permit.

Condition 5:
The project shall be completed with equipment positioned on existing paved areas or by lowering equipment into the channel or positioning equipment on planks. No heavy equipment shall enter flowing water.

Condition 6:
In the event dewatering is necessary in the workspace, dewatering shall be carried out consistent with the dewatering plan described in the program and approved by the ACOE.

Condition 7:

Staging, storing, fueling, and maintenance of equipment and materials shall be located outside the ACOE jurisdiction at all times.

Condition 8:
No debris, soil, silt, sand, oil, or petroleum products or washings thereof, cement or concrete washings thereof, unless specifically authorized herein, shall be allowed to enter into or placed where it may be washed by rainfall or runoff into the creek.

***B. NMFS***

Condition 1:
Avoid work in flowing water.

Condition 2:
Minimize the amount and extent of negative temporary and permanent changes to the quality and quantity of instream and riparian habitat.

Condition 3:
Improve habitat complexity in the action area.

Condition 4:
Employ a biologist for the purpose of monitoring the action area.

Condition 5:
Implement effective sediment and turbidity control measures.

Condition 6:
The applicant shall use existing ingress or egress points, or perform work from the top of the creek banks, for the purposes of avoiding work and heavy equipment in flowing water and disturbing instream and riparian habitat. Lowering heavy equipment into the channel (but not flowing water) and positioning equipment on planks is acceptable, however.

Condition 7:
Excavation of a channel for the purpose of isolating the workspace from flowing water is prohibited.

Condition 8:
The applicant shall minimize disturbance to riparian and upland vegetation.

Condition 9:
The applicant shall retain a biologist for the purpose of monitoring construction activities, instream habitat, and performance of sediment control/detention devices for the purpose of identifying and reconciling any condition that could adversely affect steelhead or their habitat. The biologist shall be empowered to halt work activity and to recommend measures for avoiding adverse effects to steelhead and their habitat.

Condition 10:
The applicant's biologist shall monitor dewatering of the channel for the purpose of capturing any steelhead that becomes stranded. Captured steelhead shall be relocated to a suitable instream area immediately upstream or downstream of the dewatered area. Only the following NMFS approved methods shall be used to capture steelhead: dip net, seine, trap, and hand. Electrofishing is prohibited from use.

Condition 11:
The applicant's biologist shall contact NMFS (Anthony Spina, 562-980-4045) immediately if one or more steelhead are found dead or injured. The purpose of the contact shall be to review the activities resulting in take and to determine if additional protective measures are required.

Condition 12:

Effective erosion control and sediment detention devices shall be used at the time of construction. These devices shall be in place during all construction activities, and after if necessary, for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and of detaining sediment-laden water on site. The devices shall be placed at all locations where the likelihood of sediment input exists.

Condition 13:
Placement of any soil/sediment berm for isolating any workspace from flowing water is prohibited.

Condition 14:
When dewatering the work area, either a pump shall remove water to an upland disposal site, or a filtering system shall be used to collect then return clear water to the creek for the purpose of avoiding input of sediment/water slurry to flowing water. The pump intake shall be fitted with fish exclusion netting or similar device that accomplishes the same purpose. An alternate dewatering scheme may preclude the use of a pump.

### *C. USFWS*

Condition 1:
A Service-approved biologist will be present at the work site until such time as all removal of CRLF, instruction of workers, and habitat disturbance have been completed. After this time, the contractor or permittee will designate a person to monitor on-site compliance with all minimization measures. The Service-approved biologist will ensure that this individual receives training in the identification of CRLF. The monitor and the Service-approved biologist will have the authority to halt any action that might result in impacts that exceed the levels anticipated by the ACOE and Service during review of the proposed action. If work is stopped, the ACOE and Service will be notified immediately by the Service-approved biologist or the on-site biological monitor.

Condition 2:
During project activities, all trash that may attract predators will be properly contained, removed from the work site, and disposed of regularly. Following construction, all trash and construction debris will be removed from the work areas.

Condition 3:
All fueling and maintenance of vehicles and other equipment and staging areas will occur at least 20 meters from any riparian habitat or water body. The ACOE and permittee will ensure that contamination of habitat does not occur during such operations. Prior to the onset of work, the ACOE will ensure that the permittee has prepared a plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

Condition 4:
A Service-approved biologist will ensure that the spread or introduction of invasive exotic plant species shall be avoided to the maximum extent possible. When practical, invasive exotic plants in the project areas will be removed.

Condition 5:
The number of access routes, number and size of staging areas, and the total area of the activity shall be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated, and these areas will be outside of riparian and wetland areas. Where impacts occur in these staging areas and access routes, restoration will occur as identified in USFWS post construction measures 1 and 2 below.

Condition 6:
To control erosion during and after project implementation, the applicant will implement best management practices, as identified by the appropriate Regional Water Quality Control Board.

Condition 7:
If a work site is to be temporarily dewatered by pumping, intakes will be completely screened with wire mesh not larger than 5 millimeters (mm) to prevent CRLF from entering the pump system. Water will be released or pumped downstream at an appropriate rate to maintain downstream flows during construction. Upon completion of construction activities, any barriers to flow will be removed in a manner that would allow flow to resume with the least disturbance to the substrate.

Condition 8:
A Service-approved biologist will permanently remove, from within the project area, any individuals of exotic species, such as bullfrogs, crayfish, and centrarchid fishes, to the maximum extent possible. The permittee will have the responsibility to ensure that their activities are in compliance with the California Fish and Game Code.

Condition 9:
The workspace will be isolated from flowing water using a combination of sandbags, visqueen, and/or a culvert.

Condition 10:
The creek diversion will remain in place during the project and removed immediately after work is completed.

Condition 11:
During creek diversion, the ACOE will ensure maintenance of a corridor for unimpeded passage of steelhead during project construction.

Condition 12:
Erosion control and sediment detention devices will be used to minimize off-site sedimentation run-off and turbidity in the creek.

Condition 13:
Dewatering devices will be fitted with netting to ensure exclusion of fish

Condition 14:
Ingress or egress points at the top of the creek banks will be used to avoid work and heavy equipment from entering flowing water and from disturbing instream and riparian habitat.

Condition 15:
A biologist will monitor construction activities, instream habitat improvements, functionality of sediment control/detention devices and revegetation/willow planting success.

Condition 16:
Only biologists authorized by the Service shall survey for and capture CRLF.

Condition 17:
Take of CRLF shall be reduced by following well defined procedures during surveys for, and capture and handling of individuals prior to and during project activities and during restoration activities.

Condition 18:
Worker education programs and well-defined operational procedures shall be implemented, with oversight by authorized biologists, to avoid or minimize the take of CRLF during project activities.

Condition 19:
All CRLF found during surveys shall be captured by the authorized biologist by using nets and bare hands. Authorized biologists handling CRLF shall not use soaps, oils, creams, lotions, repellants, or solvents of any sort on their hands before and during periods when they are capturing and translocation CRLF.

Condition 20:
The authorized biologist shall limit the duration of handling and captivity of CRLF to the minimum necessary to efficiently complete this task. While in captivity, CRLF shall be kept in a cool, moist environment, such as a bucket containing a damp sponge.

Condition 21:
CRLFs found during surveys shall be captured by the authorized biologist and translocated within 8 hours to appropriate habitat following contact with the USFWS to determine agreed upon release sites. However, the USFWS will cooperate with the authorized biologist in identifying potential release sites prior to project implementation. Release sites shall be within the same drainage but at least 150 feet from dewatering activities. If more than one CRLF is to be released at the same time, individuals shall be released at least 35 feet apart from each other in suitable habitat.

Condition 22:
If tadpoles of the CRLF are found in an area that will be affected by project activities, the USFWS will be contacted to determine the appropriate course of action. This may include moving tadpoles to nearby suitable habitat or holding them in captivity until project completion.

Condition 23:
Authorized biologists shall conduct a daily, visual survey of the entire length of access roads to a distance of 35 feet from the creek or any wetlands for CRLF prior to the start of any vehicle traffic. Authorized biologists shall also conduct a daily, visual survey of the length of the creek bed and any other CRLF habitat that is within the work is each morning before work begins. The surveys shall be conducted for five consecutive days. If no CRLF are found for five consecutive days, the surveys shall be conducted at least twice a week prior to the start of work. In CRLF are found at any time, or if rainfall is predicted or occurs, the daily surveys shall be reinitiated until CRLF are not found for five consecutive days. CRLF observed in these areas shall be translocated as described in 19, 20, and 21 above.

Condition 24:
Access to each work area shall be via pre-existing access routes to the greatest extent possible. The boundaries of all roads shall be marked clearly. Vehicle traffic on these roads shall be limited to only those vehicles necessary to perform the proposed work.

Condition 25:
The areas of disturbance from all work activities shall be confined to the smallest practical area.

Condition 26:
Vehicles and all construction activities shall remain within well-defined construction areas and designated access roads. No vehicular traffic shall be allowed outside of these areas.

Condition 27:
Members of the work crew shall be designated to monitor all construction activities to ensure compliance with the terms and conditions of the USFWS BO. The designated monitors shall be trained by the authorized biologist to identify CRLF. The designated monitors shall immediately notify the authorized biologist if CRLF are discovered by members of the construction crew in the work area. The designated monitors are not authorized to capture or handle CRLF. The designated monitors shall have the authority to temporarily halt work activities that may injure or kill CRLF until they have been translocated by the authorized biologist.

***D. CDFG***

Condition 1:
If CRLF are found after construction activities have begun, the Operator shall cease all construction activities and shall notify the USFWS and the CDFG immediately. The CDFG may amend the Agreement conditions if CRLF are found, or other sensitive species are found.

Condition 2:
If southwestern pond turtles, or two-striped garter snakes are found after construction activities have begun, all construction shall cease, and the Operator shall contact the CDFG. The CDFG may amend the Agreement conditions if these two species are found.

Condition 3:
During construction, a qualified biologist shall monitor construction activities including, but not limited to, installation and removal of diversion structures and sediment/erosion control devices.

Condition 4:
To minimize the possibility of injuring CRLF and other wildlife, herbaceous and small shrubby vegetation within the project boundaries that would be disturbed by subsequent project activities shall be removed by hand prior to the use of heavy equipment or machinery. All trash shall be removed from the site daily to avoid attracting potential predators to the site. No pets shall be permitted to be at the site during construction.

Condition 5:
The Operator shall hire a biologist, with all necessary State and Federally permits, to rescue all fish/amphibians within the work site prior to dewatering. Rescued fish/amphibians shall be moved to the nearest appropriate site on the stream. A record shall be maintained of all fish, amphibians rescued and moved, and the record shall be provided to the CDFG (c/o 1600 Program, Post Office Box 47, Yountville, California 94599) with appropriate Streambed Alteration Agreement number.

Condition 6:
No heavy equipment shall operate in the live stream.

Condition 7:
Staging/storage areas for equipment, materials, fuels, lubricants and solvents, shall be located outside of the stream's high water channel and associated riparian area. Stationary equipment such as motors, pumps, generators, compressors, and welders, located within the dry portion of the stream channel or adjacent to the stream shall be positioned over drip-pans. Vehicles and equipment shall be moved out of the normal high water area of the stream prior to refueling and lubricating. No litter or construction debris shall be deposited, or allowed to remain, in the riparian/stream zone. All such material shall be picked up daily. Spoil sites shall not be located within the stream channel, where spoil may be washed back into the stream, or where it will cover wetland or riparian vegetation. Building materials and construction equipment shall not be stored where materials could be washed into the water or where it will cover wetland or riparian habitat.

Condition 8:
If the site must be dewatered during construction, any muddy or otherwise contaminated water shall be pumped to a settling pond located outside the stream channel or to a stable upland site where the water can clear prior to re-entering the stream.

Condition 9:
All invasive exotic plant species shall be removed from the project site. Any Vinca, cape or German ivy, castor bean, arundo, or other exotic plant species shall be bagged and appropriately disposed of in a landfill. Exotic species shall not be used in composting or left otherwise exposed in or around the project site.

Condition 10:
Heavy equipment and other machinery shall be inspected for the presence of undesirable species prior to on-site use and cleaned to reduce the risk of introducing exotic plant species into the project area.

Condition 11:
All work shall be done according to the plans submitted to the CDFG with the project notification.

Condition 12:
Building materials and/or construction equipment shall not be stockpiled or stored where they could be washed into the water or where they will cover aquatic or riparian vegetation.

Condition 13:
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 which could be hazardous to aquatic life, resulting from project related activities, shall 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, by Operator or any party working under contract, or with the permission of the Operator, shall be removed immediately.

Condition 14:
During construction, the contractor shall not dump any litter or construction debris within the riparian/stream zone. All such debris and waste shall be picked up daily and properly disposed of at an appropriate site.

### *E. RWQCB*

Condition 1:
The Avoidance/Mitigation Measures included in the Supplemental Permit Information Package shall be implemented as stated.

Condition 2:
Construction activities shall occur during the dry season when the channel is at low flow.

Condition 3:
Equipment shall not enter flowing water.

Condition 4:
Fueling or maintenance of equipment shall not occur within the channel.

Condition 5:
Water from equipment washing or concrete wash water shall not enter the channel.

Condition 6:
Stockpiled materials shall not enter the creek. Appropriate setbacks must be maintained.

Condition 7:
Water shall be diverted around work areas to prevent increased turbidity or contamination.

## III. Post Construction

### *A. ACOE*

Condition 1:
Immediately upon completion of the project, the permittee shall completely remove any planks used for access to the creek, as well as any and all sandbags, visqueen and culvert used to divert creek flow during construction.

Condition 2:
Within 20 days of completion of the project, the environmental monitor shall submit a report and color photographs taken of the project site before, during, and after construction to document compliance with the terms and conditions of the ACOE permit.

Condition 3:
Within 15 days of implementation of the mitigation task, the environmental monitor shall submit a report documenting compliance with the ACOE approved mitigation plan.

***B. NMFS***

Condition 1:
Report to NMFS activities associated with minimizing and monitoring proposed action effects on steelhead and critical habitat.

Condition 2:
The applicant shall revegetate soil exposed as a result of the proposed action using seed casting, hydroseeding, or live planting methods no later than 15 days following the completion of the proposed action. Only native plant species shall be used.

Condition 3:
The applicant shall inspect the revegetated area during spring and fall for the purpose of qualitatively assessing growth of the plantings or seedlings and the presence of exposed soil. The applicant shall note the presence of native and non-native vegetation and extent (percent area) of exposed soil and photograph the revegetated areas during each inspection.

Condition 4:
The applicant shall revegetate all soil exposed as a result of the proposed action using hydroseeding, seed casting, or live planting methods. Only native plant species shall be used.

Condition 5:
The applicant shall provide a written monitoring report to NMFS (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) within 15 working days following completion of the proposed action. The report shall include the number of steelhead killed or injured during the proposed action and biological monitoring; the number of steelhead relocated; a description of the effectiveness of the sediment control measures; any effect of the proposed action on steelhead that was not previously considered; and photographs taken during and before and after work activity.

Condition 6:
The applicant shall provide a written report describing results of the revegetation (including planting willow cuttings) task to NMFS (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) within 15 working days following completion of the overall revegetation task. The report shall include a description of the locations planted or seeded, the area ($ft^2$) revegetated, a plant palette, planting or seeding methods, proposed methods to monitor and maintain the revegetated area, performance or success criteria, and pre- and post-planting color photographs of the revegetated area.

Condition 7:
The applicant shall provide a written report describing the results of the vegetation monitoring to NMFS (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) within 15 working days following completion of the fall site inspection. The report shall include the color photographs taken of the action areas during each inspection and before and after implementation of the project, and estimated percent of exposed soil remaining within the area affected.

***C. USFWS***

Condition 1:
Project sites will be revegetated with an appropriate assemblage of native riparian wetland and upland vegetation suitable for the area. A species list and restoration and monitoring plan will be included with the project proposal for review and approval by the Service and the ACOE. Such a plan must include, but not be limited to, location of the restoration, species to be used, restoration techniques, time of year the work

will be done, identifiable success criteria for completion, and remedial actions if the success criteria are not achieved.

Condition 2:
Stream contours will be returned to their original condition at the end of project activities, unless consultation with the Service has determined that it is not beneficial to the species or feasible.

Condition 3:
The ACOE will ensure that a monitoring report is submitted to NMFS, which assesses the success of the revegetation and willow planting activities.

Condition 4:
Soil exposed during the proposed action will be revegetated with native trees, shrubs, and herbaceous plant species.

***D. CDFG***

Condition 1:
Upon completion of construction, the streambed shall be left smooth with no pot holes or depressions. Natural features will not be backfilled. Large woody debris or trees within the stream channel or on the lower bans of the stream shall not be removed.

Condition 2:
The Operator shall notify the CDFG at least 5 days prior to the completion of work. Notification may be made by phone to the Yountville office at (707) 944-5520.

***E. RWQCB***

Condition 1:
Seed and hydromulch exposed soil areas as soon as possible after completion of construction.

Condition 2:
Commence permanent revegetation as soon as possible after completion of construction.