Sonoma County Water Agency Stream Maintenance Program

Program Manual

February 2020

Stream Maintenance Program
Program Manual

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February 2020

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Horizon Water and Environment. 2020. *Stream Maintenance Program Manual*. February. (HWE 16.023.) Oakland, CA.

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LIST OF ACRONYMS

°C	degrees Celsius
°F	degrees Fahrenheit
0.1	CRPR Seriously Threatened in California
0.2	CRPR Moderately Threatened in California
1B	CRPR Rare, Threatened, or Endangered in California and Elsewhere
2B	CRPR Rare, Threatened, or Endangered in California, but more Common Elsewhere
A	
ADRP	archaeological data recovery program
ARM	Agreement for Routine Maintenance
ASC	Anthropological Studies Center
ASR	Archaeological Survey Report
B	
BA	Biological Assessment
BAAQMD	Bay Area Air Quality Management District
Basin Plans	water quality control plans
BMP	Best Management Practice
BO	Biological Opinion
C	
CAL FIRE	California Department of Forestry and Fire Protection
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CDOD	California Division of Safety of Dams
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CIP	capital improvement projects
CMP	corrugated metal pipe
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRLF	California red-legged frog
CRPR	California Rare Plant Rank
CSC	California Species of Special Concern
CSWP	Central Sonoma Watershed Project
CTS	California tiger salamander
CWA	Clean Water Act

D

DPR	California Department of Pesticide Regulation
DSOD	California Division of Safety of Dams
DTSC	California Department of Toxic Substances Control

E

EFH	Essential Fish Habitat
EIR	Environmental Impact Report
ESA	Endangered Species Act
ESL	environmental screening level

F

F&G Code	California Fish and Game Code
FCDC	Flood Control Design Criteria
FD	federally delisted
FE	federally endangered
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMP	Fishery management plans
FT	federally threatened
ft.	feet

G

GIS	geographic information system

H

H	historic occurrence; recent occurrence not confirmed

I

IAWG	Inter Agency Working Group
IPM	Integrated Pest Management
ITP	Incidental Take Permit

K

K(f)	Soil Erodibility Factor

L

LIDAR	light detection and ranging
LOS	Level-of-Servcie
LWD	large woody debris

M

M	migration corridor (fish only)
Marg	martinal habitat
MBTA	Migratory Bird Treaty Act
MCRRFCD	Mendocino County Russian River Flood Control and Water Conservation Improvement District

MRP	Monitoring and Reporting Program
MSAA	Master Streambed Alteration Agreement
MSL	mean sea level
N	
NAHC	Native American Heritage Commission
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NGO	Non-government organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWIC	Northwest Information Center
O	
O	known occurrence in reach
OHWM	Ordinary High Water Mark
P	
P	potential habitat
PAH	polycyclic aromatic hydrocarbons
Porter-Cologne Act	California Porter-Cologne Water Quality Control Act
PPE	personal protective equipment
PRMD	Permit and Resource Management Department
Program	Stream Maintenance Program
PS	public safety
PSN	Project Specific Notification
PWA	Philip Williams and Associates
R	Known or potential rearing habitat (fish only)
RCD	Resource Conservation District
RGL	Regulatory Guidance Letter
RPM	Reasonable and Prudent Measures
RUSLE	Revised Universal Soil Loss Equation
RWQCB	Regional Water Quality Control Board
S	
S	Known or potential spawning habitat (fish only)
SAA	Streambed Alteration Agreement
SC	Federal Species of Concern
SE	state endangered
SEFI	San Francisco Estuary Institute
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board

SHPO	State Historic Preservation Officer
SMP	Stream Maintenance Program
SN	Survey needed (habitat conditions not recently documented)
Sonoma Water	Sonoma County Water Agency
sq. mi.	square miles
SRPCS	Santa Rosa Plain Conservation Strategy
SSURGO	Soil Survey Geographic Database
ST	State Listed State Threatened
STC	State Listed as Candidate Species
STLC	Soluble Threshold Limit Concentration
SWMP	Storm Water Management Plan
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
T	
TMDL	Total Maximum Daily Load
TOB	top-of-bank
TTLC	Total Threshold Limit Concentration
U	
U	Unsuitable habitat, unlikely to occur and/or no known occurrence
UFM	urban forestry management
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
V	
VM	vegetation management
W	
WDR	waste discharge requirements
WPP	Watershed Partnerships Program

Chapter 1
INTRODUCTION AND PROGRAM SUMMARY

1.1 Program Background

The Sonoma County Water Agency (Sonoma Water) was created as a special district in 1949 by the California Legislature to provide flood protection and water supply services to portions of Sonoma and Marin counties. Legislation enacted in 1995 added the treatment and disposal of wastewater to Sonoma Water's responsibilities. Today, Sonoma Water is a multi-objective and integrated water resources agency providing many services that integrate natural resource management including providing water supply, flood protection services, treatment of wastewater and distribution of recycled water, and recreational opportunities. Sonoma Water's mission and vision statements are as follows:

Sonoma Water Mission Statement:

> The mission of the Sonoma County Water Agency is to effectively manage the water resources in our care for the benefit of people and the environment through resource and environmental stewardship, technical innovation, and responsible fiscal management (2018).

Sonoma Water Vision Statement:

> The Sonoma County Water Agency is a regional leader in water resources management. The Water Agency strives to look forward, beyond today's issues, to anticipate ways to advance its mission. Additionally, the Water Agency continues to adapt its mission in response to changing opportunities, keeping the Water Agency at the forefront of developments in the water industry (2018).

The Stream Maintenance Program (SMP or Program) was developed by Sonoma Water in 2006-2009 to improve and define the management and maintenance of flood control channels and streams under Sonoma Water's authority. The initial version of this SMP Manual (2009) was developed with significant input from stakeholders and regulatory staff during 2006-2009. This 2019 version of the SMP Manual reflects many developments and updates in the program as it has evolved over the previous 10 years. This 2019 version of the SMP Manual also reflects updates in Program permits.

The SMP established programmatic guidance to conduct maintenance activities and avoid and minimize environmental impacts. The SMP also created an organizational framework to oversee routine channel maintenance activities and ensure the program is compliant with the terms and conditions of its permits. The SMP was developed to be consistent with Sonoma Water's mission and vision statements.

As background, Sonoma Water has operated and maintained engineered, modified, or natural channels for several decades. Many of the engineered channels included in this SMP Manual were initially constructed as a result of the Central Sonoma Watershed Project (CSWP) Work Plan (Sonoma County 1958) in the Laguna de Santa Rosa watershed. The 1958 CSWP Work Plan described facility and channel maintenance as follows:

The Flood Control District[1] will assume full responsibility for operating and maintaining all structural works of improvement installed under this plan in such a manner that they will serve the purpose for which they were installed, to the degree for which they were designed (Sonoma County 1958).

The original Work Plan did not provide detailed guidance on how routine maintenance should occur for the CSWP. However, the Work Plan did require that all works were to be inspected twice annually and after each major flood event. Spring, fall, and other interim inspections were to occur as needed to determine required maintenance activities prior to the coming rainy season. Since the CSWP program, several other channels and facilities have been constructed within the Laguna de Santa Rosa, Petaluma River and Sonoma Creek watersheds. Since the original channel design capacities for the CSWP and other programs typically assumed that the stream banks would be maintained in grass vegetation with little or no tree growth and that the streambed would be maintained clear of vegetation and sediment.

Over the years, Sonoma Water's stream management perspective expanded to include multiple objectives including resource protection and environmental sustainability in addition to just flood control and channel maintenance. Sonoma Water also received requests from the public to incorporate more environmentally conscious management principles, such as wildlife habitat enhancement, into stream maintenance activities. Additionally, local, state, and federal regulations and their requirements have changed over time. Compliance with federal environmental laws and regulations such as the federal Endangered Species Act (ESA) and Clean Water Act (CWA), and state laws and regulations administered by the California Department of Fish and Wildlife (CDFW) and Regional Water Quality Control Boards (Regional Boards or RWQCBs) has required an increasingly extensive authorization process.

Prior to the SMP, each individual maintenance project underwent separate permit approval. This typically involved submitting between 5-15 individual permit applications to various regulatory agencies per year. The time, effort, and costs of the annual permitting process were key factors in developing the SMP. The annual permitting process required a 10 to 18 month planning and application process for a work period that typically lasted only 3 to 4 months. The costs of annual permitting often exceeded the costs of the maintenance work itself. Similarly, the work effort and time commitment for the regulatory agencies had also become heavy. By the early 2000s, the annual permitting process for routine and repeating maintenance activities had become inefficient for Sonoma Water and the regulatory agencies. The RWQCBs specifically requested that Sonoma Water develop a long-term plan to streamline and shorten this annual permitting process.

The SMP was developed to implement maintenance activities according to consistent standards, avoid and minimize program impacts, inform maintenance decision making using resource

Flood Control District was a predecessor agency to today's Sonoma Water.

information, consider SMP activities within a watershed context, develop suitable mitigation, and provide long-term oversight.

1.2 Program Purpose and Objectives

The primary purpose of the SMP is to provide an efficient and organized program to conduct stream maintenance activities, comply with all relevant environmental regulations, and maintain flood capacity while enhancing the program area's natural resources. The SMP was developed to balance the goals of flood protection, permit compliance, and protecting and enhancing natural resources.

SMP objectives include:

- Provide adequate flood protection and channel conveyance capacity for channels under Sonoma Water authority;
- Use a systemic and scientific understanding of the watershed and individual stream reaches to guide maintenance activities;
- Use the scientific understanding of the stream system to develop informed maintenance approaches that avoid and/or minimize environmental impacts;
- Improve communication, coordination, and permitting efficiency between regulatory agencies and Sonoma Water through an open and collaborative program notification and reporting process;
- Develop an adaptable and sustainable program that can respond to changing environmental, maintenance, and regulatory conditions;
- Provide an administratively stable program that provides consistency in oversight and implementation of program activities;
- Obtain long-term permits providing coverage of program activities under Federal and State regulations such as ESA and CWA; and
- Comply with the California Environmental Quality Act (CEQA) and National Environmental Protection Act (NEPA) requirements.

The purpose of this SMP Manual is to establish and define the overall maintenance program and describe the program's maintenance activities, natural resources, and approaches to avoid or minimize impacts to environmental resources. This SMP Manual is intended for use by Sonoma Water maintenance staff, engineers, and resource managers, as well as environmental regulatory agency staff and other watershed stakeholders.

This SMP Manual provides a description of the activities that conducted as part of the SMP. As such, this manual serves as the description of activities permitted by the relevant regulatory agencies. The evaluation of the SMP's environmental impacts are described in the Program's Environmental Impact Report (EIR) developed in compliance with CEQA. The SMP EIR uses the description of program activities in this manual as the basis for its evaluation. The SMP EIR can be found at: www.scwa.ca.gov/environmental-documents/

The SMP is envisioned to be a flexible program subject to periodic revisions reflecting improved understanding of resource conditions, maintenance technologies, or management practices over time. In developing the program and supporting the technical needs of this SMP Manual, the SMP EIR, and the programmatic permits, several additional technical studies and coordinating activities were conducted, including:

- Inventorying and assessing the natural resources of the program area including vegetation mapping and identification of special status plant, wildlife, and fish species;
- Conducting a wetland delineation for the program area's engineered flood control channels;
- Evaluating geomorphic and biologic conditions for each engineered flood control channel in the program area;
- Evaluating the program area's cultural and historic resources;
- Creating an SMP Database to organize program information and communicate information regarding maintenance activities and natural resources;
- Developing an operations manual for stream maintenance activities;
- Developing a sediment disposal plan for the SMP;
- Revising Sonoma Water's current hydrology and flood control design criteria manual;
- Establishing an Inter-Agency Working Group (IAWG) comprised of regulatory agency representatives to provide the program guidance and regulatory coordination through an open and transparent forum; and
- Establishing an integrated watershed mitigation program to help mitigate environmental consequences of the SMP through stream restoration, erosion control, education and other land management practices implemented by local partner organizations.

1.3 Program Area and Channel Types

Figure 1-1 presents the SMP program area located in Sonoma County, California and shows Sonoma Water's nine flood control zones, Zones 1A – Zone 9A. The great majority of SMP activities (over 95%) are located in the engineered flood control channels of Zones 1A, 2A, and 3A – the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watershed, respectively.

Of these three primary zones of activity, most maintenance activities occur in Zone 1A (**Figure 1-2**). The majority of the flood control channels of the program area are found in the greater Santa Rosa and Rohnert Park regions. These channels of Zone 1A require the most maintenance attention, with typically several projects occurring annually. Maintenance activities in Zone 2A (**Figure 1-3**), the Petaluma area, are the next most common, with typically one or two sediment removal projects per year and on-going vegetation maintenance. Maintenance activities in Zone 3A (Figure 1-3), the Sonoma Creek watershed, are even less common. Maintenance activities in the other six zones are rare and are not expected to occur with any regular frequency.

There are four different channel types in the program area. The zone maps presented in Figure 1-2 through Figure 1-9 include color designations for the four types of channel, and **Figure 1-10** provides photograph examples of each type. A typical cross section of an engineered flood control channel is shown in **Figure 1-11**, illustrating many of the channel features (e.g., top-of-bank, toe-of-slope, etc.) that are referred to throughout this document.

The ownership and general maintenance activities for the four channel types are described below:

1. **Engineered Channel–Owned in Fee (Red Channels):** These channels are owned and maintained by Sonoma Water through limited zone-specific property taxes. Sonoma Water is responsible for maintenance of the flood control channels that it owns. Sonoma Water maintains approximately 61 miles of owned in fee-engineered channels. Engineered channels are channels that were designed and built to convey a design discharge. In the program area, engineered channels have typically been built with a trapezoidal cross-sectional shape. Most of the engineered channels have earthen banks and streambeds, however some channels have hardened banks and beds. Bed and bank hardening typically occurs at or near road and culvert crossings to protect these structures. Maintenance activities in these engineered channels include bank stabilization, landscaping, fencing, mowing, sediment removal, debris removal, vegetation thinning, herbicide stump treatment, and access road herbicide spraying. Structures such as access roads, drop inlet culverts, outfalls, flap gates, and road crossing culverts constructed in association with the engineered channels also require routine maintenance. Owned in fee-engineered channels are shown in red in the zone maps of Figure 1-2 through Figure 1-9.
2. **Engineered Channel–Easement Maintained (Orange Channels):** These channels are not owned by Sonoma Water, but Sonoma Water performs channel maintenance on them through permissive easement agreements. For example, cities such as Petaluma or Rohnert Park may own such channels and may have entered into easement agreements with Sonoma Water to conduct maintenance. These easement agreements authorize Sonoma Water to conduct maintenance, but do not require or obligate Sonoma Water to maintain any specific level of hydraulic capacity or conduct any maintenance. Generally, the level of maintenance is defined by the municipality and implemented by Sonoma Water. Sonoma Water performs some maintenance activities within approximately 15 miles of easement engineered channels. Maintenance activities in these channels are similar to the activities described above for Sonoma Water-owned engineered channels with the exception that for the easement engineered channels, Sonoma Water works only within the channel banks and does not maintain roads, ditches, fences, or other structures outside the channel. Easement engineered channels are shown in orange in the zone maps of Figure 1-2 through Figure 1-9.
3. **Modified Channel–Easement Maintained (Blue Channels):** Modified channels are natural channels with existing earthen beds and banks that have been modified either through vegetation removal, in-channel grading, channel widening or straightening, or debris clearing to improve flow conveyance. Though modified, these channels are not engineered or constructed according to specific design criteria to convey a discharge of a particular magnitude. These are permissive easements where another jurisdiction, authority, or private landowner owns the modified channel feature. Sonoma Water is not obligated to conduct maintenance and has no responsibility to perform any specific level of maintenance in easement modified channels. However, Sonoma Water may

perform limited maintenance on these channels. Sonoma Water holds hydraulic easements (for work within the channel) for over approximately 49 miles of modified channels. Maintenance activities in modified channels typically include the removal of log jams, debris jams, and clearing vegetation to remove significant flow obstructions. The most common type of work conducted in these channels is the removal of blackberry thickets or fallen trees that significantly increase the potential for flood damage to structures. Trash or vegetation debris may also cause a blockage and require removal. Sonoma Water occasionally performs sediment removal and bank stabilization work in modified channels. Work in modified channels occurs only on an as-needed basis, usually at the request of an adjacent land-owner during or following a large storm event. Modified channels are shown as blue streams in the maps of Figure 1-2 through Figure 1-9. If sediment removal is needed in a modified channel, such activities would be permitted outside of the SMP. However, Sonoma Water would incorporate the impact avoidance and minimization measures from the SMP, as well as other best management practices (BMPs) and standard protocols, to ensure that such projects are implemented in a careful manner.

4. **Natural Channel–Easement Maintained (Green Channels):** Natural channels are non-engineered and non-modified creek systems with a permissive clearing easement. Sonoma Water holds hydraulic easements to work within the channel banks for over approximately 80 miles of natural channels. Natural channels may require maintenance activities to maintain flow conveyance and reduce the flooding hazard. Maintenance work in natural channels typically involves clearing debris or vegetation that is causing a flow obstruction. In this way, maintenance activities for natural channels are similar to modified channels. Work in natural channels is infrequent and typically occurs at the request of an adjacent landowner who has observed a problem. Similar to modified channels, Sonoma Water occasionally conducts sediment removal or bank stabilization activities in natural channels. Additional environmental protections are included for natural channels as described in Chapter 7, Section 7.4, “Vegetation Management Activities in Modified and Natural Channels for the Lower Bank and Channel Bed Zone”. Natural channels are shown as green creeks in the zone maps of Figure 1-2 through Figure 1-9. If sediment removal is needed in a modified channel, such activities would be permitted outside of the SMP. However, Sonoma Water would incorporate the impact avoidance and minimization measures from the SMP, as well as other BMP’s and standard protocols, to ensure that such projects are implemented in a careful manner.

1.4 Overview of SMP Approach

This SMP Manual was developed with past maintenance lessons in mind to create an improved program that maintains channels effectively, provides greater environmental protection and benefits, and is time and cost efficient for both Sonoma Water and regulatory agency staff. The development of the SMP benefited from review of other stream maintenance programs throughout the state and incorporation of their experiences.

The central tenet of the SMP approach is that management activities are conducted using an informed and systemic approach to minimize stream impacts while providing necessary flow conveyance. A thorough understanding of the physical and biological stream system is at the core of this informed approach. As described in subsequent chapters (Chapter 3, *Environmental*

Setting, Appendix C *Channel Characterization*) the SMP utilizes an analytic and targeted approach to understand the degree of maintenance work actually required for a given situation. For example, hydraulic and field analysis can be used to assess and guide sediment removal activities whereby flood control channel cross sections can be compared to as-built designs to determine when sediment removal is necessary. In this way the removal of sediment will not be arbitrary or excessive.

While the analysis of maintenance problems may be focused, the development of solutions is watershed-wide in perspective. For example, in the sediment removal case described above, the SMP approach also considers how to reduce in-stream sediment loads from erosion “hot spots” in the watershed lands upstream that are introducing large amounts of sediment to the stream system downstream (see the integrated watershed mitigation program described in Chapter 11, *Program Mitigation*).

The SMP employs a comprehensive watershed approach, while considering annual specific maintenance needs. The watershed approach of the SMP manages streams and channels with an understanding of the overall stream system and its physical and biological processes. The SMP approach considers each site and reach as a component within a watershed system integrating upstream inputs and downstream outputs. This perspective supports resource management across the entire watershed system. For example, consideration of sensitive habitats, sediment sources in the upper watershed areas, or the most efficient way to manage a stream corridor’s vegetation are all improved in planning and implementing maintenance through a broader watershed perspective.

1.5 Program Activities

The SMP has three primary activities: sediment management, vegetation management, and bank stabilization. These primary maintenance activities occur mainly in engineered flood control channels (red and orange channels on Figure 1-2 through Figure 1-9), but may also occur in other engineered structures, sediment basins, or other facilities on an as-needed basis. In addition to the three core SMP activities, the SMP also involves other smaller and infrequent maintenance activities such as road maintenance, sediment removal around reservoir inlet structures, and debris removal. The SMP also includes the transport and disposal of collected sediment and vegetation. SMP activities are summarized below and described in more detail in Chapters 5 through 9.

1.5.1 Sediment Management

In general, sediment management refers to the removal of excess accumulated sediment from engineered flood control channels and facilities. This accumulated sediment reduces flow capacity and increases the potential for flooding. SMP sediment management activities seek to provide flow capacity while also providing geomorphic and ecologic channel functions, through such means as shaping a two-stage channel form (see Chapter 5) within the original engineered flood control channel (Figure 1-11). Sediment management activities are generally conducted from June 15th to October 31st when streams are typically at their driest. The number of sediment removal projects undertaken annually and the quantity of sediment removed in a given year depend on recent weather and hydrologic conditions, as well as the frequency and extent of past maintenance activities.

There are three general types of sediment removal projects: (1) Reach scale projects where sediment is removed from an entire reach (typically 1,000-3,000 foot [ft] long); (2) localized sediment removal projects (typically 0-400 feet at culverted stream crossings and 400-1,000 ft long at other locations outside of culverted crossings, including geomorphic shaping activities or individual bar grading) where sediment is removed from individual crossings, culverts, or other in-channel facilities.

On average, Sonoma Water conducts 1-3 reach scale projects annually. The main difference between reach scale and localized projects are the length of work activities and the frequency in which the work occurs. Whereas reach scale projects may be revisited every 5-7 years, localized sediment removal projects are typically revisited every 1-3 years.

Sediment removed from Sonoma Water facilities is hauled off-site for reuse or to an approved upland disposal sites or to the Sonoma County Central Landfill. Example sites that may be able to reuse sediment include local gravel reuse companies, landscaping-related businesses, local dairies, and local contractors seeking fill material for construction projects. Sediment disposal and reuse activities are essential to the completion of the sediment removal, bank stabilization, and vegetation removal activities of the SMP. Sonoma Water anticipates that on average, the SMP involves removing between 20,000 and 25,000 cubic yards of sediment per year. More detail on sediment disposal and reuse activities is provided in Chapter 9, *Sediment Disposal and Reuse*.

1.5.2 Vegetation Management

Vegetation management refers to the trimming, mowing, and removal of vegetation within the flood control channels and other constructed facilities. Vegetation management activities are conducted to maintain flow conveyance capacity, establish a canopy of riparian trees, control invasive vegetation, remove hazardous vegetation, reduce fire fuel, and increase visibility for public safety. Vegetation management and removal activities are relatively consistent from year to year, though locations change depending on recent growth and blockages. Vegetation management also includes the planting of new trees and shrubs in engineered channels in accordance with the SMP's restoration and mitigation program (see Chapter 11, *Program Mitigation*).

1.5.3 Bank Stabilization

The repair and stabilization of stream or reservoir banks is undertaken when a bank is weakened, unstable, or failing. Negative consequences of failing stream banks include:

- causing damage to adjacent properties;
- increasing the flood hazard and threaten public safety;
- impairing roads, transportation, and access;
- generating erosion and increasing downstream sediment yields; and
- impacting riparian habitat and other natural resources.

Bank stabilization activities may occur in engineered channels or other facilities including culvert outlets and banks around reservoirs. Bank stabilization activities are generally conducted June 15th to October 31st when streams are at their driest.

1.5.4 Other Activities

Other Program maintenance activities include:

- maintaining vegetation in the upper bank zone;
- maintaining channel access roads for accessibility;
- maintaining proper drainage along channel access roads;
- maintaining proper functioning of drop-inlet culverts which direct local surface flow toward the flood control channels;
- maintaining culverts free of sediment and vegetative blockages;
- sediment removal around reservoir inlet structures;
- trash clean-up;
- repairing fences along the channels; and
- removing or covering graffiti on Sonoma Water facilities.

The majority of these activities are considered to be minor and small in scale.

1.5.5 Activities in Modified and Natural Channels

As described above, maintenance activities in modified and natural channels (blue and green channels as shown on Figure 1-2 through Figure 1-9) occur on an as-needed basis usually following large storm events or particularly wet winters with seasonally elevated stormflows. Maintenance in these reaches is conducted only to maintain hydraulic conveyance and reduce flooding potential. For example, Sonoma Water may remove a fallen tree or debris jam that backwaters flows upstream or diverts flows toward a bank or structure in a natural channel. Maintenance may also be required when overgrown vegetation blocks a culvert. Such flow blockages can lead to more excessive bank erosion, the undermining of a facility, or potential overbank flooding if not removed. Maintenance in these channels is usually conducted at the request of an adjacent landowner.

During the initial SMP development and review process, representatives from the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), CDFW, and Regional Boards identified concerns about maintenance activities conducted in natural channels (where Sonoma Water has hydraulic easements) that support listed salmonids and/or California freshwater shrimp. Through discussions with these agencies, Sonoma Water agreed to remove these channels of concern from coverage under the SMP. As a result, potential direct impacts to these species and their habitat are avoided. The streams supporting sensitive habitats that were removed from the SMP are shown in Figure 1-12. These channels are also represented by green dashed lines in the maps of Figure 1-2 through Figure 1-9.

The one creek that is known to support California freshwater shrimp but was not removed from the SMP is Sonoma Creek. This creek is mostly comprised of modified and natural channel reaches. Two short segments of Sonoma Water owned-in-fee engineered channels are located on the main stem of Sonoma Creek. These reaches are relic parcels that came under Sonoma Water ownership at some point in the past, but are managed by Sonoma Water as if they were modified or natural channel and are treated by this SMP as a natural or modified channel (i.e., no sediment removal or bank stabilization activities are covered in those reaches by this SMP). Because several homes border this creek, risks to property and safety due to flow blockages and potential flooding exist and Sonoma Water may need to conduct vegetation management in Sonoma Creek. However, specific BMPs to conduct maintenance in this creek were developed to greatly reduce the potential for impacts to California freshwater shrimp (see Table 10-1).

1.5.6 Activities Not Covered in the SMP

Activities not covered under the SMP include:

- maintenance activities on the main stems of the Russian River and Dry Creek in Zone 4A and 6A related to management of Lake Mendocino and Lake Sonoma;
- maintenance activities on streams outside of Sonoma Water authority for which no maintenance agreement exists;
- capital improvement projects (CIPs); and
- emergency activities and procedures.

A situation is considered an “emergency” if it is a sudden, unexpected occurrence involving a clear and imminent danger that demands immediate action to prevent or mitigate loss of or damage to life, health, property, or essential public services (Public Resource Code Section 21060.3). Although emergency situations are not covered in the SMP, Sonoma Water makes every effort to follow the guidance provided in the SMP when implementing activities under emergency conditions.

Routine stream maintenance does not include projects that would alter the designed flood conveyance capacity of a channel. Large construction projects and CIPs are not considered routine stream maintenance and are not included in the SMP. However, future CIPs may consider using, or adapting, the SMP to cover their maintenance needs and mitigation once their project becomes operational and requires maintenance.

1.6 Impact Avoidance and Minimization

The informed approach of the SMP not only requires a clear understanding of the location, extent, and specifics of maintenance activities; it also requires an understanding of the stream system’s natural and aquatic resources. As described in this manual (Chapter 3 and Appendix C), the SMP includes a method to inventory and assess each stream reach for its geomorphic, habitat, and species conditions. Each reach is also considered within its sub-basin and watershed context. Defining this baseline of what resources exist and what processes operate at a given reach is fundamental to the SMP. Understanding these resources, their locations and how they interact informs an approach to avoid, minimize, and mitigate environmental impacts.

Understanding these resources also influences how, where, and when routine maintenance activities should occur.

Chapter 4, *Maintenance Principles* describes how maintenance principles are taken to avoid and reduce impacts before any maintenance work occurs. The following maintenance principles were developed as guidelines to avoid and minimize environmental impacts of the program. Chapter 4 provides additional detail on how the following impact avoidance and minimization principles are used.

1. No unnecessary intervention
2. Understand the system and its processes
3. Consider adjacent land uses and public safety
4. Apply system understanding to inform maintenance actions
5. Manage for incremental ecologic improvement (lift)
6. Integrate maintenance activities towards sustainability (reducing maintenance frequency)
7. Maintain adequate conveyance capacity of channels and other facilities to prevent flooding or reduce the potential scope and impact of flooding

When applied, these principles determine when action is needed, consider the natural function of the system, provide an understanding of local physical constraints, identify sensitive habitats, consider watershed processes, identify the maintenance activities needed at the reach and site scale, and seek solutions to minimize the on-going need for maintenance activities at a particular site or reach.

The maintenance activities described in Chapters 5-8 incorporate a range of measures to minimize undesired effects that could not be entirely avoided through the pre-maintenance planning approaches described in Chapter 4. These additional measures are described in Chapter 10, *Impact Reduction, Minimization Measures, and Best Management Practices (BMPs)*. Measures to protect natural resources, as well as “good-neighbor” policies were drafted to reduce the effects of maintenance activities. Table 10-1 organizes these measures and BMPs according to program activities and specific environmental resources. Taken together, the pre-maintenance principles described in and the maintenance activity based measures described in Chapter 10 provide a comprehensive and integrated approach to avoiding and minimizing program impacts.

1.7 Program Mitigation

Through the use and application of avoidance and minimization measures and maintenance principals described above, potential impacts are greatly reduced. However, potential impacts that are not reduced through avoidance measures or project elements may require additional mitigation. The mitigation program for the SMP is described in Chapter 11.

The SMP’s mitigation approach was developed through multiple discussions with agency representatives from the RWQCBs, CDFG, NMFS, USFWS, and the U.S. Army Corps of Engineers

(USACE). Meetings were held with individual agencies and also together through group meetings of the IAWG. The SMP mitigation approach was also developed over the course of 3 years of interim permitting (2006-2008). During that period maintenance projects were developed, submitted for agency review, permitted, and implemented. The interim permitting period was used to demonstrate and refine program approaches, including the mitigation approach.

The mitigation planning approach follows a three-tiered system where mitigation opportunities are sought sequentially. Tier 1 mitigation is implemented on-site at the specific project reach where the maintenance work was conducted. Mitigation approaches on-site seek to enhance and restore the stream and aquatic functions and resources (in-kind) that were impacted through the maintenance activities.

Tier 2 mitigation is similar to Tier 1 mitigation in seeking in-kind mitigation in stream channels that had undergone maintenance. However, Tier 2 mitigation is applied at other stream channels, and is therefore not specifically on-site. Tier 2 mitigation is sought when there are no suitable opportunities for enhancement or restoration on-site at a specific channel reach and the next best opportunity is to pursue in-kind mitigation at a neighboring reach that does afford an opportunity for mitigation.

Tier 3 mitigation is off-site mitigation that provides compensating watershed based functions and values to SMP program impacts. Tier 3 mitigation addresses residual impacts from SMP activities that are not adequately avoided or minimized as described above or mitigated through Tier 1 and 2 mitigation actions. The Tier 2 and Tier 3 off-site mitigation address the temporary loss of Beneficial Uses and ecological functions and values during the time gap between SMP maintenance activities and when Tier 1 mitigation occurs, and the time when Tier 1 mitigation has become fully functional and the temporary impacts have been eliminated. Tier 3 mitigation provides restorative and mitigating watershed solutions for SMP impacts. Tier 3 mitigation is not only different in its geographic scope, it is also different in that it is not solely a Sonoma Water effort, but is a collaborative effort with partnering agencies. This is accomplished through the off-site watershed mitigation program, whereby Sonoma Water funds Tier 3 projects to be implemented with local non-profit agencies, municipalities, restoration organizations, creek groups, schools and Resource Conservation Districts (RCDs).

During the 2006-2008 interim period, while the SMP was in development, four Tier 3 off-site watershed mitigation projects were successfully implemented with local RCDs, landowners, or non-profit agencies. These projects included headwater erosion control through stream fencing to protect streams from cattle grazing, erosion control activities at an active landslide to reduce downstream sediment yields into SMP flood control channels, and restoration and vegetation planting activities in the Upper Laguna watershed.

A key objective of Tier 3 mitigation is to reduce the overall necessity for channel maintenance. This is achieved through both erosion control and improved land use practices in upper watershed lands. Headwaters are a source for eroded sediments that are transported downstream to the many engineered, modified, and natural channels of the SMP. Reducing the sediment loading from headwater areas or upstream reaches is anticipated to reduce the need for subsequent downstream sediment removal activities.

The three-tiered mitigation approach ensures that mitigation is first and foremost directed to compensate for the impacts occurring at the specific project reach, then expands to consider all impacted reaches, and finally addresses the watershed as a whole. Chapter 11 provides details on the SMP's mitigation program.

1.8 Program Management

1.8.1 SMP Work Cycle

Implementation, administration and oversight of the SMP is described in Chapter 12, *Program Management*. The SMP is managed as an annual cycle of activities. Stream reconnaissance and assessment begins in late winter or early spring, followed by the development of the maintenance workplan. During the spring months, the year's maintenance projects are further refined and described, appropriate mitigation is identified, and the relevant regulatory agencies overseeing program permitting are notified. Projects are then implemented during the summer season, when the channels are at their driest. During the fall, and before the end of the year, an annual summary report of the year's maintenance, mitigation, and monitoring activities is sent to the permitting agencies.

1.8.2 Program Tracking

An important component in managing the SMP is to establish and maintain a comprehensive SMP Database. Data management is required throughout the SMP work cycle including: organizing the initial stream assessment and inventory; characterizing reach conditions; identifying maintenance needs; identifying sensitive habitats, weed populations, or other environmental considerations; documenting the implemented maintenance activities; documenting and tracking the implementation of restoration and mitigation activities; monitoring the on-going status of mitigation activities; and tracking all regulatory reporting requirements. The SMP Database organizes all of this information and other data including stream reach assessments, geographic information system (GIS) mapping, habitat conditions, and aerial photography. This SMP Database provides a consistent and transparent way to monitor overall program activities, permitting compliance and track habitat and canopy development.

1.8.3 Program Reporting

As described above, at the conclusion of each year's maintenance season a summary report is developed, posted to the program website, and submitted to the appropriate regulatory agencies. This report includes: a summary of the year's sediment removal, bank stabilization, and in-channel vegetation management projects. For these maintenance projects the following topics are described in the annual summary report: description of work activities and locations; a description and confirmation of the restoration and mitigation activities implemented during the current year mitigation; a status and monitoring report of on-going mitigation activities initiated during previous seasons; and other program updates as necessary. The report may include additional information on project area conditions, activities employed, the effectiveness of certain activities, possible recommendations for future maintenance, or suggestions to improve the program's implementation and management.

1.8.4 Program Review

Following the submittal of the annual maintenance report, regulatory agency staff are invited to a review meeting to discuss the events, maintenance activities, and lessons learned over the past work cycle. Every 5 years, Sonoma Water and the permitting agencies review the SMP for its overall effectiveness. This review includes an assessment of maintenance activities conducted to date, BMPs employed, adequacy of the SMP Mitigation Program, SMP database, adequacy of SMP adaptive updates and revisions, and overall program coordination and communication between Sonoma Water and the regulatory permitting agencies. The SMP is flexible to accommodate new resource information, management standards, and maintenance technology over time. The SMP is a “living program” that is updated and modified as needed.

1.8.5 Regulatory Agency and Stakeholder Input

The SMP, the program manual, and the associated regulatory permitting, environmental compliance, and technical studies conducted to support the program were developed by Sonoma Water during the period 2006-2009. During the program development period, close collaboration with regulatory agency representatives occurred through the IAWG. Numerous meetings were held with individual agencies and as a collective group. Guided field trips also occurred to show regulators the conditions at several sites in the program area. Regulatory agency staff members of the IAWG were instrumental in guiding the overall development of the program and providing direction on permitting, resource characterizations, impact avoidance, and mitigation approaches. Members of the IAWG reviewed the Draft SMP Manual thoroughly and provided detailed comments and suggested edits. In addition to regulatory agency guidance and review, Sonoma Water presented the SMP at public meetings in 2008 with key watershed and governmental stakeholders to garner additional input. Additional public review and comment for the program occurred through the CEQA process and public commenting on the SMP EIR.

Since the SMP’s initial development phase 2006-2009, regulatory agency staff have continued to be engaged in program oversight and review. This has included annual field trips to maintenance and mitigation sites and review of annual SMP notification and summary reports. During on-going IAWG meetings and the permit renewal process several additional comments were provided by regulatory staff to update and improve this Manual. This 2019 version of the SMP Manual includes that input and feedback.

1.8.6 Program Commitment

Essential to SMP program success is Sonoma Water’s commitment to dedicate the required resources and staffing necessary to effectively administer, oversee, implement, and monitor the SMP. One of the key recommendations from reviewing other similar stream maintenance programs was the need for the agency developing and implementing the program to provide consistency, continuity, and a centralized manager in the operation of the program. Sonoma Water has dedicated the resources necessary to ensure program success, including support of a full-time SMP Manager who oversees implementation of the Manual and compliance with program permitting.

1.8.7 Program Documents and Materials

All documents and supporting materials used in developing the SMP, this manual, the program EIR, and the above referenced technical studies (Section 1.2) are housed in the SMP program library under the management of the SMP Manager and are available for viewing upon request. Most of the program documents and materials are available for view through the program website at: www.scwa.ca.gov/stream-maintenance-program/

1.9 Program Permitting and CEQA/NEPA Compliance

The regulatory context for the SMP and the program's permitting approach are described in Chapter 2, *Environmental Regulations and Compliance*. Sonoma Water obtained long-term multi-year permits for routine stream maintenance activities in channels and streams under the jurisdiction of the USACE, including Waters of the United States and special aquatic sites (wetlands) pursuant to Section 404 of the CWA. An Individual Permit (IP) was issued for routine stream maintenance activities subject to jurisdiction of the USACE. Sonoma Water and USACE complied with requirements under Section 7 of the ESA for listed salmonids outside of Zone 1A and for other federally listed species not covered by the NMFS Russian River Watershed Biological Opinion. The North Coast and San Francisco Bay RWQCBs issued Waste Discharge Requirements (WDRs) under Section 401 of the CWA and in compliance with Porter-Cologne Water Quality Control Act. CDFW issued a Master Streambed Alteration Agreement for stream maintenance activities in compliance with Fish and Game Code (F&G Code) Section 1602, the Streambed Alteration program. In addition, CDFW issued authorization for the SMP under the California Endangered Species Act (CESA).

CEQA compliance was met through the development of an EIR for the SMP Manual, with Sonoma Water serving as the Lead Agency. The SMP EIR was certified by the Sonoma County Board of Directors in June 2009. The 2009 EIR evaluated the environmental impacts of the maintenance activities proposed in the SMP Manual.

The USACE served as the Lead Agency for NEPA compliance in 2009. Similar to CEQA, The SMP Manual provided the basis for developing the project description for National Environmental Protection Act (NEPA) compliance. The 2009 NEPA process met environmental compliance requirements for permitting actions conducted by all federal agencies granting permits for the SMP.

1.10 SMP Manual Organization

This SMP Manual is organized into the following chapters:

Chapter 1. Introduction and Program Summary provides an overview of the SMP including describing the program's purpose, area, channel types, maintenance activities, impact avoidance, mitigation, and permitting approaches.

Chapter 2. Environmental Regulations and Compliance describes the federal, state, and local regulations that are applicable to the SMP, reviews regulatory agencies and their permitting responsibilities for the SMP, and presents the program's compliance and permitting approach.

Chapter 3. Environmental Setting describes the physical and biological resource conditions in the program area that influence the SMP. This setting includes descriptions of topography, landforms, geology, hydrology, water quality, natural communities and vegetation, and wildlife in the program area.

Chapter 4. Maintenance Principles describes how planning measures are taken to avoid and reduce impacts are before any maintenance work occurs. This chapter presents the guiding principles and approach of the program to avoid and minimize environmental impacts.

Chapter 5. Sediment Management and Removal describes Sonoma Water's approach, sediment management goals, and sediment removal activities conducted under the program.

Chapter 6. Bank Stabilization describes Sonoma Water's approach and goals for conducting bank stabilization.

Chapter 7. Vegetation Managementdescribes vegetation management activities conducted under the program.

Chapter 8. Other Maintenance Activities describes secondary program activities including road maintenance, culvert repair/replacement, debris removal, fence repair, etc.

Chapter 9. Sediment Disposal and Reuse describes Sonoma Water's planning approach for disposing and reusing sediment generated from sediment removal activities (described in Chapter 5).

Chapter 10. Impact Reduction, Minimization Measures, and Best Management Practices (BMPs) presents additional measures to protect natural resources, provide good-neighbor policies, and other measures to reduce the effects of maintenance activities.

Chapter 11. Program Mitigation describes the SMP's 3-tiered mitigation approach, including the integrated watershed mitigation program to mitigate remaining impacts that were not effectively avoided or minimized.

Chapter 12. Program Management describes SMP administration and oversight including the implementation of the SMP annual work cycle, data management, regulatory agency notification and reporting, and program review.

Chapter 13. References and Preparers provides a listing of the reference materials and documents used in the development of this SMP Manual and it's supporting planning studies. This chapter also includes a list of authors that prepared this SMP Manual.

Appendix A. Program Summary Data – This appendix includes program summary data including canopy density of trees along SMP creeks, overview of SMP maintenance activities completed between 2008 and 2018, and creeks that have undergone sediment testing.

Appendix B. Outlines for Annual Reports – this appendix includes three outlines to illustrate the anticipated contents of the annual notification report (Appendix F-1), annual post-maintenance summary report (Appendix F-2), and sediment sampling report (Appendix F-3).

Appendix C. Channel Characterization – This appendix describes the program area subwatersheds and provides detailed fact sheets for each of the engineered and easement engineered channels in the program area. For each maintenance reach key physical and biological conditions are described, photographs presented, and management needs and opportunities summarized.

Appendix D. Accounts of Special-Status Species – This appendix includes detailed descriptions of special-status species known to occur in the program area.

Appendix E. **Sonoma County Water Agency 4-Year Summary of Stream Maintenance Program, 2009-2013** – This appendix includes a 2014 summary evaluation report of the SMP for years 2009 through 2013. The report focuses on determining which elements and aspects of the Program worked effectively and which could be modified to improve the program.

Appendix F. **Glossary** – This appendix includes a glossary of terms used throughout this manual.

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

Figure 1-1
Program Area

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

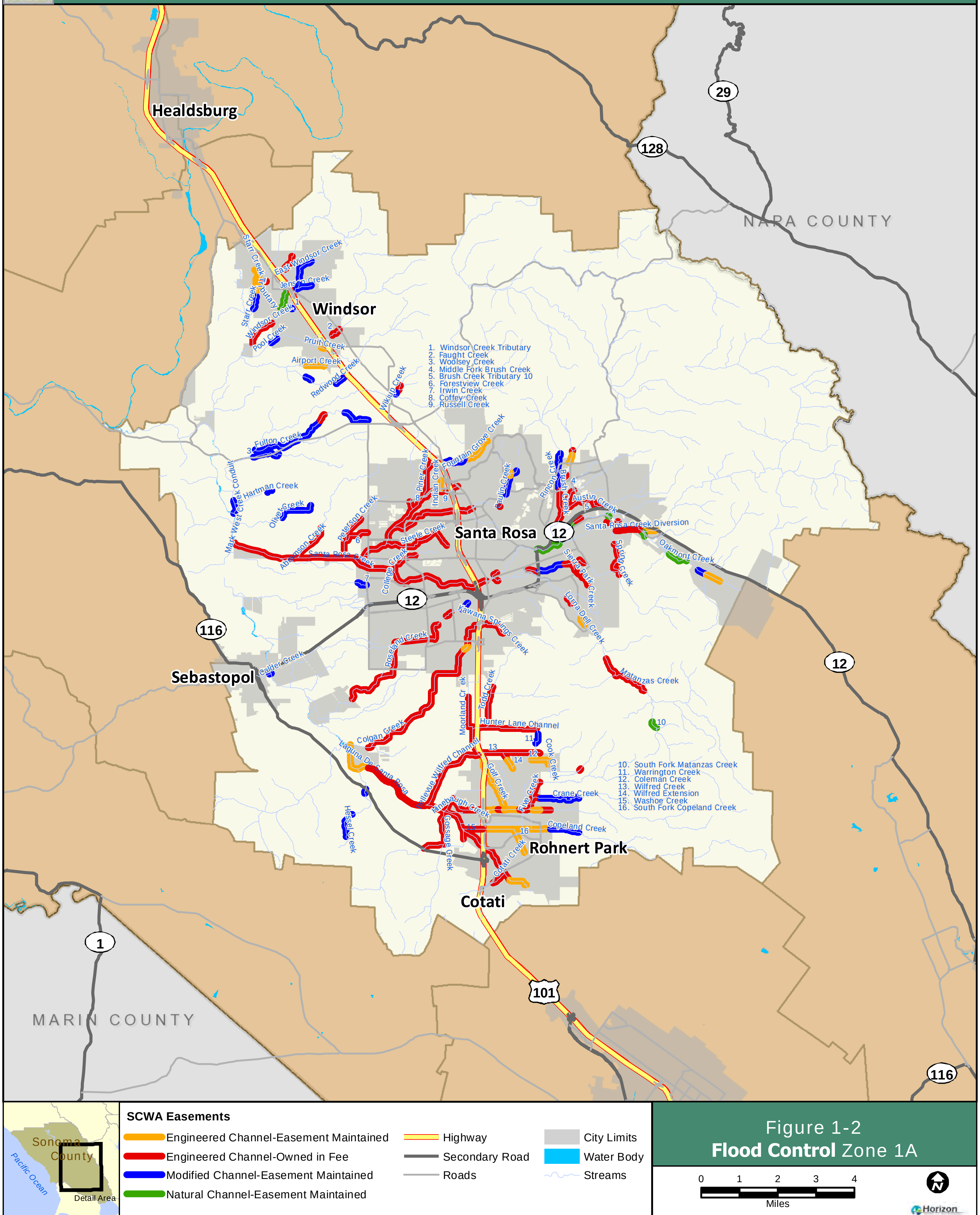

Figure 1-2
Flood Control Zone 1A

Sources: Sonoma County Water Agency; Sonoma County GIS

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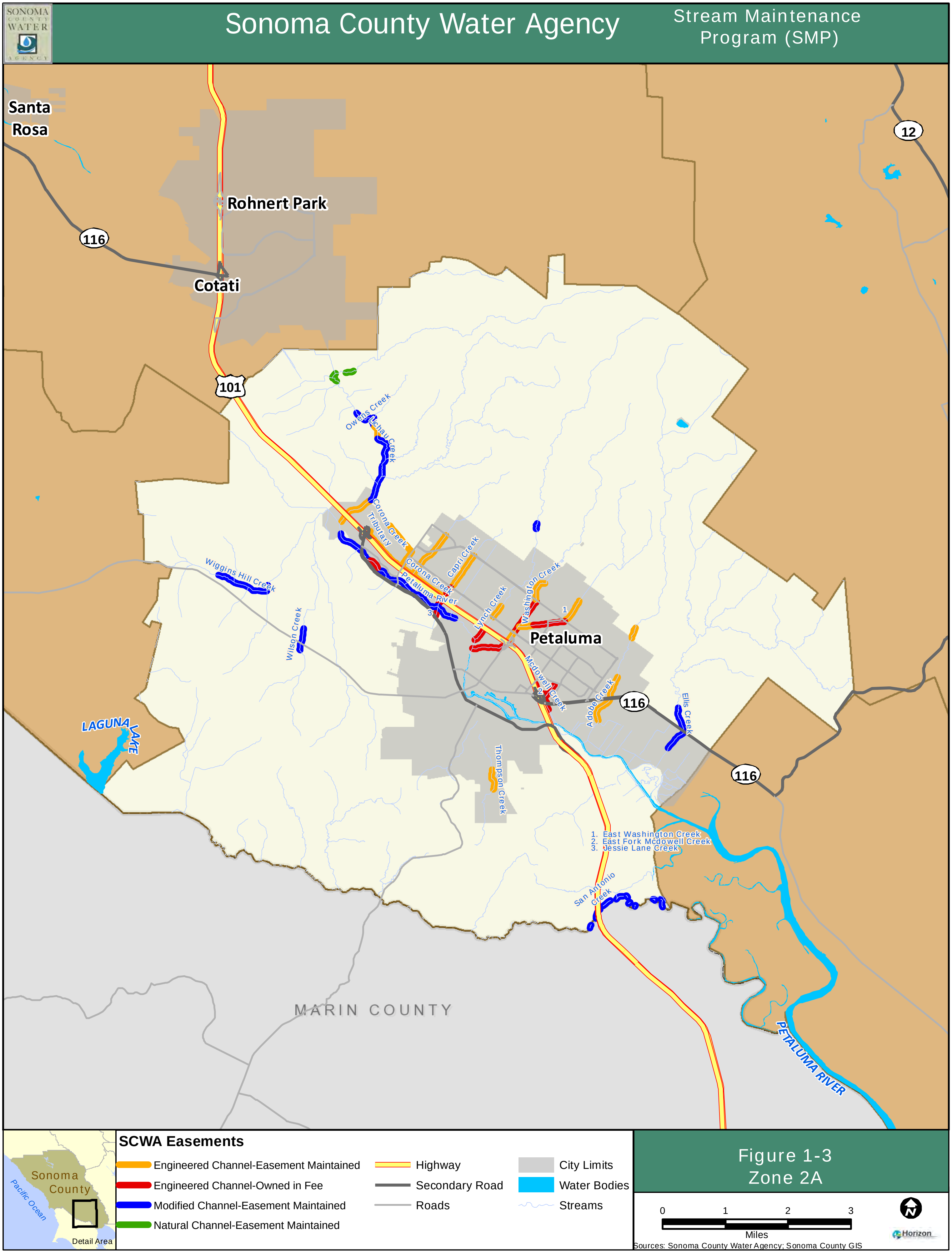

Figure 1-3
Zone 2A

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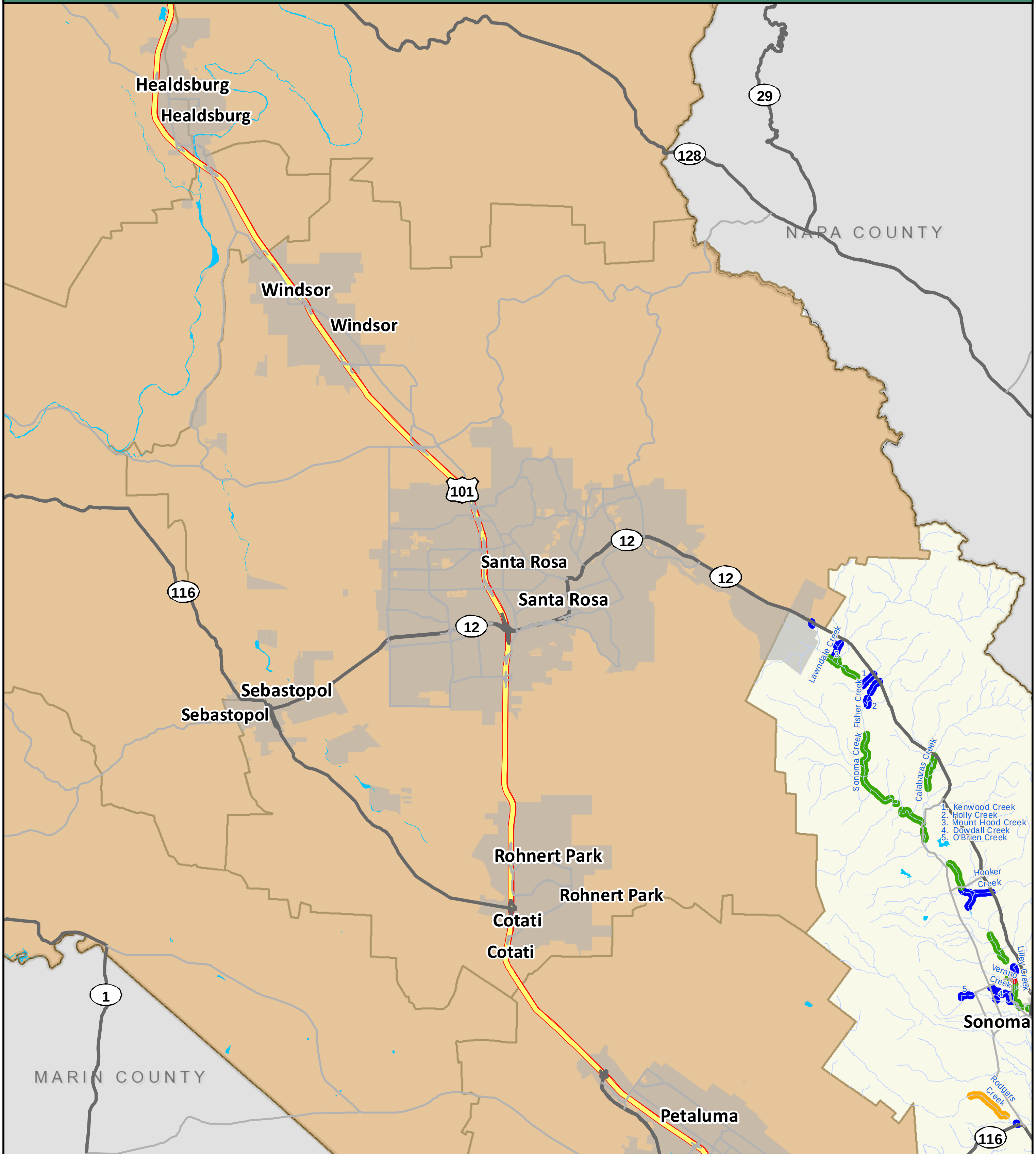
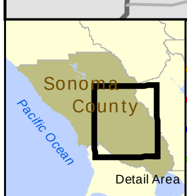
Sonoma County Water Agency

Stream Maintenance Program (SMP)





SCWA Easements

- Engineered Channel-Easement Maintained
- Engineered Channel-Owned in Fee
- Modified Channel-Easement Maintained
- Natural Channel-Easement Maintained
- Highway
- Secondary Road
- Roads
- City Limits
- Water Body
- Streams

Figure 1-4
Zone 3A

0 1 2 3 4
Miles

Horizon

Sources: Sonoma County Water Agency; Sonoma County GIS

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

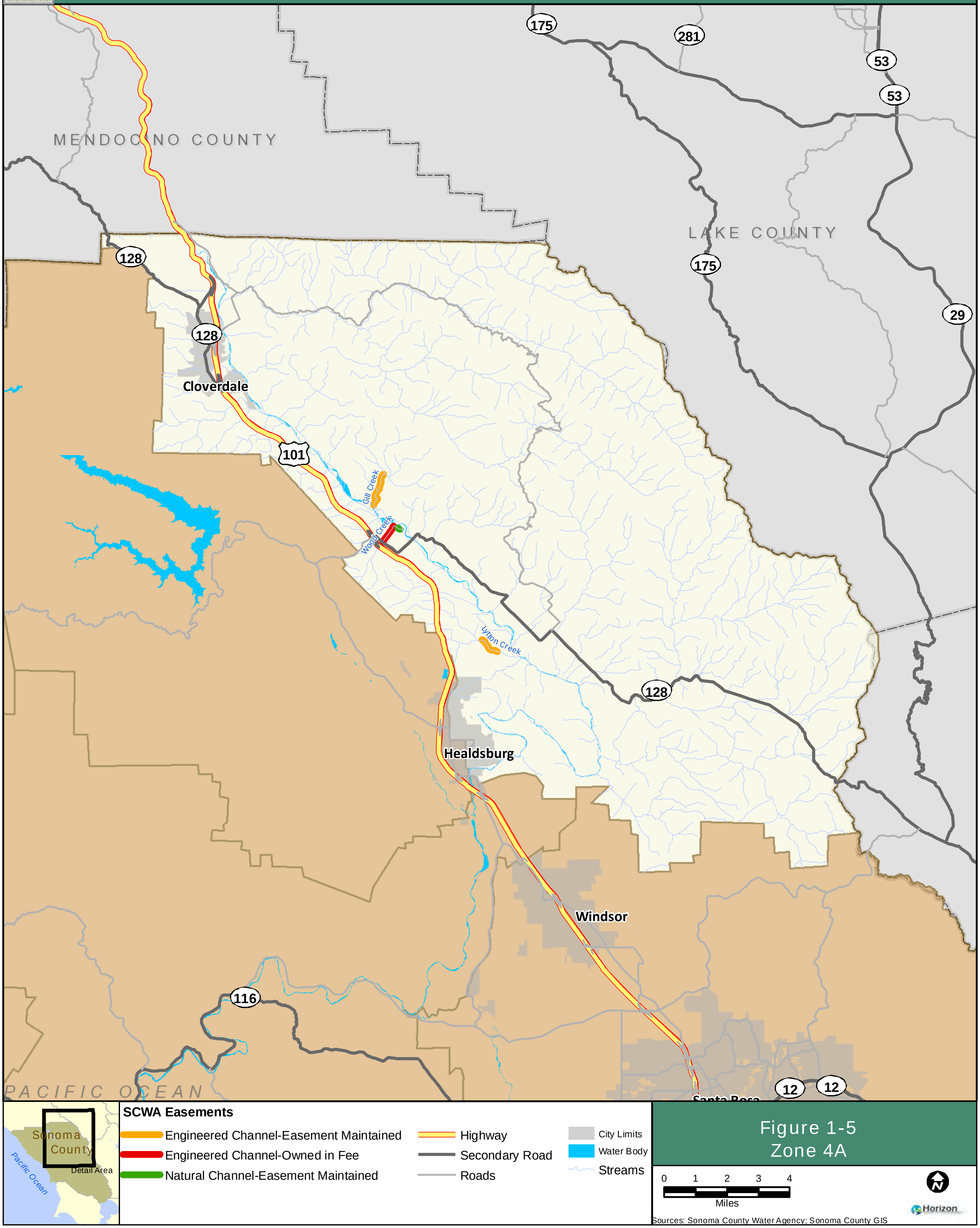

Figure 1-5
Zone 4A

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

SCWA Easements

- Engineered Channel-Owned in Fee
- Modified Channel-Easement Maintained
- Natural Channel-Easement Maintained
- Highway
- Secondary Road
- Roads
- City Limits
- Water Body
- Streams

Figure 1-6
Flood Control Zone 5A

0 1 2 3 4
Miles

Horizon

Sources: Sonoma County Water Agency; Sonoma County GIS

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

Figure 1-7

Zone 6A

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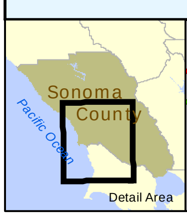
Sonoma County Water Agency

Stream Maintenance Program (SMP)



SCWA Easements

- Engineered Channel-Owned in Fee
- Natural Channel-Easement Maintained
- Highway
- Secondary Road
- Roads
- Water Body
- City Limits
- Streams

Figure 1-8
Zone 8A

0 1 2 3 4
Miles

Sources: Sonoma County Water Agency; Sonoma County GIS

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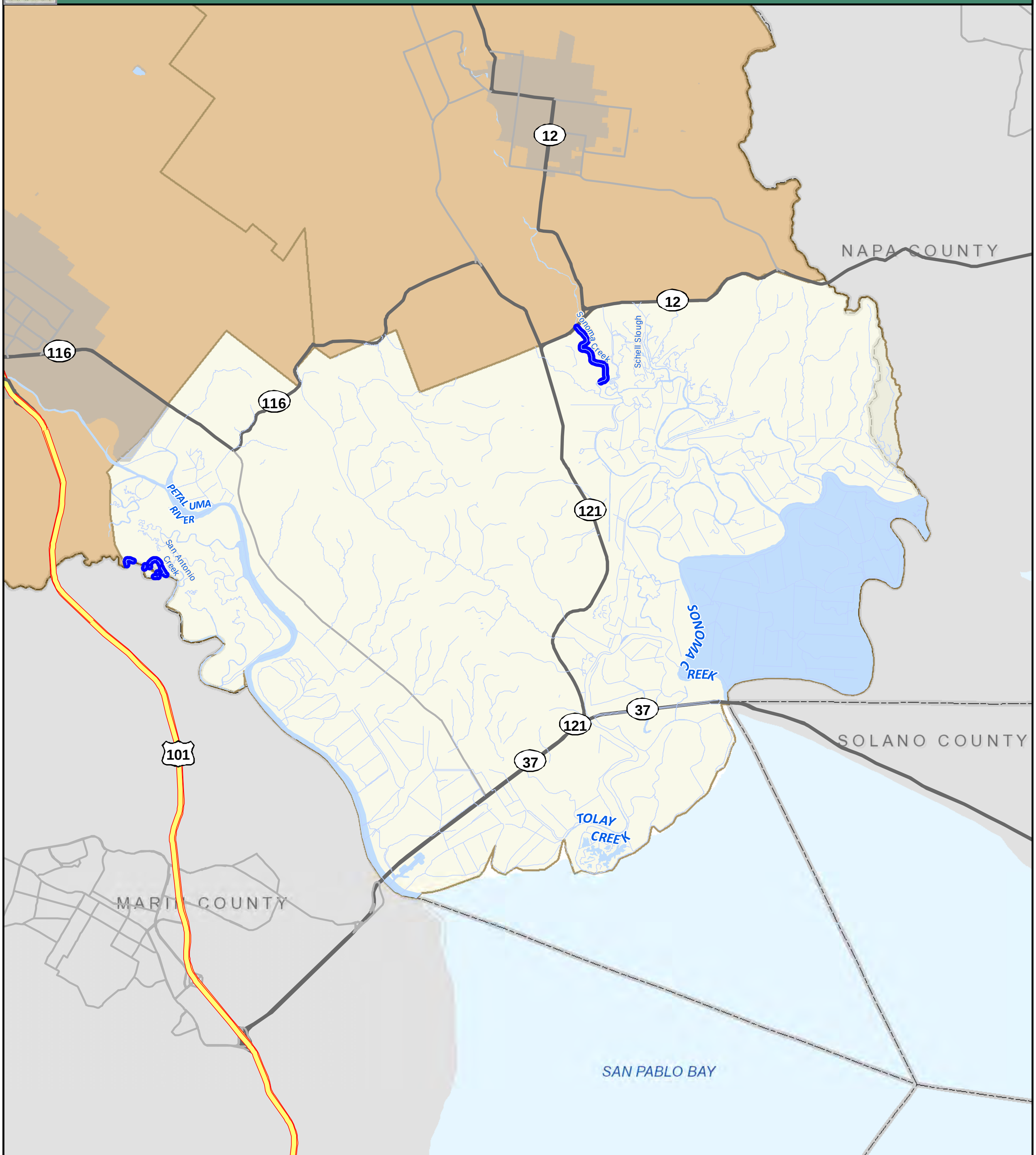
Sonoma County Water Agency

Stream Maintenance Program (SMP)



SCWA Easements

- Modified Channel-Easement Maintained
- Highway
- Secondary Road
- Roads
- Water Body
- City Limits
- Streams

*Following guidance provided by NMFS & USFWS regarding sensitive species habitat, certain natural channels were removed from maintenance activites and coverage of the SMP. These creeks and reaches are indicated in Figure 1-12

Figure 1-9
Zone 9A

0 1 2 3 4
Miles

Horizon

Sources: Sonoma County Water Agency; Sonoma County GIS

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Photo a. Owned in Fee - Engineered Channel -- Adobe Creek at Sartori Drive looking downstream (Zone 2A).

Photo b. Easement Engineered Channel -- Coleman Creek at Hillview Way looking upstream (Zone 1A).

Photo c. Easement Modified Channel -- Nathanson Creek north of Napa Road looking upstream (Zone 3A).

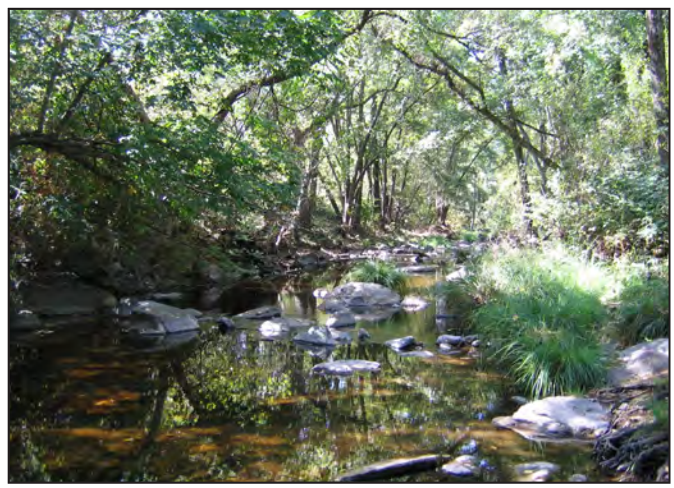

Photo d. Easement Natural Channel -- Santa Rosa Creek at Brush Creek confluence looking downstream (Zone 1A).

Figure 1-10
Sonoma Water Channel Types

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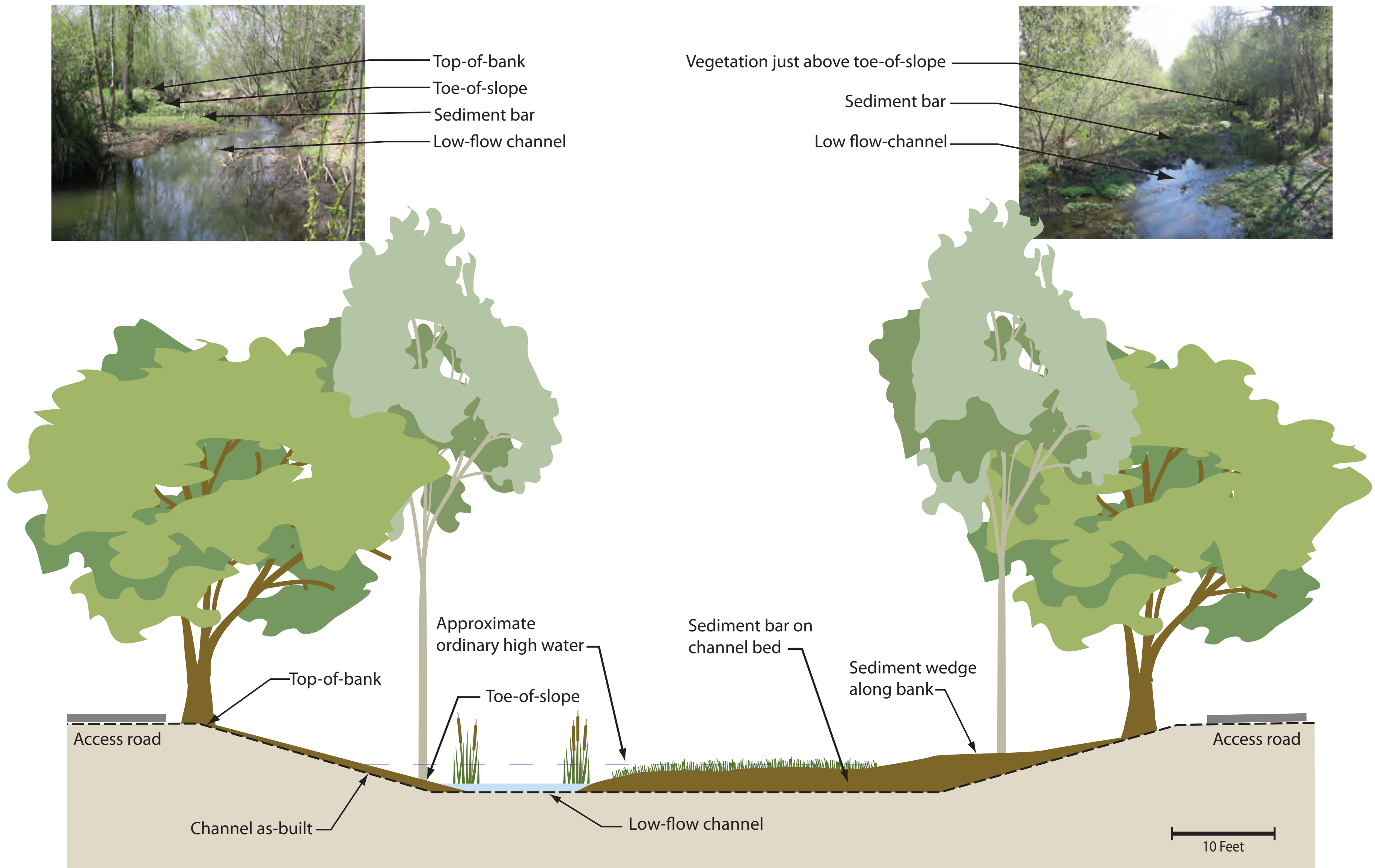

Figure 1-11

Typical Engineered Channel Cross Section

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Sonoma County Water Agency

Stream Maintenance Program

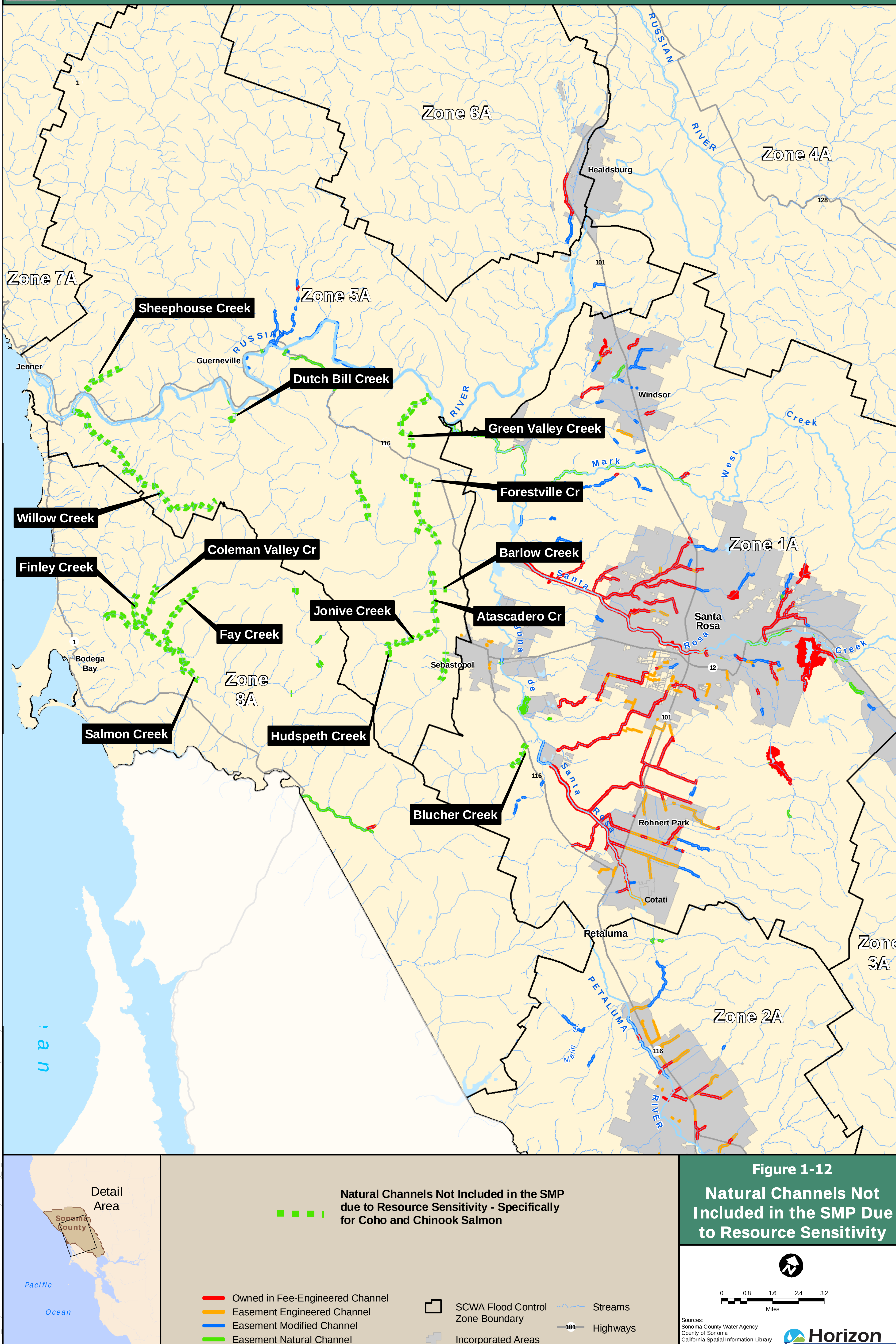

Figure 1-12

Natural Channels Not Included in the SMP Due to Resource Sensitivity

Sources:
Sonoma County Water Agency
County of Sonoma
California Spatial Information Library
U.S. Geological Survey
California Dept. of Fish & Game

e:\2008_Projects\Horizon\SCWA\SMP\GIS\Layouts\Fig_3_ExcludedChannels.mxd MG (11-18-08)

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Chapter 2
ENVIRONMENTAL REGULATIONS AND COMPLIANCE

2.1 Background and Regulatory Guidance

This chapter describes federal and state environmental regulations, policies, and local resource management plans applicable to maintenance activities of the Stream Maintenance Program (SMP or Program). This chapter also summarizes how the program complies with these requirements.

SMP activities primarily include sediment management, vegetation management, and bank stabilization. Depending on the activity type, where the activity occurs, and how the activity is implemented, different permits or environmental compliance may be required.

The Sonoma County Water Agency (Sonoma Water) formed an Inter-Agency Working Group (IAWG) in 2006 to guide development of the SMP. This group included representatives from the U.S. Army Corps of Engineers (USACE), the North Coast Regional Water Quality Control Board (NCRWQCB), the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB), the California Department of Fish and Wildlife (CDFW), the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), and the U.S. Environmental Protection Agency (USEPA). Sonoma Water worked closely with IAWG members to develop the SMP Manual (2006-2008) and guide the permitting approach. IAWG members reviewed each chapter of the SMP Manual carefully and provided guidance and comments. Meetings and several field tours were held to familiarize regulators with the program area, flood control channels, maintenance activities, and impact avoidance approaches. Since its forming, the IAWG has continued to participate in annual site visits, review annual notification and summary reports, coordinate permit renewals and meet with Sonoma Water periodically to review and discuss program updates.

Table 2-1 summarizes permits that have been issued to authorize SMP activities or satisfy other regulatory requirements. The remainder of this chapter presents the regulations and regulatory agency jurisdictions applicable to the SMP along with the regulatory compliance approach of the program.

Table 2-1. Applicable Regulatory Permits and Approvals

Agency	Permit/Approval/Consultation	File Number	Effective Date	Expiration Date
Federal Agencies				
U.S. Army Corps of Engineers (USACE)	Section 404 of the Clean Water Act (CWA) – Programmatic Individual Permit, Zones 1A, 4A-8A	2009-00079N	May 27, 2010	May 15, 2020
	Section 404 of the Clean Water Act – Programmatic Individual Permit, Zones 2A, 3A, 9A	2009-00136N	April 18, 2011	May 15, 2020
National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)	Programmatic Biological Opinion (BO) and formal consultation pursuant to Section 7 of the Endangered Species Act of 1973, Zones 2A, 3A	2009/03082	April 5, 2010	April 5, 2025
	Programmatic Biological Opinion (BO) and formal consultation pursuant to Section 7 of the Endangered Species Act of 1973, Russian River, Zone 1A	F/SWR/2006/07316	September 24, 2008	September 24, 2023
U.S. Fish and Wildlife Service (USFWS)	Programmatic Biological Opinion (BO) and formal consultation pursuant to Section 7 of the Endangered Species Act of 1973, Stream Maintenance Program	81420-2009-F-0788-1	October 29, 2009	October 29, 2019
State Agencies				
California Department of Fish and Wildlife (CDFW)	Section 1600 *et seq.* of the California Fish and Game Code (F&G Code) – Master Streambed Alteration Agreement	1600-2009-0399-R3	May 20, 2010	December 31, 2025
	Major Amendment to Master Streambed Alteration Agreement	1600-2009-0399-R3	November 2, 2017	December 31, 2025
	Zones 2A and 3A Natural Channel Maintenance	1600-2016-0298-R3	March 17, 2017	December 31, 2021

Agency	Permit/Approval/Consultation	File Number	Effective Date	Expiration Date
	Request for Consistency Determination pursuant to F&G Code section 2080.1, incidental take under California Endangered Species Act (CESA)	2080-2010-029-03	August 6, 2010	--
San Francisco Bay Regional Water Quality Control Board, Region 2 (SFBRWQCB)	Porter-Cologne Water Quality Control Act – Waste Discharge Requirements and Section 401 of the Clean Water Act (CWA) – water quality certification	R2-2016-0020	April 13, 2016	April 13, 2021
North Coast Regional Water Quality Control Board, Region 1 (NCRWQCB)	Porter-Cologne Water Quality Control Act – Waste Discharge Requirements and Section 401 of the Clean Water Act (CWA) – water quality certification	R1-2009-0049	June 20, 2014	July 23, 2019

2.2 Clean Water Act

The Clean Water Act (CWA) is the primary federal law protecting the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. Under the CWA, discharges into the nation's waters are unlawful unless specifically authorized by a permit. The following paragraphs describe specific sections of the CWA that are relevant to the SMP.

2.2.1 Section 404 – Fill Placement in Waters and Wetlands

CWA Section 404 regulates the discharge of dredged and fill materials into waters of the United States. "Waters of the United States" (Water of the U.S.) include all navigable waters, their tributaries and some isolated waters, as well as any adjacent wetlands to the aforementioned waters (33 Code of Federal Regulations [CFR] 328.3).

Before actions are carried out that would result in discharge of dredge or fill material to Waters of the U.S., a delineation of jurisdictional waters of the U.S. including wetlands or other waters of the United States which qualify for CWA protection. Waters under Section 404 coverage include:

- Areas below the ordinary high water mark (OHWM)[2] of a stream, including non-perennial streams with a defined bed and bank and any stream channel that conveys natural runoff, even if it has been realigned; and

OHWM - Defined by USACE as that line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of

- Seasonal and perennial wetlands, including coastal wetlands.

Wetlands are defined as areas “inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions” (33 CFR 328.3, 40 CFR 230.3).

Project proponents must obtain a permit from the USACE for all discharges of dredged or fill material into waters of the U.S., including wetlands, before proceeding with a proposed activity. The extent of USACE jurisdiction for waters of the U.S. is the OHWM or, if adjacent wetlands are present, the outer limits of those wetlands.

CWA Section 404 permits may include mitigation requirements to account for negative impacts to waters of the U.S. The USEPA and USACE published the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule in 2008. This mitigation guidance is found at: www.epa.gov/cwa-404/compensatory-mitigation-losses-aquatic-resources-final-rule .

SMP Permitting Approach

SMP activities including sediment management, bank stabilization, and other activities that may result in a discharge of dredged or fill material that would require permit authorization under CWA Section 404 from the USACE. Sediment removal activities by Sonoma Water only occur at channels with engineered designed cross-sections. The San Francisco District of the USACE issued two individual permits in 2009 to provide programmatic coverage for SMP maintenance activities conducted within the program area; one for SMP activities in Flood Control Zone 1A and another for Flood Control Zones 2A and 3A. Supporting documentation for the permits included developing a wetland delineation report, biological assessments, and a cultural resources inventory. The individual permits have a 10-year coverage period expiring on May 15, 2020. Sonoma Water will coordinate permit review and renewal with the USACE, including consulting with USFWS and NMFS to maintain on-going regulatory coverage for the program. The Biological Opinions issued by USFWS and NMFS that provide Endangered Species Act (ESA) coverage for the Program will expire between 2023-2025 (Table 2-1 and Section 2.3 below). Sonoma Water will work with the federal agencies to ensure that ESA compliance is maintained into the future as needed to support the Program.

2.2.2 Section 401 – Water Quality Certification

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of dredged and fill materials into surface waters of the United States (including wetlands) must obtain a Water Quality Certification (or Section 401 Certification) to ensure that any such discharge will comply with the applicable provisions of the CWA, including sections 301, 302, 303, 306, and 307, and state water quality standards. The goal of CWA Section 401 is to evaluate water quality when considering dredging or placement of fill materials into waters of the United States.

the soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas. The USACE is the final arbitrator in determining the OHWM.

Permitting Agency and Related Regulations

In California, Water Quality Certifications are issued by the State Water Resources Control Board (SWRCB or State Board) and its nine Regional Water Quality Control Boards (Regional Boards or RWQCBs). Each Regional Board is responsible for implementing Section 401 in compliance with the CWA and with each Regional Board's respective water quality control plan (also known as a basin plan). Section 2.8 below provides more detail on the Porter-Cologne Water Quality Control Act, basin plans, and SWRCB regulatory requirements for projects occurring outside of waters of the U.S. It is the policy of the Regional Boards to provide public notice of pending Section 401 Certification actions in order to gather comments from concerned agencies and the public.

SMP Permitting Approach

The USEPA, San Francisco Bay RWQCB and the North Coast RWQCB have jurisdictional authority over CWA Section 401 in Sonoma County for waters of the U.S. Within the SMP area, the North Coast RWQCB (Region 1) has jurisdiction over watersheds draining towards the Pacific Ocean, including the Russian River watershed and the Mark West Creek, Santa Rosa Creek, and Laguna de Santa Rosa subwatersheds (Sonoma Water Zone 1A). The San Francisco Bay RWQCB (Region 2) has jurisdiction over the Petaluma River watershed (Sonoma Water Zone 2A) and the Sonoma Creek watershed (Sonoma Water Zone 3A). All maintenance activities conducted under the SMP within USACE jurisdiction (federal nexus) require CWA Section 401 Certification from the appropriate RWQCB with jurisdiction over the project area.

When the SMP was initiated the North Coast and San Francisco Bay Regional Boards each issued a Section 401 water quality certification for SMP maintenance activities conducted in their jurisdictions. The original certifications issued by the NCRWQCB (2009) and the SFBRWQCB (2011) had 5-year terms and were successfully renewed in 2014 and 2016, respectively, by the two regional boards for additional 5-year terms.

Representatives from the two Regional Boards were active in providing guidance and direction to Sonoma Water during the development of the SMP including participation at IAWG meetings, providing review and comment on the manual drafts, participating in multiple site visits, and reviewing and permitting several interim maintenance projects while the SMP was in development. In particular, the stream channel and subwatershed assessments provided in Chapter 3 and Appendix C were designed and developed specifically to provide the Regional Boards with baseline reach characterizations, photos, and map references for the program area.

2.2.3 Regulations for Use of Pesticides

Stipulated Injunction Regarding Pesticides and the California Red-Legged Frog

On October 20, 2006, the Federal District Court for the Northern District of California issued a Stipulated Injunction regarding a lawsuit brought against USEPA by the Center for Biological Diversity. The Court agreed that the USEPA failed to comply with section 7(a)(2) of the federal Endangered Species Act (ESA) by not ensuring that its registration of 66 named pesticide active ingredients will not affect the California red-legged frog.

Terms of the Stipulated Injunction require the USEPA to make determinations on the potential effects of 66 named pesticides on California red-legged frog. The injunction also establishes buffer areas around certain habitats of the California red-legged frog, and disallows use of certain pesticides within those habitats and buffer zones. The injunction addresses pesticide use only in and within 400 feet of certain geographic areas designated by the USFWS as critical habitat, and specified non-critical habitat ‘sections.’ Sections are defined one-square mile areas of land, based on the Meridian-Township-Range-Section geographic system.

The Injunction allows a reduced buffer for localized spot treatments using handheld devices on rights-of-way, roadsides, pastures, lawns, or in forests and individual tree removal using cut stump application. The Injunction prohibits use of listed pesticides within 60 feet of aquatic breeding or non-breeding aquatic critical habitat or within 60 feet of aquatic features within the non-critical habitat sections subject to the Injunction.

The Injunction does not apply to proposed pesticide use if all of the following conditions are met:

- the pesticide is applied for the purpose of controlling state-designated invasive species and noxious weeds under a program administered by a public entity; and
- the pesticide is not applied within 15 feet of aquatic breeding critical habitat or non-breeding aquatic critical habitat, or within 15 feet of aquatic features within non-critical habitat sections subject to the injunction; and
- application is limited to localized spot treatment using hand-held devices; and
- precipitation is not occurring or forecast to occur within 24 hours; and
- the pesticide is applied by a certified applicator or working under the direct supervision of a certified applicator; and
- if using 2,4-D or triclopyr, only the amine formulations are used.

Stipulated Injunction Regarding Pesticides and the Pacific Salmonids

A citizen suit was filed under the ESA against the USEPA by a group of environmental organizations (Washington Toxics Coalition, et al. v. [US]EPA). In response, on January 22, 2004, the United States District Court for the Western District of Washington issued an order that establishes pesticide buffer zones on waters that support endangered or threatened Pacific salmon and steelhead. Buffer zones are areas adjacent to certain streams, rivers, lakes estuaries and other water bodies, in which the court ordered that certain pesticides not be used. Generally, the buffers established by the Court are 20 yards for ground application and 100 yards for aerial application, adjacent to certain "salmon-supporting waters" in Washington, Oregon and California. In Sonoma County, these buffers apply to all streams and rivers for the 37 listed pesticides.

The injunction included a reduced one-yard buffer for localized spot treatments using hand-held, ready-to-use devices, as long as the area treated is limited to 10 percent of the treated right-of-way, roadside, pasture, lawn or forestry site, individual tree removal using cut stump applications, and basal bark applications to individual plants.

If used to control state-designated noxious weeds as part of a program administered by a public entity, no buffer is required if:

- the application is overseen by a Certified Applicator and precipitation is not occurring or forecast to occur within 24 hours.
- if using 2,4-D or Triclopyr, only the amine formulations are used.

SMP Actions and Compliance Approach

Sonoma Water does not use or apply pesticides (including herbicides) within any channels below the OHWM, but uses some pesticides in targeted applications for weed control on access roads, cut tree stumps, and for blackberry control. Application of pesticides on access roads in the SMP program area is carried out by Sonoma County under an agreement with Sonoma Water. The agreement requires that Sonoma County complies with all application regulations, including the Federal Insecticide and Fungicide Act, and that all County pesticide applicators are certified by the state. Currently, Sonoma County applies AquaMaster®, which contains glyphosate as the active ingredient, to access roads along Sonoma Water-maintained channels. As part of tree removal activities within maintenance channels, AquaMaster® is applied primarily on cut willow stumps by hand, as shown in Figure 7-12. Approximately 5-10 gallons of AquaMaster® are applied per month during the dry season (June-October) throughout the SMP area. Sonoma Water may apply AquaMaster® to control problematic blackberry patches. The herbicide would be applied with a truck mounted sprayer with a hose reel or backpack sprayer after initial mechanical removal. More specifically, in 2017 Sonoma Water used one gallon of AquaMaster® for stump treatment, 2 gallons for access road maintenance, and 21.5 gallons for invasive species control. The SMP does not include application of pesticides directly to water bodies, such as for control of invasive ludwigia.

Herbicide use is conducted consistent with Sonoma Water's Integrated Pest Management Plan (Blankinship & Associates, Inc. 2019), which focuses on long-term prevention of pests through a combination of techniques including biological control habitat manipulation, modification of cultural practices, and use of resistant varieties. Herbicide use is minimal and applied only used after primary methods such as mechanical removal and mowing are used for managing problematic vegetation. See Chapter 7, *Vegetation Management,* Section 7.7, "Herbicide Use," for additional discussion about Sonoma Water's approach for complying with their Integrated Pest Management Plan.

Coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit is not required because pesticides are not being applied directly to water under the SMP.

As described above, court-ordered buffers have been established to protect California red-legged frog habitat. In the SMP program area, these buffers would apply in the application of AquaMaster® to maintenance roads and cut tree stumps. Though there are no Sonoma Water-maintained channels within the sensitive areas identified in Zones 1A, 2A, or 3A where the majority of SMP maintenance activities would occur, Sonoma Water may conduct herbicide application activities in Zones 8A or 9A. If so, the court-ordered buffers for use of AquaMaster® near sensitive habitat would apply.

Court-ordered buffers have also been established to protect salmonid habitat. However, AquaMaster®, the herbicide used by the County on maintenance roads and cut stumps, is not listed as a pesticide requiring buffering for salmonid habitat. If Sonoma Water or the County decided to use one of the herbicides listed in the court injunction, the mandated buffers around streams and rivers in the SMP area would apply.

2.2.4 Section 303[d] – Impaired Water Bodies and Total Maximum Daily Loads

Under CWA Section 303[d], states are required to identify "impaired water bodies," (that do not meet established water quality standards), identify the pollutants causing the impairment, establish priority rankings for waters on the list, and develop a schedule for developing control plans to improve water quality. The Section 303[d] List identifies priorities for development of pollution control plans for each listed water body and pollutant. The pollution control plans triggered by the Section 303[d] List are called Total Maximum Daily Loads (TMDLs). The TMDL is a "pollution budget" designed to restore the health of a polluted body of water. The TMDL contains the target reductions needed to meet water quality standards and allocates those reductions among the pollutant sources in the watershed.

SMP Compliance Approach

The current Section 303[d] List was last reviewed and approved by the USEPA April 6, 2018. Impaired water bodies in the SMP area included in the 2014/2016 list are shown in Table 2-2. TMDLs that have been adopted and are under development in Sonoma County are listed in **Table 2-3**. The SMP includes many BMPs to prevent release of pollutants, including those sequestered in channel sediments during and after maintenance activities. These BMPs ensure that maintenance activities do not contribute to existing impairments within the program area. Reducing the amount of sediment entering the Laguna de Santa Rosa and larger Russian River system, as well as entering Sonoma Creek are important objectives of local TMDLs.

Table 2-2. 2014/2016 Clean Water Act Section 303(d) List of Water Quality Limited Segments in Program Area

Watershed	Subbasin	Pollutant	Potential Sources
Regional Water Quality Control Board – North Coast (Region 1)			
Gualala River		Temperature	Removal of riparian vegetation, streambank modification/ destabilization, channel erosion, erosion/siltation, nonpoint sources
		Aluminum	Source unknown
		Sedimentation/ Siltation (entire watershed)	Silviculture, construction/land development, disturbed sites, flow regulation/ modification, erosion/siltation, harvesting, restoration, residue Management, nonpoint source, removal of riparian vegetation, specialty crop production. Being addressed by USEPA approved TMDL.

Watershed	Subbasin	Pollutant	Potential Sources
Russian River		Sedimentation/ Siltation (entire watershed)	Silviculture, construction/land development, disturbed sites, dam construction, flow regulation/ modification, erosion/siltation
		Temperature (entire watershed)	Hydromodification, flow regulation/ modification, habitat modification, removal of riparian vegetation, nonpoint sources
	Geyserville	Diazinon, Indicator Bacteria	Source unknown
	Guerneville	Aluminum, Indicator Bacteria, Specific Conductivity	Nonpoint/point source, source unknown
	Green Valley Creek	Indicator Bacteria, Dissolved Oxygen	Nonpoint source, other; source unknown
	Laguna de Santa Rosa	Indicator Bacteria, Dissolved Oxygen, Mercury, Phosphorus	Internal nutrient cycling, nonpoint source, point source, source unknown
	Santa Rosa Creek	Indicator Bacteria, Mercury	Nonpoint source, other, source unknown
	Lake Sonoma	Mercury	Resource extraction, nonpoint source
Regional Water Quality Control Board – San Francisco Bay (Region 2)			
Petaluma River		Diazinon, Nutrients, Pathogens, Sedimentation/ siltation, Trash	Agricultural, construction/land development, urban runoff/storm sewers, source unknown
Sonoma Creek		Nutrients, Pathogens, Sedimentation/ siltation	Agriculture, construction/land development, land development, urban runoff/storm sewers
San Antonio Creek		Diazinon	Urban runoff/storm sewers

Source: SWRCB (2016)

Table 2-3. Status of TMDLs in the SMP Area

Water Body	Impairment	TMDL Status
Regional Water Quality Control Board – North Coast (Region 1)		
Laguna de Santa Rosa	Indicator Bacteria, Dissolved Oxygen, Mercury, Phosphorus, Sediment, Temperature	A TMDL for high levels of ammonia and low dissolved oxygen concentrations was approved by the USEPA in 1995 as the Waste Reduction Strategy for the Laguna de Santa Rosa. TMDLs are currently being developed for nitrogen, phosphorus, dissolved oxygen, temperature, and sediment in the Laguna de Santa Rosa watershed to address continuing water quality impairments. These TMDLs will apply to the entire Laguna de Santa Rosa watershed, including Mark West Creek, Santa Rosa Creek, and all tributaries. Indicator bacteria levels in the Laguna de Santa Rosa and Santa Rosa Creek are being addressed as part of the larger Russian River Pathogen TMDL development effort. TMDLs for aluminum, manganese and mercury are not being developed at this time.
Russian River	Sediment Temperature	The Russian River watershed TMDL for sediment is expected to be complete in 2025. The North Coast RWQCB adopted the Sediment TMDL Implementation Policy on November 29, 2004 to control sediment pollution using permitting and enforcement tools. The Regional Board is proposing to address the Russian River temperature impairment in part through development of a region-wide temperature TMDL implementation policy.
▪ Fifes Creek to Dutch Bill Creek ▪ upstream of Healdsburg Memorial Beach to the Highway 101 crossing	Pathogens / Fecal Indicator Bacteria	TMDL for sediment was expected to be complete in 2010; TMDL for nutrient impairment was expected to be completed in 2018.
Regional Water Quality Control Board – San Francisco Bay (Region 2)		
Sonoma Creek	Pathogens	A TMDL and implementation plan for pathogens in the Sonoma Creek watershed was completed in June 2006 and approved by USEPA on February 29, 2008.

	Sediment Nutrients	TMDL for sediment was expected to be complete in 2010; TMDL for nutrient impairment was expected to be completed in 2018.
Petaluma River	Diazinon	San Francisco Bay Area urban creeks, including the Petaluma River, exceed water quality standards for aquatic toxicity, primarily due to runoff of the common insecticide diazinon. In order to address this water quality issue, the Diazinon and Pesticide-Related Toxicity in San Francisco Bay Area Urban Creeks TMDL and supporting documents, was developed and adopted in 2005.
San Pablo Bay	Mercury	The San Francisco Bay Mercury TMDL was completed to examine this water quality problem and identifies sources of mercury. On February 12, 2008, the USEPA approved a Basin Plan amendment incorporating a TMDL for mercury in San Francisco Bay and an implementation plan to achieve the TMDL.
	PCBs	A TMDL and associated implementation plan addressing the PCB issue within the San Francisco Bay was completed, and adopted by the Regional Water Board in 2008. The TMDL was approved by USEPA on March 29, 2010.
	Chlordane, DDT, Dieldrin	TMDLs for Chlordane, DDT, Dieldrin were expected for completion in 2013.
	Selenium	TMDL for Selenium was expected in 2016.
	Dioxin compounds (including 2,3,7,8-TCDD), Furan compounds, and invasive species	TMDL for Dioxin compounds, Furan compounds and invasive species are expected to be complete in 2019.

RWQCB's Nutrient Offset Program with City of Santa Rosa

The NCRWQCB and City of Santa Rosa developed the Santa Rosa Nutrient Offset Policy (Resolution No. R1-2008-0061) in 2008 to provide a framework to enable water quality improvement activities through a credit program. As part of the Nutrient Offset Program, the City of Santa Rosa has completed projects to stabilize stream crossings and roadways; enhance stream bank vegetation; reshape stream channels to more natural contours; and remove polluted sediment by dredging. Recently in July 2018, the NCRWQCB adopted Resolution No. R1-2018-0025 approving the Water Quality Trading Framework for the Laguna de Santa Rosa Watershed (approved Framework). The approved Framework is intended to replace the 2008

Santa Rosa Nutrient Offset Program and is available to both the City of Santa Rosa and the Town of Windsor as an approved method for complying with "no net loading" effluent limitations for total phosphorus in each of their NPDES permits.

In support of the nutrient offset program and the new approved Framework, Sonoma Water is partnering with the City of Santa Rosa to undertake sediment removal and disposal projects targeting channels with sediment with high nutrient contents. Sonoma Water acts as the credit provider and the City of Santa Rosa acts as the credit purchaser. The credit trading between Sonoma Water and the City of Santa Rosa will be integrated into the SMP as a "module". Sonoma Water and the City of Santa Rosa follow the NCRWQCB's approved Framework for acceptable projects. More specifically sediment removal projects have been identified in the Laguna de Santa Rosa that will comply and support the approved Framework. A historical ecology resource study of the Laguna de Santa Rosa conducted by the San Francisco Estuary Institute (SEFI) identified target areas where sediment removal would aid in restoring aquatic functions. Additional information can be found at: www.waterboards.ca.gov/northcoast/ water_issues/programs/nutrient_offset_program/.

2.3 Federal Endangered Species Act

The ESA was enacted in 1973 to protect plant and wildlife species determined by USFWS or NMFS to be at risk of extinction. Species are protected through listing under the ESA as either *threatened* or *endangered*. An *endangered* species is at risk of extinction throughout all or a significant portion of its range (ESA Section 3[6]). A *threatened* species is likely to become endangered within the foreseeable future (ESA Section 3[19]). Species protected under the ESA are often referred to as "federally listed."

Table 2-4 lists special status plants, fish, and wildlife that are recognized by federal and state agencies as threatened, endangered, or species of concern and are known to occur or may occur within Sonoma Water-maintained channels.

Table 2-4. Special-Status Species with the Potential to Occur in Sonoma Water-Maintained Channels

Species	Scientific Name	Status*	
		State/CRPR	Federal
Invertebrates			
California freshwater shrimp	*Syncaris pacifica*	SE	FE
Fish			
Central California Coastal Chinook	*Oncorhynchus tshawytscha*	—	FT
Central California Coast Coho	*Oncorhynchus kisutch*	SE	FE
Central California Coast steelhead	*Oncorhynchus mykiss*	—	FT
Russian River tule perch	*Hysterocarpus traskii pomo*	CSC	—
Pacific lamprey	*Lampetra tridentata*	--	SC

Species	Scientific Name	Status*	
		State/CRPR	Federal
Hardhead	*Mylopharodon conocephalus*	CSC	—
Navarro roach	*Lavinia symmetricus navarroensis*	CSC	—
Sacramento splittail	*Pogonichthys macrolepidotus*	CSC	—
Amphibians and Reptiles			
California tiger salamander	*Ambystoma californiense*	ST	FE
California red-legged frog	*Rana draytonii*	CSC	FT
California giant salamander	*Dicamptodon ensatus*	CSC	—
Foothill yellow-legged frog	*Rana boylii*	CSC, STC	—
Red-bellied newt	*Taricha rivularis*	CSC	—
Western pond turtle	*Actinemys marmorata*	CSC	—
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	SE	FD
Burrowing Owl	*Athene cunicularia*	CSC	—
San Pablo Song Sparrow	*Melospiza melodia samuelis*	CSC	—
Saltmarsh Common Yellowthroat	*Geothlypis trichas sinuosa*	CSC	—
Tricolored Blackbird	*Agelaius tricolor*	ST	—
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	SE	FT
White-tailed Kite	*Elanus leucurus*	FP	—
Yellow-breasted Chat	*Icteria virens*	CSC	—
Yellow Rail	*Coturnicops noveboracensis*	CSC	—
Yellow Warbler	*Setophaga petechia*	CSC	—
Mammals			
American badger	*Taxidea taxus*	CSC	—
Pallid bat	*Antrozous pallidus*	CSC	—
Townsend's big-eared bat	*Corynorhinus townsendii*	CSC	—
Western red bat	*Lasiurus blossevillii*	CSC	—
Plants			
Baker's navarretia	*Navarretia leucocephala* ssp. *bakeri*	1B.1	—
Burke's goldfields	*Lasthenia burkei*	SE/1B.1	FE

Species	Scientific Name	Status*	
		State/CRPR	Federal
California beaked-rush	*Rhynchospora californica*	1B.1	—
Deceiving sedge	*Carex saliniformis*	1B.2	—
Dwarf downingia	*Downingia pusilla*	2B.2	—
Legenere	*Legenere limosa*	1B.1	—
Many-flowered navarretia	*Navarretia leucocephala* ssp. *plieantha*	SE/1B.2	FE
Saline clover	*Trifolium depauperatum* var. *hydrophilum*	1B.2	—
Sebastopol meadowfoam	*Limnanthes vinculans*	SE/1B.1	FE
Sonoma alopecurus	*Alopecurus aequalis* var. *sonomensis*	1B.1	FE
Sonoma sunshine	*Blennosperma bakeri*	SE/1B.1	FE
Sonoma white sedge	*Carex albida*	SE	FE
Swamp harebell	*Campanula californica*	1B.2	—

* Status Definitions

Federal

- FE Federally Endangered
- FT Federally Threatened
- SC Federal Species of Concern
- FD Federally delisted

State

- SE State Listed as Endangered
- ST State Listed as Threatened
- STC State Listed as Candidate Species
- CSC California Species of Special Concern

California Rare Plant Rank (CRPR)

- 1B Rare, Threatened, or Endangered in California and Elsewhere
- 2B Rare, Threatened, or Endangered in California, but more Common Elsewhere
- 0.1 Seriously Threatened in California
- 0.2 Moderately Threatened in California

ESA Section 9 prohibits the take of any fish or wildlife species listed under the ESA as endangered. Take of threatened species is also prohibited under ESA Section 9 unless otherwise authorized by federal regulations.[3] *Take*, as defined by the ESA, means “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” *Harm* is defined as “any act that kills or injures the species, including significant habitat modification.” In addition, ESA Section 9 prohibits the “removal or reduction to possession” of any listed plant species “under federal jurisdiction” (i.e., on federal land, where federal funding is provided, or where federal authorization is required).

Through a consultation process between federal agencies, ESA Section 7 allows for take coverage of federal actions. This process is described in more detail in the section below. For activities conducted outside of federal jurisdiction, ESA Section 10 permits may provide incidental take coverage. For the SMP, Sonoma Water has obtained incidental take authorization through Section 7 of the ESA and has not needed to develop a conservation plan under ESA Section 10. Therefore, ESA Section 10 is not discussed further in this SMP Manual.

2.3.1 Section 7 – ESA Authorization for Federal Actions

ESA Section 7 provides a means for authorizing take of threatened and endangered species by federal agencies under certain circumstances. It applies to actions that are conducted, permitted, or funded by a federal agency. Under ESA Section 7, the federal agency conducting, funding, or permitting an action (the lead agency) must consult with USFWS or NMFS, as appropriate, to ensure that the proposed action will not jeopardize endangered or threatened species or destroy or adversely modify designated critical habitat[4]. If a proposed project “may affect” a listed species or designated critical habitat, the lead agency is required to prepare a biological assessment (BA) evaluating the nature and severity of the expected effect. In response, USFWS or NMFS issues a biological opinion (BO), with a determination that the proposed action either:

- may jeopardize the continued existence of 1 or more listed species (*jeopardy finding*) or result in the destruction or adverse modification of critical habitat (*adverse modification finding*), or
- will not jeopardize the continued existence of any listed species (*no jeopardy finding*) or result in adverse modification of critical habitat (*no adverse modification finding*).

The BO[5] issued by USFWS or NMFS may stipulate “reasonable and prudent” conservation measures. If the project would not jeopardize a listed species, USFWS or NMFS issues an incidental take statement to authorize the proposed activity.

[3] In some cases, exceptions may be made for threatened species under ESA Section 4[d]; in such cases, the USFWS or NMFS issues a “4[d] rule” describing protections for the threatened species and specifying the circumstances under which take is allowed.

Critical Habitat is defined as specific geographic areas, whether occupied by listed species or not, that are determined to be essential for the conservation and management of listed species, and that have been formally described in the Federal Register.

[5] The SMP Manual has been developed to address resource issues governed by a variety of laws and regulations. In an attempt to standardize language in the SMP, there are situations when specific terms are appropriate for one resource agency working under one set of laws or regulations, but not for others. A case in point is the use of the terms “impact” and “mitigation” in the SMP. These are the terms most commonly used by the RWQCB, CDFW, and

Permitting Agency and Related Regulations

The ESA is administered by the USFWS and NMFS. In general, NMFS is responsible for protection of ESA-listed marine species and anadromous fishes while other listed species are protected under USFWS jurisdiction. As described above, USFWS and/or NMFS are engaged in the consultation process by the lead federal agency, often the USACE, and release of a final BO represents the conclusion of the consultation.

In Sonoma County, Region 8 (California, Nevada, and Klamath Basin) of the USFWS and the NMFS Southwest Regional Office are responsible for take authorizations under the ESA. These agencies evaluate proposed actions, review BAs, and issue BOs in support of federal permitting activities.

In the program area, USFWS and NMFS have developed the Santa Rosa Plain Conservation Strategy (SRPCS) (USFWS 2005a) and the Russian River Watershed BO for water supply, flood control, and channel maintenance activities (NMFS 2008), respectively, to provide protection and management of certain listed species in these areas. These documents were considered in development of the SMP Manual and the program's Section 7 compliance approach, and are described below.

Santa Rosa Plain Conservation Strategy

The SRPCS was developed in 2005 by the Santa Rosa Conservation Strategy Team to provide a long-term conservation program to mitigate potential adverse effects on five-federally listed species due to future development on the Santa Rosa Plain. The SRPCS study area includes a large portion of the Laguna de Santa Rosa Watershed, within Zone 1A of the SMP program area (Figure 2-1). The conservation strategy focuses on the distinct population segments of the California tiger salamander (*Ambystoma californiense*), Burke's goldfield (*Lasthenia burkei)*, Sonoma sunshine (*Blennosperma bakeri)*, Sebastopol meadowfoam (*Limnanthes vinculans),* and the many-flowered navarretia (*Navarretia leucocephala ssp. plieantha*) in Sonoma County. Due to the presence of the SRPCS, USFWS has not proposed critical habitat for any of these federally listed species within the SRPCS area.

The SRPCS and its associated BO focus on new development and capital projects and do not explicitly cover operations and maintenance activities such as those in the SMP. The SMP activities could result in limited temporal impacts to the species covered under the SRPCS, but will not result in permanent impacts to, or significant levels of, take of federally listed species. Nonetheless, California tiger salamander and the listed plant species in the SRPCS may potentially be found in Sonoma Water-maintained channels or V-ditches. The SRPCS provides guidance on evaluating potential impacts to these species as well as developing avoidance measures and appropriate mitigation ratios. The SRPCS guidance was incorporated into the SMP's mitigation approach as described in Chapter 11, *Program Mitigation*. The SRPCS guidance was also incorporated into the BAs developed to support additional Section 7 compliance for the SMP programmatic permits (described below).

USACE, but not within Section 7 of the ESA. As such, please note that within the context of the ESA the term "impact" will refer to "affect" or "effect" and the term "mitigation" will refer to "compensation".

Russian River Watershed Biological Opinion

NMFS consulted with the USACE regarding its operations of the Warm Springs Dam and Coyote Valley Dam and a suite of activities that are authorized by the USACE and undertaken by Sonoma Water and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (MCRRFCD). The USACE, Sonoma Water, and MCRRFCD proposed to implement 15 years of ongoing practices and operations related to dam operations, flood control, water supply, water diversion and storage, regulation of flows on the Russian River and Dry Creek, estuary management, hydroelectric power generation, fish hatchery production, and channel maintenance in the Russian River watershed.

A BO was issued September 24, 2008 and provides a 15-year authorization term. The BO relates the proposed program activities and their effects on listed salmonid species (including California Central Coast steelhead, Chinook salmon, and coho salmon) and their habitats in the Russian River watershed. The BO summarized the consultation process and provided the following information: environmental baseline of the program area; environmental effects of the proposed actions; potential effects of the proposed actions on critical habitat and species; conclusions on the environmental effects of the program; reasonable and prudent alternatives; and an Incidental Take Statement.

The Russian River BO provides coverage for maintenance activities in tributary watersheds to the Russian River including Sonoma Water Zone 1A. The consultation and BO provide ESA compliance and coverage for impacts on listed salmonids resulting from SMP activities in Zone 1A. Key actions, impact avoidance and minimization measures, and terms and conditions resulting from the BO were incorporated into the SMP. The implementation of the SMP will follow the findings and provisions of the BO. The Russian River BO document is available at: evogov.s3.amazonaws.com/185/media/159660.pdf.

Key BO provisions for the amount or extent of take provided by the Incidental Take Statement for the SMP are summarized in **Table 2-5**. This table includes the authorized amount of disturbed habitat to be maintained according to linear feet of creek length and the frequency of maintenance of the 15-year BO period. Reasonable and Prudent Measure 5 from the Incidental Take Statement of the BO provides guidance on measures to reduce harm and mortality to listed salmonids from channel maintenance activities (including activities in Zone 1A). These measures are relevant to the SMP and were incorporated directly into the impact avoidance measures and BMPs of Table 10-1.

Table 2-5. Terms and Conditions for Maintenance Activities in Zone 1A

Creek	Maintenance Type	Area of Maintenance (feet)	Frequency/ per 15 years
Mark West Creek and Tributaries	No coverage	-	-
Laguna de Santa Rosa	Sediment Removal	2,400	3 times between 2008-2023
	Vegetation Removal	12,000	Annually

Creek	Maintenance Type	Area of Maintenance (feet)	Frequency/ per 15 years
Copeland Creek	Sediment Removal	3,270	6 times between 2008-2023
	Vegetation Removal	9,625	Annually
Santa Rosa Creek	Sediment Removal	4,000	3 times between 2008-2023
	Vegetation Removal	12,100	Annually
Windsor Creek	Sediment Removal	500	2 times between 2008-2023
	Vegetation Removal	3,000	Annually

Source: NMFS 2008.

SMP Permitting Approach

In accordance with issuance of CWA Section 404 permits by the USACE for SMP activities, ESA Section 7 consultations with the USFWS and NMFS are required. As described above, the USFWS' SRPCS does not cover SMP activities in the Santa Rosa Plain area, but does provide guidance and approaches to avoid and minimize impacts to listed species. A BA document was submitted to the USACE and USFWS in 2008 to address the entire SMP program area and all listed species and designated critical habitat under jurisdiction of the USFWS (Table 2-4). This BA included the guidance and approaches recommended in the SRPCS that are relevant for SMP activities. The USFWS issued a BO for SMP actions in 2009 to be effective for a 10-year period that aligns with the USACE's individual permit.

In terms of salmonids, SMP activities and this manual were reviewed and updated carefully to comply with the terms and conditions of the Russian River Watershed BO issued by NMFS (September 24, 2008). As described above, this BO covers SMP activities in Zone 1A only. To support USACE consultation and permitting for all SMP activities, a BO for activities conducted in areas outside of Zone 1A (outside of the Russian River watershed) was issued by NMFS (April 5, 2010). This BO addresses the potential for incidental take of California Central Coast steelhead, Chinook salmon, and coho salmon in the Petaluma (Zone 2A) and Sonoma River (Zone 3A) watersheds. This BO has an authorization term to coincide with the 10-year Individual Permit issued by the USACE (Corps File No. 2009-00136N).

In summary, three BOs (one from USFWS for the entire SMP program area, the NMFS Russian River BO for salmonids in Zone 1A, and one from NMFS for salmonids in Zones 2A/3A) provide Section 7 ESA compliance for the SMP. These BO documents will be reviewed and updated as part of the permit renewal process as the existing SMP permits and authorizations are renewed.

2.4 Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a national program to manage and conserve fisheries of the United States through the development of Federal Fishery Management Plans (FMPs), and the Federal regulation of domestic fisheries under those FMPs, within the 200-mile U.S. Exclusive Economic Zone. The Magnuson-Stevens Act requires each existing, and any new, FMP to "describe and identify Essential Fish Habitat (EFH) for the fishery, where EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 United States Code [USC] §1802(10)).

Pursuant to the Magnuson-Stevens Act, each Federal agency is mandated to consult with NOAA's NMFS with respect to any action authorized, funded, undertaken, or proposed by such agency that may adversely affect any EFH under this Act. Further, where NMFS receives information from a Fishery Management Council, or Federal or state agency or determines from other sources that an action authorized, funded, or undertaken, or proposed to be, by any Federal or state agency would adversely affect any EFH identified under this Act, NMFS has an obligation to recommend to such agency measures that can be taken to conserve EFH.

Potential adverse effects to EFH due to SMP activities conducted in the Russian River watershed (Zone 1A) were evaluated by NMFS as part of the Russian River BO. To avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH, NMFS provided seven EFH conservation recommendations (Page 364 of NMFS 2008) to protect EFH within the Russian River estuary, modify flood control operations to improve salmonid habitat, and implement restoration projects within the watershed.

The USACE consulted with NMFS in 2009 regarding potential adverse effects of SMP activities on EFH within the Petaluma River and Sonoma Creek watersheds (Zones 2A and 3A, respectively) through the CWA Section 404 permitting process. As described above, NMFS issued a BO for activities conducted in areas outside of Zone 1A (outside of the Russian River watershed) in April 2010. This BO includes conservation recommendations to protect EFH in the Petaluma and Sonoma Creek watersheds.

2.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 USC 703-712), administered by the U.S. Fish and Wildlife Service, implements four treaties between the United States and Canada, Mexico, Japan and Russia, respectively, to manage and conserve migratory birds that cross national borders. The MBTA makes it unlawful in any manner, unless expressly authorized by permit pursuant to federal regulations, to pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export at any time, or in any manner, any migratory bird, or any part, nest, or egg of any such bird. A list of migratory birds protected under the MBTA, available in Section 10.13 of Title 50 of the Code of Federal Regulation, excludes nonnative species that have not been introduced into the U.S. or its territories, and species that belong to the families not listed in any of the four treaties underlying the MBTA, such as wrentit (*Chamaea fasciata*), European starling

(*Sturnus vulgaris*), California quail (*Callipepla californica*), Ring-necked Pheasant (*Phasianus colchicus*) and Chukar (*Alectoris chukar),* among other species less common in California.

The MBTA is administered by the USFWS. USFWS sets seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs. Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of the MBTA. Compliance with the MBTA was determined as part of USFWS's issuance of biological opinions for the Program as described above. SMP activities, such as vegetation management, may require the removal of trees or snags where migratory birds are nesting. Compliance with this regulation is met through the implementation of bird habitat avoidance measures and BMPs during program activities so that take of migratory birds is avoided. These measures are discussed in Chapter 10.

2.6 National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, requires federal agencies (or agencies to which they provide funding or issue permits) to take into account the effects of their actions on cultural resources, including historic properties and historic and prehistoric archaeological sites. In addition, NHPA Section 106 requires lead agencies to:

- provide review and comment opportunities on actions that may affect cultural resources to the Advisory Council on Historic Preservation (an independent federal agency responsible for advising the president and Congress on historic preservation), and
- coordinate with the State Historic Preservation Officer (SHPO) in the state where the proposed action will take place.

Federal review of projects is normally referred to as the Section 106 process. The Section 106 review process normally involves the following four-step procedure described in detail in the implementing regulations (36 CFR Part 800):

- identify and evaluate historic properties in consultation with the SHPO and interested parties;
- assess the effects of the undertaking on properties that are eligible for inclusion in the NRHP;
- consult with the SHPO, other agencies, and interested parties to develop an agreement that addresses the treatment of historic properties and notify the Advisory Council on Historic Preservation; and
- proceed with the project according to the conditions of the agreement.

The SHPO has jurisdictional authority over NHPA Section 106 in California. Any federal action, such as issuance of project permits, must gain approval by the SHPO for compliance with NHPA Section 106. Compliance with NHPA Section 106 may be met through the development of a Programmatic Agreement, a Memorandum of Agreement, or a project-by-project evaluation.

Compliance under each pathway generally involves completion of a cultural resources inventory, evaluation of resources, and implementation of avoidance and mitigation measures for projects that may have an impact on cultural resources.

All earth-moving activities, such as bank stabilization and sediment removal projects, conducted under the SMP within USACE jurisdiction (federal nexus) require compliance with NHPA Section 106. As such, Sonoma Water submitted a report documenting cultural resources, including historic properties and historic and prehistoric archaeological sites, in the SMP area to the USACE in 2009 who consulted with the SHPO as part of the USACE process to develop its Individual Permit. Compliance with the NHPA Section 106 is met through implementing avoidance measures and BMPs during SMP activities so that harm to cultural resources is avoided.

2.7 National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) requires federal agencies to include in their decision-making process appropriate and careful consideration of all environmental effects of a proposed action and of possible alternatives. Documentation of the environmental impact analysis and efforts to avoid or minimize the adverse effects of proposed actions must be made available for public notice and review. Project proponents must disclose whether their proposed action will adversely affect the human or natural environment. NEPA's requirements are primarily procedural rather than substantive in that NEPA requires disclosure of environmental effects and mitigation possibilities but includes no requirement to mitigate.

The USACE was the lead agency who undertook NEPA compliance when individual permits were developed for the SMP in 2009. NEPA compliance met the environmental compliance requirements for permitting actions conducted by federal agencies granting permits for the SMP. The project description was the same for all issued permits (i.e., separate NEPA documents were not required to address USACE, USFWS or NMFS permits). The SMP Manual provided the basis for developing the project description for NEPA compliance.

2.8 Porter-Cologne Water Quality Control Act

The California Porter-Cologne Water Quality Control Act (Porter-Cologne Act) was passed in 1969 and together with the federal CWA, provides regulatory guidance to protect water quality and water resources. The Porter-Cologne Act established the SWRCB and divided California into nine regions, each overseen by a RWQCB. The Porter-Cologne Act established regulatory authority over "waters of the state," which are defined as "any surface water or groundwater, including saline waters, within the boundaries of the state" (California Water Code, Division 7, § 13050). More specifically, the SWRCB and its nine RWQCBs have jurisdiction over the bed and banks of a stream channel, its riparian corridor, and its beneficial uses.

The Porter-Cologne Act requires the development and periodic review of water quality control plans (Basin Plans) for the protection of water quality in each of the state's nine regions. A Basin Plan is unique to each region and must identify beneficial uses, establish water quality objectives for the reasonable protection of the beneficial uses, and establish a program of implementation for achieving the water quality objectives. To ensure currency, Basin Plans must be updated every 3 years. Basin Plans provide the technical basis for the RWQCBs to determine waste discharge requirements (WDRs), take enforcement actions, and evaluate grant proposals.

The Basin Plans, developed by the North Coast RWQCB and the San Francisco RWQCB, outline water quality objectives for surface waters in the SMP area for a host of pollutants including, but not limited to, sediment, suspended material, temperature, toxicity, turbidity, chemical constituents (i.e., inorganic and organic compounds), and dissolved oxygen. The Basin Plans also include implementation plans for achieving the water quality objectives through RWQCB programs, e.g., CWA Section 401 Water Quality Certification, WDRs, NPDES, TMDLs. Goals and objectives of the SMP were developed to comply with RWQCB programs and promote regional efforts to achieve Basin Plan objectives and numerical targets.

As described above in the discussion of CWA Section 401, regulatory compliance for projects occurring within waters of the U.S. is met through a Water Quality Certification granted by the RWQCBs. For projects occurring within Porter-Cologne Act jurisdiction (i.e., State jurisdiction) but outside of waters of the U.S. (in streams this is the area above the OHWM, or “isolated” waters such as wetlands), WDRs or Waiver of WDRs are required. WDRs are issued by the RWQCB that has jurisdiction over the region in which the project occurs.

2.8.1 SMP Compliance Approach

The North Coast RWQCB and the San Francisco RWQCB have jurisdictional authority to implement the Porter-Cologne Act in Sonoma County. All projects conducted under the SMP which occur in waters of the State require WDRs under the Porter-Cologne Act. In practice, WDRs are combined with NPDES permitting requirements and the CWA Section 401 Water Quality Certification. WDRs require compliance with all current Basin Plan policies once they are adopted. The SMP is a multi-objective approach to protecting beneficial uses through compliance with water quality objectives. Water quality objectives as described in the Basin Plans of the SMP program area were reviewed and integrated into the impact avoidance planning approaches described in Chapters 4 through 10 of this manual.

The North Coast RWQCB issued WDRs and 401 Water Quality Certification for SMP areas draining to the Russian River and Pacific Ocean on July 23, 2009 (Order No. R1-2009-0049). The San Francisco Bay RWQCB issued WDRs and 401 Water Quality Certification for SMP areas draining to the San Francisco Bay on April 14, 2011 (Order No. R2-2011-0020).

2.9 California Endangered Species Act

In support of the California Endangered Species Act (CESA), the CDFW maintains two key species lists for CESA listed species; (1) State and Federally Listed Endangered, Threatened and Rare Plants of California[6] Listed Endangered and Threatened Animals of California[7]. These lists are updated two times per year. The CDFW also maintains other lists of species with a range of protections through the California Fish and Game Code. These include California Species of Special Concern lists (CSC) for fish, reptiles, amphibians, birds and mammals. A species of special

[6] www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEPlants.pdf
[7] www.dfg.ca.gov/biogeodata/cnddb/pdfs/TEAnimals.pdf

concern is a species, subspecies, or distinct population of an animal native to California that currently satisfies one or more of the following (not necessarily mutually exclusive) criteria:

- is extirpated from the State or, in the case of birds, in its primary seasonal or breeding role;
- is listed as Federally-, but not State-, threatened or endangered; meets the State definition of threatened or endangered but has not formally been listed;
- is experiencing, or formerly experienced, serious (noncyclical) population declines or range retractions (not reversed) that, if continued or resumed, could qualify it for State threatened or endangered status; and
- has naturally small populations exhibiting high susceptibility to risk from any factor(s) that if realized, could lead to declines that would qualify it for State threatened or endangered status.

In addition to these CSC species, the California Fish and Game Code provides protections for other species such as California Fully Protected Species and Special Plant Species. It is important to note that only species classified by the state as “threatened” or “endangered” fall under the protections of CESA. Such other special status species are generally protected through either F&G Code Section 1602 (Streambed or Lakebed Alteration Agreement Program), California Fully Protected Species regulations or through the California Environmental Quality Act (CEQA) discussed elsewhere in this chapter.

Like ESA, CESA also allows for incidental take of listed species. *Take* is defined under the California Fish and Game Code as any action or attempt to “hunt, pursue, catch, capture, or kill.” The incidental take permit process is outlined in CESA (F&G Code Sections 2081 and 2080.1).

CESA (F&G Code Section 2081[b]) provides a means by which agencies or individuals may obtain authorization for incidental take of state-listed species. Take must be incidental to, and not the purpose of, an otherwise lawful activity. Requirements for a F&G Code Section 2081[b] permit include: the identification of impacts on listed species; development of mitigation measures that minimize and fully mitigate impacts; development of a monitoring plan; and assurance of funding to implement mitigation and monitoring.

In the SMP program area, the California freshwater shrimp and Central California Coastal coho salmon are the two state-listed species (both endangered) that occur within Sonoma Water’s geography and in aquatic habitats potentially affected by SMP activities. At the time when the program’s original manual was written and the original program permits were developed, the streams that were known to support coho salmon were removed from the SMP to avoid “take” of this species. In addition, there is only one stream in the SMP that is known to support California freshwater shrimp, Sonoma Creek, and maintenance activities in this creek are focused in three small and specifically defined areas. In addition to the CESA species, four CSC have the potential to be impacted by SMP activities. These CSC species include California red-legged frog, California tiger salamander, foothill yellow-legged frog, and western pond turtle.

For state-listed species that are also federally listed under the ESA, CESA (F&G Code Section 2080.1) allows for incidental take issued through ESA Section 7 or Section 10 to potentially provide incidental take coverage under CESA, assuming CDFW believes the protection and mitigation prescribed under the federal ESA consultation are sufficient. This is known as a “consistency determination.”

Under the original program permitting, a consistency determination was developed by CDFW with the BOs issued by USFWS and NMFS for the SMP. For the SMP authorization process, CDFW issued a consistency determination (August 6, 2010) with the federal take authorization under F&G Code Section 2080.1. Sonoma Water submitted an incidental take permit for foothill yellow-legged frog and is awaiting the final determination; however such a permit will unlikely be issued for the program.

Other state species with various levels of protections that could be impacted by SMP activities, and protections for these species were addressed through CDFW’s authorization through Code Section 1602 and also disclosed through the program’s original CEQA process.

2.10 California Fish and Game Code 3503 and 3503.5 (Bird Nests and Birds of Prey)

Section 3503 of the F&G Code makes it unlawful to take, possess or needlessly destroy the nests or eggs of any bird. F&G Code Section 3503.5 makes it unlawful to take, possess or needlessly destroy birds of prey or the nests or eggs of a bird of prey; §3503.5 prohibits the take, possession, or needless destruction of any nests, eggs or birds in the orders Falconiformes (new world vultures, hawks, eagles, ospreys and falcons, among others)or Strigiformes (owls); §3511 prohibits the take or possession of fully protected birds; and §3513 prohibits the take or possession of any migratory nongame bird or part thereof as designated in the Migratory Bird Treaty Act. F&G Code Section 3503 and Section 3503.5 are administered by the CDFW and the Fish and Game Commission. These regulations are enforced under CDFW’s CEQA environmental process and issuance of species take permits under CESA. SMP activities, such as vegetation management, may require the removal of trees or snags where birds are nesting. Compliance with this regulation is met through the implementation of avoidance measures and BMPs so that take of birds is avoided. The SMP contains conservation measures to avoid such take in order to comply with F&G Code Section 3503 and 3503.5.

2.11 California Fish and Game Code Section 1602 – Lake and Streambed Alteration Agreement Program

Under the F&G Code Section 1602, CDFW regulates projects that affect the flow, channel, or banks of rivers, streams, and lakes. F&G Code Section 1602 requires public agencies and private individuals to notify and enter into a streambed or lakebed alteration agreement with CDFW prior to construction of a project that will:

- substantially divert, obstruct, or change the natural flow or the bed, channel, or bank of any river, stream, or lake;

- substantially change or use any material from the bed, channel, or bank of, any river, stream, or lake; or
- result in the disposal or deposition of debris, waste, or other material containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake.

F&G Code Section 1602 may apply to any work undertaken within the 100-year floodplain of any body of water or its tributaries, including perennial, intermittent, and ephemeral rivers, streams, or lakes in the state. In general, however, it is construed as applying to work within the active floodplain and/or associated riparian habitat of a wash, stream, or lake that provides benefit to fish and wildlife. F&G Code Section 1602 typically does not apply to drainages that lack a defined bed and banks, such as swales, or to wetlands such as vernal pools.

The CDFW has regulatory jurisdiction over the bed, bank, or channel of a stream, lake, or pond, as stated in F&G Code Sections 1600-1616. Under F&G Code Section 1602, the CDFW administers the Lake and Streambed Alteration Program and may issue a Streambed Alteration Agreement (SAA) for proposed projects within their jurisdiction. The CDFW Bay Delta Region has jurisdiction over streambed alteration activities occurring in Sonoma County. Bank stabilization and sediment removal activities, as well as some vegetation management activities, implemented through the SMP require a streambed alteration agreement from CDFW.

In May 2010 CDFW issued a Master Streambed Alteration Agreement (MSAA) to provide permitting coverage and Section 1602 compliance for all SMP routine vegetation management and bank stabilization activities. The 2010 MSAA has a 15-year permit term and will expire December 31, 2025.

2.12 California Environmental Quality Act

The California Environmental Quality Act (CEQA) requires public agencies to assess and publicly disclose the environmental implications of proposed discretionary actions through evaluating potential project effects and preparing appropriate documents. As the agency with principal responsibility for carrying out the SMP, Sonoma Water was the lead agency responsible for complying with CEQA. Compliance with CEQA was met through the development of an environmental impact report (EIR) for the SMP Manual. The EIR evaluated the environmental impacts of the channel maintenance activities proposed in the SMP Manual. The EIR was crafted to address the needs of each regulatory agencies to grant permits, as well as provide the necessary CEQA compliance to allow the Sonoma Water Board of Directors to approve the SMP. The EIR was certified by the Sonoma County Board of Directors on June 23, 2009. The Draft and Final EIR are available for review at: www.scwa.gov.

2.13 Local Stream and Watershed Plans

Applicable local plans, such as general plans, are discussed in detail in the EIR which accompanies the SMP Manual. The Santa Rosa Citywide Creek Master Plan and the Laguna de Santa Rosa Restoration and Management Plan are relevant stream and watershed management plans in the SMP program area. These plans share many common goals with the SMP. These plans are summarized below.

2.13.1 Santa Rosa Citywide Creek Master Plan

The City of Santa Rosa adopted the *Santa Rosa Citywide Creek Master Plan* in March 2007 (City of Santa Rosa 2007). The master plan presents a set of creek-related policies and recommendations for site-specific improvements on streams in the City of Santa Rosa. The plan defines and describes goals and objectives for holistic creek protection and management. The Citywide Creek Master Plan addresses the approximately ninety miles of creeks that flow through Santa Rosa. The Santa Rosa Creek Master Plan describes recommendations for habitat preservation, enhancement, restoration, and management actions on specific reaches of Santa Rosa Creek and its tributaries. Information provided in the Citywide Creek Master Plan was referenced in developing the SMP Manual's environmental setting (Chapter 3) and reach sheets (Appendix C). In particular, the consideration of management opportunities at reaches was compared to the master plan for relevant creeks.

2.13.2 Laguna de Santa Rosa Restoration and Management Plan

The Laguna de Santa Rosa Foundation published *Enhancing and Caring for the Laguna de Santa Rosa: A Plan for Restoring and Managing the Laguna de Santa Rosa Watershed* (Laguna Plan) in 2006. This plan identifies restoration opportunities for the 14-mile long wetland complex that drains the Laguna's 254-square mile watershed and encompasses most of the Santa Rosa Plain. The Laguna Plan informed the SMP Manual's *Environmental Setting* (Chapter 3), reach sheets (Appendix C), and the maintenance approach and programmatic avoidance and minimization measures discussed in Chapters 4 through 10. The Laguna de Santa Rosa Foundation is a partner in Sonoma Water's off-site watershed mitigation program. Restoration activities described within the Laguna Plan can support mitigation approaches and opportunities described in Chapter 11 of this Manual.

A central issue to both the Laguna's management plan and the SMP is the role of sediment transported through Sonoma Water flood control channels that is eventually deposited in the Laguna. According to the Laguna Plan, abundant sediment deposition from upstream watershed sources impacts habitat conditions and stream integrity (Honton and Sears 2006). In Chapter 4 of the Laguna Plan, sediment removal from flood control channels is described as a solution towards downstream natural resource protection. Another related document, the Copeland Creek Watershed Assessment (Laurel Marcus and Associates 2004) provides a similar assessment and recommendation of the benefit of removing sediment in flood control channels such as Copeland Creek prior to sediment being delivered to the Laguna downstream. Mitigation approaches described in Chapter 11 of this SMP Manual consider these opportunities to reduce sedimentation to the Laguna and preserve and enhance its habitats. The Laguna Plan also includes many useful and informative appendices including an invasive species plan that identifies the highest priority exotic plants and their respective locations and a Ludwigia management plan.

2.13.3 Water Clarity Ordinance of the County of Sonoma – Ordinance No. 3836R

Ordinance No. 3836R is an initiative measure adopted by the electorate of Sonoma County on June 7, 1988. The Ordinance requires that a roiling permit be issued prior to performing work that may decrease the clarity of the waters of the river or stream. The ordinance requires a roiling permit prior to conducting work that involves protection of riparian property adjacent to a river or stream; construction of recreational dams, construction work on riparian property, ; or construction of temporary bridges, dikes, dams, and settling ponds in connection with mining operations or for agricultural uses. The permit can only be issued upon a four-fifths vote of the Sonoma County Board of Supervisors and only for a maximum period of 30 days. The Board designated the Permit and Resource Management Department (PRMD) as the administering agency of this Ordinance. Roiling permit applications are filed at PRMD and are subject to CEQA. The PRMD has issued a programmatic roiling permit to Sonoma Water for maintenance activities conducted within riparian corridors throughout the county.

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Sonoma County Water Agency

Stream Maintenance Program

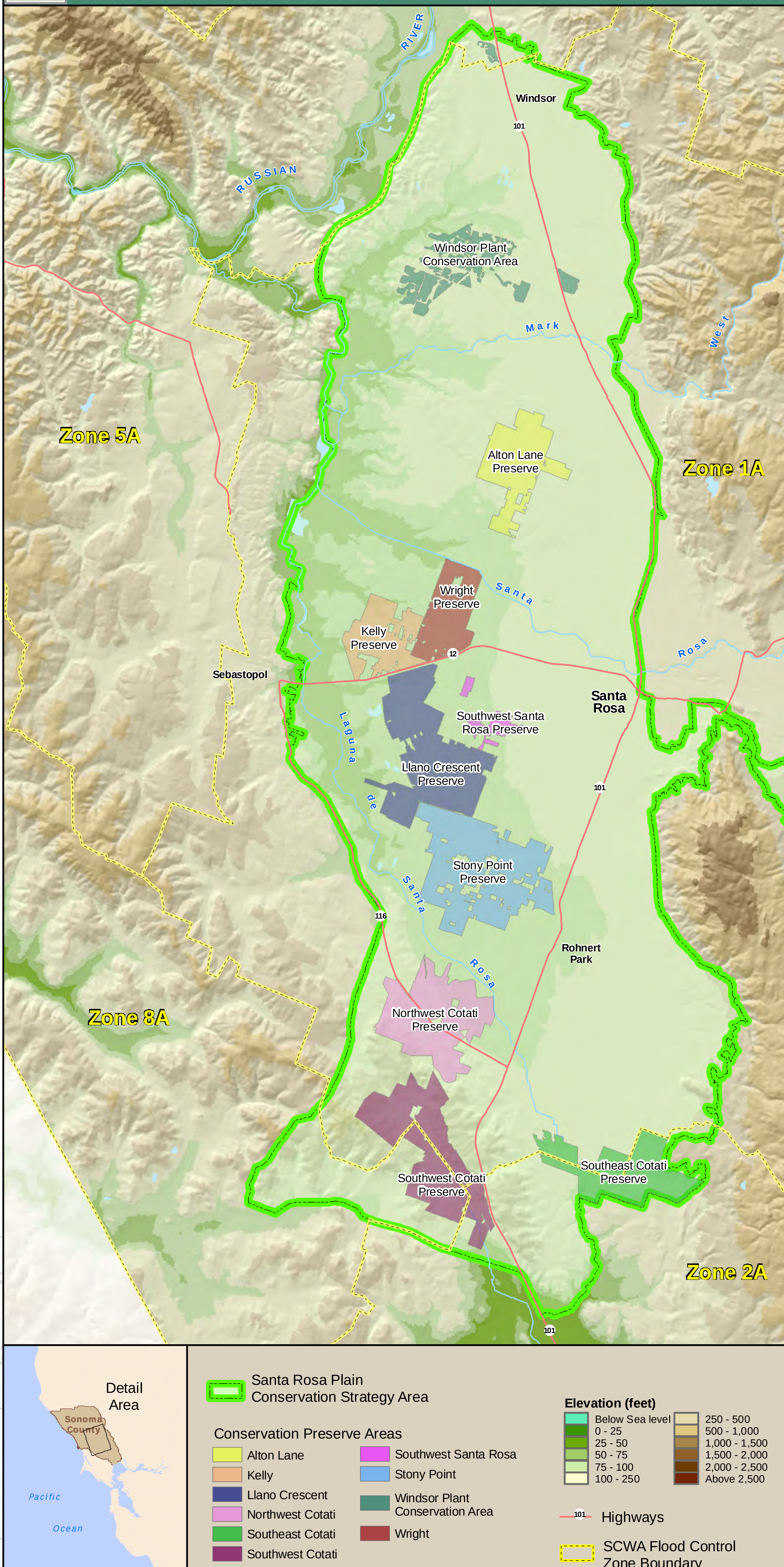

Figure 2-1

Santa Rosa Plain Conservation Strategy Area

Sources:
Sonoma County Water Agency
County of Sonoma
California Spatial Information Library
U.S. Geological Survey
Geografika Consulting

Horizon WATER and ENVIRONMENT

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Chapter 3
ENVIRONMENTAL SETTING

3.1 Introduction

This chapter presents the environmental setting focusing on the physical, hydrologic, and biological conditions of the Stream Maintenance Program (SMP) program area. Physical and biological resources are described at multiple scales including the regional or large watershed scale (e.g., Laguna de Santa Rosa Watershed), the subbasin scale (e.g., Copeland Creek Watershed), and the natural community or habitat scale (e.g., areas of Copeland Creek supporting emergent wetland marsh vegetation, etc.). This chapter also presents watershed information and stream channel characterizations for the SMP program area and provides general descriptions at the reach scale. Because the majority of the Sonoma County Water Agency (Sonoma Water) work is conducted in Flood Control Zones 1A, 2A, and 3A, this setting is generally focused on these three zones.

The resource information and channel system understanding provided in this chapter provides the basis for the maintenance approaches and environmental measures described in Chapters 5 through 10 in this manual. Since this document was originally developed in 2009, vegetation management has continued along most creeks. The result has been that canopy provided by upper bank and toe trees has continued to develop in number of layers and complexity.

Because vegetation conditions have changed and riparian canopy development has expanded throughout the program area, the stream characterizations presented in Chapter 4 of the original 2009 Manual were no longer current for this updated 2018 version of the Manual. Many areas mapped originally as open water, emergent wetlands, willow and blackberry scrub can now be classified as riparian woodland and forest. These changes were most dramatically shown in the 2013 light detection and ranging (LIDAR) flight of Sonoma County. Changes in habitat and associated flora and fauna are captured in the SMP Database by characterizing habitat during vegetation and sediment management activities.

The SMP Database includes all of the original information presented in the 2004 channel characterization sheets. Sonoma Water is now reviewing and updating the original reach descriptions to reflect current conditions. This information is available through the program website found at: www.sonomawater.org/stream-maintenance-program/.

This chapter includes the following sections:

Section 3.2 – Physical Setting
Section 3.3 – Hydrology
Section 3.4 – SMP Watersheds and Creeks
Section 3.5 – Biological Resources

The Laguna de Santa Rosa is referenced in this chapter as three different, yet related, features. The Laguna de Santa Rosa is described as being a watershed, a stream channel within the watershed, and also the namesake lagoon/marsh system near Sebastopol in the lower watershed. To provide clarity and consistency to these references, the watershed is referred to as the "Laguna de Santa Rosa watershed"; the stream channel is identified as the channel or called the "Upper Laguna" in its upper extent and into Rohnert Park; and the lagoon/marsh is identified simply as the "Laguna."

3.2 Physical Setting

3.2.1 Topography and Landforms

As described in Chapter 1, Section 1.3, "Program Area and Channel Types", the SMP program area includes all of Sonoma County but is focused on the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watersheds of the southern County. The physiography of southern Sonoma County is generally defined by a sequence of northwest to southeast aligned valleys and ridgelines which follow the regional tectonic and geologic structure. The principal landforms in the program area are shown in **Figure 3-1**. Figure 3-2 includes topographic profiles across central Zone 1A, southern Zone 1A, and central Zones 2A and 3A.

Mountains, Fans, and Plains

The Mayacamas Mountains separate Sonoma and Napa counties. The westward draining slopes of the Mayacamas Mountains provide headwater drainage areas to the northern Laguna de Santa Rosa and eastern Sonoma Creek watershed areas. The Sonoma Mountains separate the southern Laguna de Santa Rosa, northern Petaluma River, and western Sonoma Creek watershed areas.

The elevation profiles in Figure 3-2 illustrate how the Mayacamas Mountains and Sonoma Mountains provide the headwater source areas for runoff and sediment to SMP area streams to the west and east. Steep canyons and mountain streams carry flows and sediment to the valley floors building characteristic alluvial fans. The watersheds of the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek drain with different orientations. As shown in Figure 3-2 the Laguna de Santa Rosa watershed has mountains in the east and plains to the west. The slopes of the Petaluma River watershed have a more northeast-southwest alignment descending to the Petaluma River at the base of the watershed that flows southeasterly to the Bay. The Sonoma Creek watershed is more elongated and symmetrical than either the Laguna or Petaluma basins. In the Sonoma Creek system, canyon tributaries descend from both the Mayacamas in the east and Sonoma Mountains in the west on to the valley floor where Sonoma Creek leads southward to the Bay.

Alluvial fans are found at the base of mountains in each of the three focus watersheds. The fans represent the accumulation of sediment over many centuries. In some places the fans have coalesced into a combined fan surface (known as an apron or *bajada*) such as along Windsor and Mark West creeks in the Laguna de Santa Rosa watershed, where the Mayacamas Mountains transition to the alluvial fan surface east of Highway 101. Similarly, in the Rohnert Park area the alluvial fans of Copeland, Hinebaugh, Crane, and Five creeks merge into an alluvial apron at the base of the Sonoma Mountains along Petaluma Hill Road. For other streams, such as Pruit or Pool creeks in the Windsor Creek subbasin, the individual fan surface may be more independent from neighboring stream.

Historically, these alluvial fans functioned as depositional areas that stored sediments in the topographic transition between the higher and steeper mountains to the east and the lower and more gently sloping plains to the west. Streams historically migrated across these alluvial fan surfaces, sweeping across the fans over time spreading and distributing sediments evenly across the surface. Over time, fans prograded downstream onto the lower plain surface depending upon sediment sources, climatic conditions, and tectonic activity (discussed below). In the Laguna de Santa Rosa watershed the alluvial fan surfaces give way to the broader and more gently sloping Santa Rosa Plain and eventually the Laguna itself. Beside the alluvial fans, older historic sediments are also stored in relict stream terraces in the program area. Most notably, on the Santa Rosa Plain west of Highway 101 moving toward the Laguna, the Mark West Creek and Santa Rosa Creek systems both have sediments stored in historic terrace deposits.

The topographic transition between mountain, fan, and plain is particularly important in considering maintenance needs for the engineered channel systems of the SMP. Identifying the degree of slope (or gradient) across the typical profiles shown in Figure 3-2 is important in understanding the energy available to move water and sediment as well as the general distribution of coarser sediments upstream and the fining of sediments downstream.

In Flood Control Zones 1A and 2A many of the engineered channels begin in the historic alluvial fan zone, most often in the lower fan areas (Figures 1-2 and 1-3, respectively). Historically these reaches received abundant sediment from upstream sources. Over time, these reaches variably stored this sediment, distributed and deposited it along the fan surface, or carried some of it downstream depending upon the location of the active stream channel on the fan.

Under existing conditions with developed land uses adjacent to the creek either for residential, educational, commercial, transportation, or other uses; the streams have been channelized and are now operated and maintained for flood control purposes (see Chapter 1, Section 1.1, “Program Background”). Streams that previously migrated and deposited their materials across a broad fan or plain surface are now contained in generally linear channels with gradients that are typically governed by hardened road crossings.

The result of the current engineered channel system is that sediments that historically would have been deposited and spread across the larger plain and alluvial fan area now accumulate inside the engineered channels. Identifying, managing, and sometimes removing this sediment is a key aspect of the SMP. Recognizing the historical conditions and physical processes under which this sediment system operated guides maintenance approaches that are physically appropriate, environmentally sensitive, and sustainable (see Chapter 4, Section 4.2, *Maintenance Principles*).

Lowlands and the Laguna

The program area’s lowlands are formed near the outlet of the Laguna de Santa Rosa watershed. Lowlands of the Petaluma River and Sonoma creek watersheds are found in the floodplains, marshes, and tidal areas near to the edge of the San Francisco Bay. These lowlands and baylands are part of important regional ecosystems that include many sensitive habitats. In particular, the Laguna is a key hydrologic feature and ecologic resource in the program area supporting a mosaic of channels, oxbows, ponds, and wetlands. As shown in Figure 3-1, the Laguna extends nearly 12 miles from its northern confluence with the Russian River to its southern origin at creeks in the Rohnert Park and Cotati area. The Laguna is nearly a mile wide at its downstream end, is generally about three-quarters to one-half mile wide through most of its length, and tapers to a few hundred yards towards its southern upper limit.

In the winter, a natural basin at the confluence of the Laguna and Mark West Creek receives surplus (or carryover) storm flows from the Russian River. This inflow from the Russian River causes a hydraulic backwatering and detainment of other Laguna watershed flows providing flood storage and peak attenuation benefits for the lower Russian River valley. The Laguna can detain and store 80,000 acre-feet of water that would otherwise flow directly to the lower Russian River (Philip Williams and Associates [PWA] 2004; Sonoma County Flood Control and Water Conservation Improvement District 1965). Although this natural flood storage is advantageous for managing flood waters in the lower Russian River watershed, the backwatering effects upstream areas and impacts flood conveyance in many of its tributaries.

A fuller description of the Laguna de Santa Rosa watershed is found in *Enhancing and Caring for the Laguna: A Plan for Restoring and Managing the Laguna Watershed* developed by the Laguna de Santa Rosa Foundation (Laguna Foundation) (Honton and Sears 2006). An important connection between the goals of SMP and the Laguna Foundation's management plan is that both strive to find ways to reduce sediment deposition in the Laguna and reduce the impacts to habitat quality associated with sedimentation. Water quality issues affecting the Laguna, including sediment, are discussed further below.

3.2.2 Geology and Soils

Regional Geology

The geology and structure of the program area in southern Sonoma County has been shaped through a dynamic history of tectonism along the San Andreas Fault Zone. The northwest-southeast alignment of this fault zone with its characteristic right-lateral strike-slip tensional movement is reflected in the alignment and orientation of the region's ridgelines and valleys (see landform discussion above). Movement along the fault zone was not only lateral, but also included compression resulting in the mountain building of the Coast Ranges in the program area (Nilsen 1987). In Sonoma County, the main artery of the San Andreas Fault roughly follows Highway 1 near the coast. In the focus area of the SMP (Zones 1A, 2A, and 3A) the Healdsburg-Roger's Creek and Mayacama faults share the similar northwest-southeast alignment as the San Andreas Fault Zone (**Figure 3-3**).

As shown in Figure 3-3, the distribution and sequence of rock types in the program area reflect the area's geologic history (Norris and Webb 1990). The oldest rocks include the Great Valley Complex with its tilted marine sedimentary layers, mostly sandstones and shales. The Great Valley Complex underlays much of the project, but clearer exposures are found to the west and east. More prevalent in the program area are rocks of the Franciscan Complex, a mixture of chert, basalt, shale, metamorphic rocks, and mélange created by subduction zone processes. Franciscan rocks are seen in the upper Mark West and Santa Rosa creek watersheds, in the southern Petaluma watershed, and a few outcrops west of the Laguna.

However, the rocks that best define the crests and slopes of the upper watersheds in the SMP program area belong to the Sonoma Volcanics (Sloan 2006). Compared to some of the sedimentary rocks in the region, these volcanic rocks are more resilient and durable, which explains their prominence along ridgelines. Sonoma Volcanics are observed in the headwaters for several of the program area's streams in the Mayacamas and Sonoma ranges (Figure 3-3). Around the time of the Sonoma volcanism (five million years ago), but further to the west, sandy sediments were deposited in a shallow marine environment. Now lithified, these rocks are seen today as the sandstones of the Gold Ridge Hills south and west of Sebastopol, Cotati, and Petaluma.

These past processes provided the basic earth materials which are now eroded and carried in today's channels. The large majority of engineered channels in the SMP program area are located in Quaternary (last two million years) and surficial geologic materials (**Figure 3-4**). The explanation for this follows the landform discussion above which described how most channels of the SMP are found in depositional areas of alluvial fans, plains, or other lowlands where sediments have historically collected for many thousands of years.

In the Petaluma River watershed, many of the channels of the SMP are built onto medium-textured alluvium of the Petaluma plain. In the Sonoma Creek watershed, the main arm of Sonoma Creek flows south along the coarser sediments of the valley floor. Several older Pleistocene terraces also run throughout the Sonoma Valley, but are located further from the creek. Interestingly, the east side of Sonoma Valley includes abundant colluvium. Colluvium is sediment or rock that is deposited at the base of a slope by gravity or sheetwash, but it is not transported by channelized flow like in the case of alluvium. Though dependent on specific site and land use conditions, colluvium is typically highly erosive and can often enter neighboring streams.

An important feature of Figure 3-4 are several of the known and mapped larger landslides of the program area. These landslides are significant sediment sources for the streams and channels downstream. Landslides are prominent in the headwaters to Copeland, Crane, Five, and Hinebaugh creeks in the Rohnert Park area. Not shown on this map, but observed in the field, are additional landslides and gullies in the headwaters of Cook and Coleman creeks that have exacerbated downstream sedimentation. The Cook Creek landslide in particular has led to abundant downstream sedimentation in the past and has required specialized erosion control techniques at the toe of the slide, as well as multiple maintenance clearings at the Cook Creek sediment basin just downstream of the landslide. In the Petaluma River watershed a large landslide at the common headwater areas to Lichau, Willow Brook, Lynch, Washington, and Adobe creeks also supplies the creeks with eroded materials.

Understanding the causes and remedies of an individual landslide is often complex. Causes may begin with geologic conditions that favor instability, yet often the triggers for sliding are climatic, hydrologic, or land use conditions which move forces beyond a threshold. A central component of the SMP, both in terms of the program's approach towards sustainability and its goal of effective sediment management is the concern and attention towards reducing headwater area erosion sources. As described in Chapter 11, *Program Mitigation,* the SMP seeks to work with local landowners and erosion specialists to reduce erosion "hot spots" such as at Cook Creek through improved management and applied erosion control techniques.

Soils

Soils in the program area are varied, derived from diverse landform, geologic, climatic, and biologic conditions. The Soil Survey of Sonoma County (U.S. Department of Agriculture 2018) includes 15 soil associations. At the association level, soils are generally distinguished according to their geomorphic and topographic setting; whether they are located in basins, tidal flats, floodplains, terraces, alluvial fans, high terraces, foothills, uplands, and mountains. In general, the soils in the lowland basins, floodplains, and alluvial fans range from gravelly sandy loams to clays; most often composed of clays and clay loams that formed in alluvium from sedimentary and volcanic material. These soils vary in drainage capacity from poor to excessive, with the more clay-textured soils draining more poorly. The soils on the high terraces, foothills, uplands, and mountains consist of gravelly to stony sandy loams to clay loams and range in drainage capacity from moderate to excessive, with the coarser textured soils draining better.

Soils are mapped for their runoff potential according to their Hydrologic Soil Group, where: A soils have high infiltration rates and low runoff potential, B soils have moderate infiltration, C soils have slow infiltration, and D soils have very slow infiltration rates and high runoff potential. Hydrologic Soil Groups for the program area are mapped in **Figure 3-5**.

The vulnerability of natural soil types to erosion (erodibility) was mapped by the Natural Resources Conservation Service (NRCS 2007) and is available through the Soil Survey Geographic Database (SSURGO). While inherent erodibility is important in considering a soil's potential erosion, often it is the slope, type of land use, and intensity of land practices which are the more important determinants of potential erosion. **Figure 3-6** maps soil erodibility in the program area according to the Soil Erodibility Factor K(f) used in the Revised Universal Soil Loss Equation (RUSLE). As shown in Figure 3-6, most of the headwater source regions in the SMP program area have high erosion potential.

3.3 Hydrology

The hydrologic cycle describes the movement and storage of water across the atmosphere, the land surface, the subsurface, and the ocean basins (**Figure 3-7**). Surface water hydrology represents the portion of the hydrologic cycle that is in movement or storage across the land surface and is typically thought of as runoff and streamflow. Runoff is a broad category and includes a range of flows progressing from sheetwash or overland flow, to initial collection of flows in small rills and land creases. Streamflow identifies the larger concentration of flows in natural creeks or engineered channels.

The amount and timing of runoff and streamflow over a given time period (storm event, season, or year) reflect a region's and watershed's climate, topography, geology, and soil conditions. Steeper surfaces shed runoff more quickly than flatter surfaces. Soil attributes of porosity and permeability influence how precipitated water on the land surface infiltrates the ground to be either stored as soil water, travel through the soil towards a creek as interflow or throughflow, or infiltrate deeper to groundwater depending upon geologic conditions.

3.3.1 Climate and Precipitation

Climate of the program area is characterized as two-season Mediterranean with cool wet winters and warm dry summers. Annual and seasonal variability in temperatures and rainfall are high. For the period 1981 – 2010 average maximum temperatures for the area ranged between low 80s degrees Fahrenheit (°F) in the summer to mid 50s in the winter; while average minimum temperatures ranged between low 50s in the summer to upper 30s in the winter. Climate data provided by the Western Regional Climate Center (WRCC 2019). Average monthly temperature and precipitation conditions for Santa Rosa are shown in Figure 3-8.

In the Laguna de Santa Rosa watershed, average daily maximum summer temperatures in Santa Rosa are in the low 80s, while winter average daily minimum temperatures are in the high 30s (WRCC 2019). Spring and summer prevailing southwesterly-westerly winds in the Laguna de Santa Rosa watershed area are influenced by marine air channeled northeast through the Petaluma Gap, a lowland gap in the Coastal Range (the Estero Lowlands) at the southwestern end of Petaluma Valley.

Air temperatures in the Petaluma River watershed tend to be a bit warmer than the Laguna de Santa Rosa watershed. Summer average daily maximum temperatures in the Petaluma Valley are in the low-mid 80s, while winter average daily minimum temperatures are in the high 30s to low 40s (WRCC 2019). Prevailing winds in Petaluma Valley are westerly through the Petaluma Gap. Marine air and winds arriving through the Petaluma Gap descend across the Petaluma Valley and can flow north toward the Santa Rosa Plain or south toward San Pablo Bay.

Prevailing winds in Sonoma Valley tend to be from the south during the day when warming conditions create an up-valley flow. At night the pattern is reversed where cooler air in the northern Sonoma Valley and from the side valley canyons descends to the valley floor and flows southward down valley. Further east and insulated from the maritime coastal air, Sonoma Valley is warmer than the Petaluma or Laguna de Santa Rosa watershed areas and experiences average summer temperatures in the high 80s. Average daily winter minimum temperatures are in the high 30s.

The prevailing wind patterns described above are greatly affected when dominant high-pressure systems form over the western U.S. preventing the more typical marine and on-shore wind patterns of coastal California. When such high-pressure systems develop wind patterns can be driven from the north, northeast, or easterly directions. Forming over the interior away from the coast, these winds are very arid with powerful gusts sometimes exceeding 40-50 mph. These offshore winds are sometimes referred to as “Diablo” winds, or “Santa Ana” winds in Southern California. Such winds due to high pressure can occur at any time, but are most intense and destructive during the fall season (September – November) when vegetation is at its driest and the fire risk is most severe. It was under these conditions that the devastating Tubbs fire of October 2017 burnt nearly 37,000 acres, destroyed over 2,800 homes in Santa Rosa, and killed 22 people in Sonoma County. SMP vegetation management activities are important in reducing the fire risk. Following fires, bare soils can become hydrophobic reducing the soil’s ability to infiltrate rainfall resulting in increased runoff, hillslope erosion and increased risk of mudslides, debris flows, and landslides. SMP channels are likely to increase in sedimentation following fires.

Precipitation primarily falls between November and March and varies across the program area from 22 inches annually at the mouth of Sonoma Creek in the south to 50 inches at Sonoma Mountain (2,295 feet [ft]. above MSL). **Figure 3-9Figure 3-9** shows the record of annual precipitation at Santa Rosa between 1931-2010. Santa Rosa has an average annual rainfall of 30 inches. Average annual precipitation amounts for the program area are shown by isoheytal contours in Figure 3-9. As shown in Figure 3-9, topographic conditions influence rainfall patterns, winds, sunlight and evaporation and create a range of local microclimates. Winter storm fronts typically arrive from the west, but this can range from the south-southwest to northwest directions. Fronts experience orographic lifting and increased precipitation in crossing the Mayacamas and Sonoma Mountains. The lee side of these ranges typically experiences a rain-shadow effect and reduction in precipitation. Some storms approach from a more direct southerly direction beginning at San Pablo Bay and moving their way northward up the Petaluma and Sonoma valleys and Santa Rosa plain.

In general, precipitation patterns in the Laguna de Santa Rosa watershed are strongly correlated with elevation. Rainfall increases from south to north and as elevation increases. Along the Santa Rosa Plain, average annual rainfall in Rohnert Park is 29 inches, increasing to 30 inches in Santa Rosa, and 35 inches in Windsor. The mountains on the east and west sides of the plain receive 40-50 inches of rainfall annually. Average annual rainfall contours (isoheytal) are illustrated in Figure 3-9. Average annual rainfall in the Petaluma Valley is 26 inches with the surrounding higher slopes in the watershed receiving 28-30 inches. Rainfall amounts in Sonoma Valley gradually increase from south to north, with 22 inches at the San Pablo Bay margin increasing to 40 inches to the northern valley. Rainfall amounts also increase up to 50 inches with elevation in the mountains west of the valley floor as shown in Figure 3-9.

3.3.2 Groundwater

Saturated subsurface rock materials can act as reservoirs that are known locally as aquifers or more regionally as groundwater basins. Aquifers tend to be associated with porous and permeable sedimentary rocks or alluvium that have higher water-bearing capacities, but groundwater can also be held in less porous igneous or metamorphic rocks that have permeability through large joints or fractures. Faults can provide another avenue for subsurface water to collect and migrate.

In the program area, groundwater is an important water supply resource supporting municipal and agricultural uses in the Sonoma and Petaluma valleys and in the Laguna de Santa Rosa watershed. The primary regional groundwater basins in the SMP program area are the Santa Rosa Valley, Petaluma Valley, and Napa and Sonoma Valley basins. These basins contain smaller groundwater subbasins including the Santa Rosa Plain (125 sq. mi.), Rincon Valley (9 sq. mi.), and Sonoma Valley (70 sq. mi.) subbasins Figure 3-10.

Groundwater sources in the program area include fractures in the Sonoma Volcanics in the eastern watersheds, the sedimentary sandstones of the Wilson Grove Formation beneath the Santa Rosa Plain and in the Gold Ridge Hills west of the Laguna, and the coarse fluvial deposits of the Glen Ellen Formation in the Rincon and Sonoma valleys (U.S. Geological Survey [USGS] 1958). In addition to these rock unit source areas, the abundant alluvium in the program area supports groundwater.

Of particular relevance, many SMP channels are important sources for groundwater recharge. The earthen beds of SMP channels, often comprised of coarse-grained sands, gravels, and cobble provide excellent recharge capacity. Lower Mark West Creek, lower Santa Rosa Creek, the Laguna, and Petaluma River alluvial plains were identified as key recharge streams (Sonoma County 2006) but many additional sand and gravel bed creeks across in the SMP program area provide similar functions.

Sediment deposition in the engineered flood control channels can reduce the channels' ability to support groundwater recharge. Deposition of fine sediments such as mud and silt on top of coarser sand and gravel can reduce or block infiltration along the channel bed. The aggradation of in-channel bars can heighten much of the bed surface area such that lower and medium sized flows no longer infiltrate across the width of the channel bed. Though it is not a primary goal of the SMP to enhance groundwater resources, the maintenance of channel bed and bar features to heights appropriate for flood management purposes also provides the added benefit of improved groundwater recharge.

3.3.3 Surface Water

Surface water that is not infiltrated, evaporated, or transpired (taken up by plants) is available as runoff to streams. Program area streams may be ephemeral (conveying flows only immediately after a storm event); intermittent (conveying flows seasonally and supported by shallow groundwater); or perennial (flowing year-round and supported through deeper groundwater sources or human sources such as reservoirs, release of imported flows, urban runoff, or irrigation).

Headwater tributaries in the program area vary in their flow conditions from ephemeral to perennial. Surface hydrology in these first and second-order upper watershed streams is a function of watershed size, underlying geology, recent precipitation conditions, and land use. Medium sized tributaries (third and fourth-order streams) that collect flows out of the primary upper headwater canyons are generally intermittent but may be perennial. The larger named creeks that emerge from the upland canyons and alluvial fans and carry enough flows to cross the valley floors and plains without losing all their flows to percolation are typically perennial. Flow characterizations for creeks, particularly the seasonal duration of intermittent flow, varies according to climatic conditions and how wet or dry the current and past one or two years have been. Additionally, while some channels may not flow perennially, they may sustain cold-water pools throughout the year (particularly where substrate, shading, and groundwater conditions are favorable) that can provide important habitat for many species.

The urban, suburban, agricultural, or commercial development of the land surface directly affects the hydrologic cycle and infiltration and runoff conditions. In developed areas with higher proportions of impervious surfaces, infiltration is greatly reduced and storm runoff increased. Urbanized areas typically have engineered storm drain systems to convey runoff to local streams. As described in Chapter 1, Section 1.3, "Program Area and Channel Types*",* the engineered channels and engineered easement channels of the program area were designed and constructed to provide stormflow conveyance and reduce the threat of flooding in the program area. The maintenance of these channels to keep them free of accumulated debris and sediment enables them to convey runoff as designed. Urbanized areas with summer irrigation also typically show an increase in summer low flows, including the perennialization of creeks that were previously intermittent.

For the context of the SMP it is useful to consider how flow magnitude relates to water elevation in the channel, potential flooding threats to adjacent lands, and the depositional or erosional processes that may occur in channels with varying flows. Figure 3-11 provides channel cross sections for Santa Rosa Creek and Copeland Creek with estimated water levels for the 100-yr, 25-yr, 10-yr, and 2-yr sized events.

As shown on Figure 3-11 a fair degree of in-channel sedimentation has reduced the available channel capacity to convey flows. Another important feature of the cross section of Figure 3-11 is the identification of a "low flow" channel that conveys flows smaller than the approximate bankfull elevation (flows of approximately the 1.5 to 2-yr return frequency). As observed in several channels of the SMP program area, a low flow channel of proper size and slope can be an effective means to transport fine sediments downstream. Where flat bottom channels occur with little slope and without a low flow conveyance channel inset in their bed, they often accumulate fine sediments under the slow velocity, diffuse, and shallow flows conditions that favor deposition.

In addition to known flooding hazards, the Federal Emergency Management Agency (FEMA) produces maps showing where flooding may occur throughout the country. Figure 3-12 shows the FEMA-designated floodplains for 100-year flood hazard in the program area. Most of the FEMA 100-year zones occur in and around the Laguna de Santa Rosa extending up along the floodplains of several tributaries to the Laguna including Windsor Creek, Mark West Creek, Santa Rosa Creek, and Irwin Creek. In the Upper Laguna area, designated FEMA flood zones occur at the lower Bellevue-Wilfred channel, along portions of the floodplains of Copeland and Hinebaugh creeks in Rohnert Park, and along portions of the Upper Laguna channel and Cotati Creek in Cotati. In the Petaluma River Watershed (Zone 2A) flood zones are observed along Marin and Hill creeks and along the Petaluma River upstream toward Lichau Creek. In Zone 3A of the Sonoma Creek Watershed, flood zones are seen in the northern watershed along Kenwood, Sonoma, and Lawndale creeks (Figure 3-12).

3.3.4 Water Quality

This section presents an overview of water quality conditions related to sediment, temperature, nutrients, and pathogens in the SMP program area.

Erosion and Sediment

Watersheds are nested systems where a range of sedimentary processes naturally occur as materials move from higher to lower locations. Sediments can be stored in place, eroded (i.e., initiated into movement downslope or downstream), transported, or deposited. A standard, though simplified, geomorphic approach classifies watersheds into three general zones: (1) a source zone of sediment production, (2) a transport zone where sediments are generally carried, and (3) a depositional zone typically downstream in the basin where sediments are more likely to come to rest. This three-part classification generally works well for the Laguna de Santa Rosa, Petaluma River, and Sonoma Creek watersheds of the program area. As described above in Section 3.2.1, *Topography and Landforms*, in general the surrounding mountains act as source areas, the canyons and upper alluvial fans serve as transport zones, and the lower alluvial fans, plains, and valley bottoms operate as depositional zones. While generally true, the simplified three-part classification can obscure several of the erosive, transport, or depositional possibilities observed at more local scales throughout the watershed. Looking at processes in closer detail, sediments can be variably eroded, stored, or transported throughout the entire system, whether in the farthest upstream tributaries, mid-watershed fans and plains watershed plains, or the lower watershed Laguna, marshes, or estuaries.

As introduced above, there are several physical and biological conditions that influence erosion and sediment processes in a watershed, including: geologic structure, tectonism, and properties; topography and slope; climate and precipitation; soils and vegetation; and the hydrologic conditions of infiltration, runoff, and streamflow.

On top of these physical influences, land use practices, history, and structures further influence erosion and sediment processes. The intensification of land uses through agriculture, grazing, fire management, mining, recreation, or residential and commercial development in the program area has resulted in increased erosion. Under urbanization, the cause and effect between land use and erosion can be direct as in the following sequence: development reduces infiltration, increases runoff and streamflow, increases sediment delivery to streams, increases in-channel bed/bank erosion and transport, increasing sediment yield downstream. Post-fire effects on soils can have a similar increase in erosion as described above for urbanization. Or, with more agricultural land uses, increases in erosion and sediment delivery may occur without the large increases in streamflows observed with urbanization. In such a case, increased erosion may lead to net channel aggradation, at least locally, because there is not adequate streamflow to carry the material downstream.

SMP Area Regulatory Sediment Issues

The Russian River, Mark West Creek, Laguna de Santa Rosa, Santa Rosa Creek, Petaluma River, and Sonoma Creek are currently identified by federal and state regulatory agencies as being impaired by excessive sediment (State Water Resources Control Board [SWRCB] 2016). Degradation of these water bodies has been attributed to agricultural practices (grazing, crop production, and dairies are the primary sources) and land development activities (including residential/commercial development resulting in hydromodification, stream channelization, and reduced floodplain connectivity).

The San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) developed a Total Maximum Daily Load (TMDL) and implementation plan to address sediment impact in the Napa River Watershed (Resolution No. R2-2009-0064) and for Sonoma Creek (R2-2008-0103). The goals of the TMDL's are to:

- Conserve the steelhead trout population;
- Establish a self-sustaining Chinook salmon population (Napa River Watershed);
- Restore water quality to meet water quality standards, including attaining beneficial uses;

- Enhance the overall health of the native fish community; and
- Enhance the aesthetic and recreational values of the river and its tributaries

A serious concern in the program area is the degree and rate of sedimentation in the Laguna and how this sedimentation has impacted beneficial uses, particularly impacts to aquatic habitats (Honton and Sears 2006). The United States Army Corps of Engineers (USACE) also sponsored a study of historical sedimentation in the Laguna (PWA 2004). This study arose from an interest at USACE in understanding how the Laguna's ability to provide backwatering storage capacity to Russian River flows has been reduced through sedimentation in the Laguna. The study found that about 1.5 ft. of sediment had been deposited on average across the extent of the Laguna between the years 1946 and 2002. This trend was forecast to continue into the future. Excessive sedimentation can lead to further water quality degradation, as indicated by the 2016 Section 303(d) impairment listings for the Laguna due to excess levels of phosphorus, indicator bacteria, mercury, and low dissolved oxygen (SWRCB 2016).

The maintenance activities of the SMP, particularly in regard to in-channel sediment management and removal provide a direct benefit to the Laguna as a downstream resource that is currently impacted for sediment. Additionally, the SMP's off-site watershed mitigation program (described in Chapter 11, Section 11.5.2) helps to directly reduce erosion and sediment yield from headwater sediment source areas.

Temperature

Parameters that influence stream temperature include ambient air temperature, humidity, riparian vegetation, topography, surrounding land use, and flow conditions. Additionally, cold water seeps and groundwater inputs contribute to moderating and lowering stream water temperatures. Among these parameters, direct solar radiation on the water surface is perhaps the most influential factor in raising water temperature. Consequently, shade provided by riparian vegetation often controls water temperature. Water temperature influences a number of chemical processes within water bodies. Dissolved oxygen capacity is inversely related to water temperature. As water temperature rises, the maximum potential concentration of dissolved oxygen reduces. This affects the growth and decay rate of aquatic species that rely on high dissolved oxygen concentrations for survival.

Streams in Mediterranean climates, such as Sonoma County, experience seasonally reduced flows in summer, resulting in higher water temperatures. Additionally, land development often results in removal of riparian shading, reduced cold-water inputs (i.e., altered groundwater supplies), increased sediment deposition due to channel modifications, and increased surface runoff. All of these factors alter channel geomorphology, which in turn create conditions that can cause water temperatures to rise to levels that degrade habitats for cold water species. While shading creeks may help decrease water temperatures, it is important to note that runoff received from urbanized areas may exhibit relatively high water temperatures compared to runoff received from non-urbanized areas. Additionally, summer air temperatures in Sonoma County are capable of exceeding 90°F. Under such conditions, given the narrow width of the riparian corridor, shading of the creek may only modestly reduce creek water temperatures. It is also important to note that streams flowing across the valley floor often naturally have relatively warm water temperatures. These conditions are not necessarily indicative of poor water quality and can provide important habitat opportunities for native warm water fish assemblages.

Water temperature is a key constituent for assessing the quality of habitat within areas that support anadromous fish. Steelhead trout (*Oncorhynchus mykiss*), coho (*Oncorhynchus kisutch*), and Chinook salmon (*Oncorhynchus tshawytscha*) are highly sensitive to temperature and require cold water throughout the majority of their life stages. As stated in Moyle (2002), optimal water temperatures for growth and survival of steelhead trout are 59°–64°F (15°–18°Celcius [C]) and mortality occurs at 73°–81°F (23°–27°C) (Moyle 2002). Optimal temperatures for growth and survival of Chinook salmon are 55°–64°F (13°–18°C) and mortality occurs at temperatures of 72°–73°F (22°–23°C). Optimal water temperature for growth and survival of coho salmon are 54°–57°F (12°–14°C) and mortality occurs at 77°–79°F (25°–26°C) (Moyle 2002). Though not specific to the creeks within the SMP area, these thresholds are generally accepted for assessing optimal habitat conditions for steelhead, coho and Chinook salmon.

Habitat for cold-water anadromous fish species, including steelhead trout and coho and Chinook salmon is present in the SMP program area. However, the majority of the cold-water and prime rearing habitat is located outside of the SMP area, particularly for Chinook and coho. Some of the SMP program area channels are used by salmonids for migration to upper watershed spawning areas.

SMP Area Temperature Issues

The Laguna de Santa Rosa, Mark West Creek, and Santa Rosa Creek, as part of the Russian River watershed, are identified by federal and state regulatory agencies as being impaired by high temperatures (SWRCB 2016). Sonoma Water channels primarily serve as migratory corridors for anadromous fish passing from the Russian River to spawning and rearing areas higher in the tributary watershed. Proper maintenance of creekside vegetation and new plantings along Sonoma Water-maintained channels help shade the channel, which is anticipated to reduce water temperatures.

Nutrients

Nutrients, specifically nitrogen and phosphorus, are essential for life and play a primary role in ecosystem functions. Nitrogen and phosphorus are naturally occurring inorganic ions present within the atmosphere and in fixed forms within organic matter, such as plants and soils. In addition to naturally present concentrations, nutrients are introduced to water bodies through human or animal waste disposal or agricultural application of fertilizers.

Nutrients are commonly the limiting factor for growth in aquatic systems. In freshwater streams of the Bay Area, nitrogen is the limiting nutrient (Krottje and Whyte 2003). Many types of activities, such as agriculture, land development, and urban runoff, can result in excessive loading of nutrients to water bodies. Excessive nutrient loading in streams can produce toxic or eutrophic conditions, both of which impair aquatic life. Eutrophication also can lead to increased algal growth and reduced oxygen levels in the water, thus reducing aesthetic quality and habitat value. Sediments contain nutrients that stimulate growth of invasive aquatic weeds. Nutrients can leach from sediments and cause eutrophication in water. Sediments can also deplete oxygen from water. Ammonia is a plant growth nutrient that is also toxic to aquatic life under elevated pH conditions associated with eutrophication.

The nutrient content of sediment in some streams in the SMP area has been studied and found to be elevated in some cases. In the Laguna de Santa Rosa in particular, sediments have been found to contain as much as 2,400 milligrams per kilogram (mg/kg) and 4,600 mg/kg of total phosphorus and total nitrogen, respectively (see *The Altered Laguna: a Conceptual Model For Watershed Stewardship*, Laguna de Santa Rosa Foundation 2007). The quantity of nutrients in sediment within the SMP area is large and is considered a major factor contributing to eutrophication in the Laguna de Santa Rosa.

SMP Area Nutrient Issues

The Laguna de Santa Rosa (phosphorus), Petaluma River, and Sonoma Creek are identified by federal and state regulatory agencies as being impaired by excessive nutrients (SWRCB 2016). Excess nutrients in these water bodies often encourage excessive vegetation growth. For example, the Laguna is currently impacted throughout much of its length and may be a factor in the spread of ludwigia, or water primrose (*Ludwigia peploides montevidensis*). As the species also occurs in low nutrient areas such as gravel bars in the upper Russian River, nutrients may not be the only causal factor in the spread of this species. The Laguna Foundation, with funding assistance from Sonoma Water and other supporters, has conducted regular ludwigia control activities to better manage impacted channels and improve ecosystem function. In addition to impacting streams (i.e., filling a channel to capacity), vegetation can also trap sediment and reduce flow capacity of the channel.

Section 2.2.4of Chapter 2, *Environmental Regulations and Compliance*, describes the NCRWQCB and City of Santa Rosa’s, nutrient offset program. Sonoma Water is partnering with the City of Santa Rosa to undertake sediment removal and disposal projects targeting channels with sediment with high nutrient contents. In this way, Sonoma Water acts as the credit provider through implementing its SMP activities and the City of Santa Rosa acts as the credit purchaser.

Pathogens

Pathogens are microorganisms that cause diseases in other organisms. Bacteria are the primary indicator organisms of pathogens, particularly for the detection of waterborne diseases. Waterborne diseases threaten the health of recreational users of waters and wildlife. Pathogenic bacteria contained within fecal waste are the common source of waterborne diseases. Fecal contamination can be detected by bacterial indicators, such as total coliforms, fecal coliforms, *Escherichia coli* (*E. coli*), and fecal *enterococci*. High concentrations of these indicator bacteria – resulting from poor waste management and disposal, and sometimes from homeless encampments along the creek banks – can degrade water quality for human consumption, recreation, and wildlife use.

SMP Area Pathogen Issues

The Laguna de Santa Rosa, Santa Rosa Creek, Petaluma River, and Sonoma Creek have been identified by federal and state agencies as being impaired by pathogens (SWRCB 2016). A TMDL and implementation plan to address the pathogen impairment in Sonoma Creek was adopted by the SFBRWQCB in 2006 (R2-2006-0042). The SFBRWQCB is currently developing a TMDL for indicator bacteria in the Petaluma River.

Accumulated trash and homeless encampments can foster favorable conditions for pathogens. The SMP maintenance activities would remove or reduce opportunities for pathogens by maintaining channels free of trash and encouraging better flow conditions in Sonoma Water maintained channels. Please refer to Section 8.9.2, "Homelessness", for further discussion on homeless-related water quality issues.

3.4 SMP Watersheds and Creeks

This section describes the watersheds and creeks within the SMPs primary maintenance zones, including the Laguna de Santa Rosa Watershed (Zone 1A), the Petaluma River Watershed (Zone 2A), and the Sonoma Creek Watershed (Zone 3A), and is organized geographically by watershed and subwatershed.

For each subwatershed area in Zones 1A through 3A, an index map is provided followed by a sequence of maps that locate and name the engineered channel reaches. These reach maps include an aerial photo base map and the primary vegetation classifications within the reach.

SMP channel reaches are defined according to Sonoma Water's Facility Guide (Sonoma Water 2007b). In general, a reach can be thought of as a continuous channel segment. Reaches are typically defined at their upstream and downstream ends by road crossings, railroad lines, or other structures.

Stream reach characterization sheets (reach sheets) were developed for the original 2009 SMP Manual with the objective of providing Sonoma Water maintenance managers and regulatory agency staff a common resource inventory of the program area. These original reach sheets are accessible through the SMP Database.

The management direction for the SMP has moved from the static reach sheet approach of the original SMP Manual as a way to document reach specific conditions to a more dynamic database approach where the viewer can examine a wider array of channel conditions and maintenance history documentation. The SMP Database includes a wider array of information including the tracking of significant habitat features in the SMP channels; identifies and summarizes survey findings pre and post maintenance activities; and includes photographs and other site records to document maintenance activities and site conditions.

3.4.1 Laguna de Santa Rosa Watershed (Zone 1A)

The Laguna de Santa Rosa watershed encompasses 253 square miles (sq. mi.) and is the largest southern tributary to the Russian River. The highest elevation in the watershed is 2,463 feet (ft.) above MSL along the eastern mountains. Elevations at the confluence with Mark West Creek are 50 ft. above MSL. As described above, several steep, high-gradient creeks originate in the Mayacamas and Sonoma Mountains of the upper watershed. These smaller tributaries combine and collect into primary subbasin creeks that then flow west across the alluvial fans and Santa Rosa Plain, eventually meeting the Laguna main channel that flows north joining the Russian River. The primary subbasins of the Laguna de Santa Rosa watershed are shown in **Figure 3-13** and include: Windsor Creek, Mark West Creek, Santa Rosa Creek (which includes Piner, Matanzas, Spring, Brush, and Oakmont creeks); Roseland Creek; Colgan Creek; Bellevue-Wilfred creeks; and the creeks of the upper Laguna subbasin including Gossage, Upper Laguna, Copeland, and Hinebaugh creeks. In the descriptions below, subwatershed and subbasin are used synonymously as smaller drainage areas within a larger watershed.

Land uses in the Laguna de Santa Rosa watershed are mixed and include high density urban development, rural residential uses, public recreational areas, varying degrees of agricultural uses, and some rangeland. The distribution of these land uses is shown in Figure 3-14. Areas of higher elevations on the east side of the watershed are encompassed by public lands, rural residential, agriculture (vineyards), and open ranchlands and woodlands. As the elevation levels towards the west, residential and commercial land uses intensify, particularly at the urban areas of Santa Rosa and Rohnert Park. Land use shifts to rural residential and more intensive agriculture use moving further west across the watershed.

For the purposes of the SMP, it is important to recognize the influence of land use on surface hydrology and sediment transport throughout the watershed. Urban land uses typically have more impervious land surfaces leading to increased surface runoff, higher runoff peaks, and shorter lag times to reach peak runoff. Urbanized areas also typically have higher summertime low flow conditions resulting from irrigation and other urban inputs. Some creeks that would typically be dry in the summer are often perennialized through urbanization.

Agricultural land uses once supported a variety of orchard, row, and feed crops. However, today the valley floor and gentle sloping plains largely support vineyards, dairy, and livestock operations (California Department of Food and Agriculture [CDFA] 2007). These types of agricultural land uses result in a range of runoff, erosion and sediment yield, and water quality conditions. In general, the hydrologic and sediment related impacts from these agricultural land uses primarily depend upon the intensity of the activity, the degree of vegetated land cover, the degree of soil disturbance, the slope of the land surface, the rural road network and its influence on drainage patterns, and the local precipitation and water balance conditions.

Windsor Creek Subwatershed

The Windsor Creek subwatershed, shown in Figure C-1, encompasses approximately 26 sq. mi. Windsor Creek is a tributary to Mark West Creek and the Russian River. Elevations in the subbasin range from 50 ft. above MSL near the confluence with Mark West Creek to nearly 1,000 ft. above MSL in the Mayacamas Mountains to the east. Major creeks and tributaries in the subbasin include Windsor Creek, Starr Creek, Faught Creek, and Airport Creek. Similar to many of the subwatersheds in the Laguna de Santa Rosa, the creek systems of the Windsor subwatershed can generally be classified between the more mountainous headwaters to the east (east of Highway 101) and the more gently sloping lands of the alluvial Santa Rosa Plain to the west. During larger winter stormflows, backwatering of flows from the Russian River can inundate the floodplains along the Windsor Creek and Mark West Creek confluence. The gentler gradients of the lower watershed encourage sediment deposition. In terms of land use, areas of cropland and pasture are found throughout the Santa Rosa Plain portion of the subbasin with urbanized areas in and around the town of Windsor. A number of headwater tributaries, east of Windsor are dammed creating small local reservoirs. SMP engineered channels in this subwatershed are generally located in the urban areas around Windsor (Figure C-1). Sensitive habitat for western pond turtle is present in the maintenance reaches in the Windsor subbasin. Known migratory and rearing habitat for steelhead trout is present in the *Windsor 1* reach.

Steelhead habitat is not considered present in reaches upstream of Highway 101 (Bill Cox, California Department of Fish and Game (CDFG) pers. comm., 2008).

Porter Creek-Mark West Creek Subwatershed

The Porter Creek-Mark West Creek subwatershed is a tributary to the Russian River. Elevations in the subbasin range from 50 feet MSL near the confluence with the Russian River to over 2,000 feet MSL near Diamond Mountain in the Mayacamas range to the east. The major creeks and tributaries in the subbasin include Mark West Creek, Wikiup Creek, and Fulton Creek. As seen in Figure C-2, the subwatershed is elongated between its western lowlands and its eastern headwaters where creeks flow through deep canyons cut into the Mayacamas Mountains. As described for Windsor Creek above, the winter backwatering of flows from the Russian River can inundate the floodplains along the Windsor Creek and Mark West Creek confluence. The gentler gradients of the lower watershed encourage sediment deposition in those locations.

The headwaters in the eastern subbasin are densely vegetated by oak woodland and some Douglas fir forest. The upper watershed includes rural to low density development and Mark West Springs Road which follows the south bank of Mark West Creek. At Wikiup Creek (*Wikiup 1*) located at the base of the Mayacamas Mountains, storm flows have the erosive power to scour banks and create meanders. In contrast, the gently sloping areas in the western half of the subbasin are generally grasslands with scattered oaks. In addition, there are some areas of cropland and pasture, with vineyards located on the Santa Rosa Plain and the nearby hillsides and valleys to the east. Urban development is focused in northern Santa Rosa along the Highway 101 corridor.

As described in the Russian River Biological Opinion (BO) (National Marine Fisheries Service [NMFS] 2008), the Mark West Creek subwatershed supports habitat for steelhead and Chinook and coho salmon. The Russian River BO specifies that maintenance activities in this portion of the Mark West Creek subbasin, upstream of the confluence with the Laguna de Santa Rosa, are not covered by the 2008 BO. Historically, maintenance requirements for Wikiup and Fulton Creek have been limited to infrequent culvert clearing. If maintenance is required at these reaches, Sonoma Water conducts a separate consultation with the USACE and NMFS prior to proceeding with maintenance activities. Maintenance on modified and natural channels in this subbasin is very rare and would only occur when requested by private property owners.

Santa Rosa Creek Subwatershed

Elevations in the Lower and Upper Santa Rosa subbasins (77 sq. mi.) range from approximately 2,000 feet MSL in the Mayacama Mountains to the east to roughly 50 feet MSL at the Laguna de Santa Rosa at the western watershed limit. Major streams and tributaries in the subbasins include Santa Rosa Creek, Spring Creek, Brush Creek, Matanzas Creek, Colgan Creek, and Piner Creek.

This subwatershed can be divided into four topographic subregions: the eastern headwaters in the highest portion of the watershed; the central foothills and valleys west of the eastern highlands (including lower Oakmont Valley, Brush Creek); the southern Matanzas Creek tributary; and the low-lying Santa Rosa plain to the west. Much of the eastern headwaters area is protected from development in the Hood Mountain Regional Park. These steep lands are covered mostly in Douglas fir forest. The southern arm of the upper watershed drains the eastern “backside” of Taylor Mountain and the northern edge of Sonoma Mountain into Matanzas Creek. Matanzas Creek flows north toward Bennett Valley which is flanked by Annadel State Park to the east and Taylor Mountain to the west. Oak woodland is the dominant vegetation type in this part of the watershed. The Matanzas Reservoir and Spring Lake, located in this area, are managed for water supply and flood control.

The upper subbasin creeks (upper Santa Rosa Creek, Matanzas Creek, Spring Creek, and Brush Creek) join the main Santa Rosa Creek in town east of Highway 101. Further downstream, west of Highway 101, Santa Rosa Creek becomes larger and wider to accommodate flows from the larger watershed area and stormwater from the urban areas around Santa Rosa. In the lower subbasin, Piner Creek is the principal tributary. Piner Creek includes Russell Creek, Paulin Creek, and Steele Creek all of which drain mostly urban portions of Santa Rosa and flow westerly. College, Peterson, and Abramson creeks are smaller more local tributaries that directly merge with lower Santa Rosa Creek.

Approximately 40% of the watershed is urbanized (U.S. Geological Survey [USGS] 2018). Urbanization influences the hydrology and stream functioning, particularly in the lower subbasin, downstream of the urban Santa Rosa areas. Urbanization has also encroached east into Bennett Valley, portions of Brush Creek, and sections in the upper watershed along Highway 12. Urbanization has negatively impacted water quality in the subwatershed. Santa Rosa Creek is listed as impaired by pathogens and mercury (Table 2-2).

Some channels in the watershed support habitat for salmonids and other federal and state-listed species. As such, maintenance activities in the subbasin must be conducted according to the terms and conditions of the BOs issued by NMFS or U.S. Fish and Wildlife Service (USFWS), which cover SMP-related impacts on habitat for salmonids, California tiger salamander, California red-legged frog, and endangered plants. Habitat for state-listed western pond turtle and foothill yellow-legged frog are also present in this subbasin. Specific reaches where federal or state-listed species are potentially present in the watershed are shown in Table 10-3 in Chapter 10.

Upper Santa Rosa Creek

In upper Santa Rosa Creek, SMP maintenance activities in Bennett Valley focus at Spring Lake, the Spring Lake Diversion Structure, the Matanzas Reservoir, Sierra Park Creek, Lorna Dell Creek, and Spring Creek. This portion of the Santa Rosa Creek watershed is influenced by low to medium density residential development, the Bennett Valley Golf Course, flood and water storage modifications, and Highway 12.

The Spring Lake diversion structure shown in Figure C-42 controls flood flows and diverts water from Upper Santa Rosa Creek to Spring Lake. The diversion structure was designed to also contain sediment moving downstream. The diversion structure is typically cleared of sediment every 3-4 years. The Matanzas Reservoir, shown in Figure C-49, provides flood control for Bennett Valley and helps reduce flows downstream. Sediment at this reservoir is also periodically removed, approximately two times every 10 years. Lorna Dell Creek (Figure C-48), Sierra Park Creek (Figure C-45), and Spring Creek (Figure C-44) are intermittent creeks in wetter years and ephemeral in drier years, with water retained in some pools throughout the year. Lorna Dell Creek has concrete-lined banks in its maintenance reach (*Lorna Dell 1*). Areas of sensitive California red-legged frog habitat are present near Matanzas Creek, east of the Matanzas Reservoir, as shown in **Figure** 3-. Western pond turtle habitat is present in locations with standing water. Steelhead are known to inhabit areas near the Santa Rosa Creek diversion. Foothill yellow-legged frog habitat is present in some reaches of Spring Creek.

Brush Creek

The Brush Creek tributary drainage area is located in the upper Santa Rosa Creek watershed. This drainage flows through Rincon Valley (east of Highway 101 and north of Highway 12). Located at the foot of steep slopes and higher stream velocities of the Mayacamas Mountains, creeks in this subbasin are relatively sensitive to in-channel facilities such as box culverts, hardened banks, and grade control structures (*Austin 2*). There are several points of erosion and bank destabilization noted in the reach sheets for this subbasin. Runoff from Brush Creek's headwaters is controlled by the Brush Creek Middle Fork Reservoir, an earthen dam constructed for flood protection. The reservoir has altered flow and sediment transport functioning downstream, with channel erosion and aggradation observed in downstream reaches. Riparian woodland vegetation along Brush, Ducker, and Austin creeks has been maintained by Sonoma Water and provides large canopy cover through the majority of the drainage area (see Figures C-39, C-40, C-41, as well as Table A-1 in Appendix A). This canopy provides high quality wildlife habitat as well as improved flow passage by discouraging growth of cattails (see reach sheet for *Austin 3*). As shown in Table 10-3, steelhead migratory and rearing habitat and western pond turtle habitat are present in Austin and Brush creeks.

College Creek

Only the lower half mile of College Creek, west of Ridley Avenue, flows above ground (see Figure C-34). As shown in Figure C-34 and Appendix A, the riparian canopy at these reaches restricts growth of emergent vegetation like cattails. In reaches 1 and 2, habitat quality is somewhat degraded by channel modifications such as hardened banks, invasive plant species such as blackberry, and accumulated sediment in bars and box culverts. A barrier to fish passage exists at the confluence with Santa Rosa Creek. However, College Creek supports habitat for western pond turtle, as shown in Table 10-3.

Piner Creek

The headwaters of Piner Creek are located in the northern portion of the City of Santa Rosa limits, including Fountain Grove Lake along Fountain Grove Parkway (Figures C-26, C-30, and C-33). The creek then flows southwest from Highway 101 and merges with Santa Rosa Creek just west of Fulton Road. Major tributaries to Piner Creek include Coffey, Russell, Paulin, and Steele creeks. Paulin Creek includes an in-line flood control reservoir (known as Piner Reservoir – despite it being located on Paulin Creek), approximately 1 mile upstream of Highway 101 (and downstream of County Farm Road). A large portion of the City of Santa Rosa is located in the Piner Creek subbasin; including industrial, commercial, residential, schools, and park land uses located adjacent to SMP channels.

Because of the highly developed land uses in this subbasin, the creeks now receive a relatively larger proportion of stormwater runoff compared to pre-development times. Many of the stream banks of this area, particularly along Piner and Paulin creeks have been armored. Reaches in this subbasin have numerous culverts which influences discharge and water quality functions. Along with stormwater, the reaches collect trash and fine sediments washed from streets.

The upper reaches of Piner, Russell, Paulin, and Steele creeks tend to be narrow and widen moving downstream to their mid-basin locations. Riparian woodland vegetation in some reaches provide large patches of canopy cover, particularly along Paulin Creek (Figures C-27, C-29, C-30). Cattails dominate the channel in reaches lacking canopy cover. In terms of biological resources, habitat within the urban areas is limited and not diverse. Marginal migratory and rearing habitat for steelhead is present in the lower reaches of Piner Creek and throughout Paulin Creek (see Table 10-3). If salmonid habitat is present on Steele Creek, there is a significant barrier to fish passage at the confluence of Steele and Piner creeks. California tiger salamander and western pond turtle habitat is supported by many of the reaches in this subbasin (see Table 10-3).

Lower Santa Rosa Creek

Lower Santa Rosa Creek (Reach *Santa Rosa 6* and reaches west of Highway 101), is a wide, nearly uniform trapezoidal channel, which widens moving further downstream. The width of the channel provides opportunities for low-flow channels and gravel bars to develop. East of Fulton Road, the creek flows through primarily residential neighborhoods with some patches of commercial and industrial areas. West of Fulton Road and downstream of the confluence with Piner Creek, the creek flows through agricultural fields in a straight channel for nearly four miles leading to the Laguna de Santa Rosa. At the downstream end of Santa Rosa Creek (Reach 1), just upstream of the Laguna de Santa Rosa confluence, the Santa Rosa Reservoir is found just south of the creek. The reservoir has large earthen berms around its perimeter.

As listed on Table 10-3, Santa Rosa Creek Watershed supports habitat for steelhead trout and Chinook salmon (on rare occasions), as well as California tiger salamander, western pond turtle, and special status plants. Because of resource sensitivity, maintenance activities are restricted by the regulations discussed in Chapter 2. Forestview, Peterson, and Abramson creeks are situated at lower elevations of the Santa Rosa Plain, before entering the Laguna (Figure C-56) with sediment accumulating in bars, particularly along Peterson and Abramson creeks. Sediment transport, water quality, and riparian vegetation along Peterson and Abramson creeks are influenced by surrounding agriculture, compared to creeks higher in the watershed which are more influenced by urban development.

Roseland and Colgan Creek Subwatershed

Roseland and Colgan Creeks are located south of Santa Rosa Creek and drain the middle portion of the Laguna de Santa Rosa subbasin . The two creeks flow parallel to each other from the southwest area of Santa Rosa to the Laguna, south of Sebastopol. Colgan Creek encompasses approximately 7 square miles is located approximately one mile south of Roseland Creek. Elevations in the drainage areas range from nearly 75 ft. above MSL at the Laguna to 1,400 feet above MSL at Taylor Mountain. The upper portion of these catchment basins are mostly urbanized within the Santa Rosa city limits. The headwaters of Colgan Creeks include smaller tributaries that drain the north side of Taylor Mountain. Both Colgan and Roseland creeks flow through residential and industrial areas and Colgan Creek is directed under Highway 101 through culverts. The lower portions of both drainages flow through agricultural fields until they meet the Laguna. The primary land use in the lower portion of the subwatershed is cattle grazing.

Roseland Creek has a slightly larger drainage area (7.8 square miles) compared to Colgan Creek. The creek's middle reaches have been straightened between Burbank and Ludwig avenues. Further downstream, the creek exhibits a more natural meandering form. Vegetation is primarily ruderal with little to no riparian canopy over the channel (see Figures C-55 and C-57). The majority of Roseland Creek flows through agricultural lands which can strongly influence habitat and water quality in the channel. For example, in Reach *Roseland 1*, cattle were formerly allowed to graze in the channel which resulted in potential water quality and sediment inputs to the Laguna. But now, through local coordination, seasonal fences are installed at the cattle creek crossings to avid and minimize such effects. As listed in Table 10-3, western pond turtle habitat is supported along lower Roseland Creek and this region of the Laguna watershed supports a sensitive population of California tiger salamander.

The headwaters of Colgan Creek are found at Kawana Springs Creek (Figure C-55). Kawana Creek flows from the foothills of Taylor Mountain and merges with Colgan Creek at Highway 101. The gentle gradient, linear trapezoidal channel, hardened stream banks, and lack of riparian canopy along much of the length of Colgan Creek have encouraged growth of invasive vegetation and sediment deposition. Vegetation along Colgan Creek varies from ruderal with patches of blackberry scrub in the middle of the watershed to more riparian woodland in the lower reaches of the watershed (see Figures C-59, C-60, C-61, C-63, C-64). Significant accumulation of sediment and poor water quality is noted on the reach sheets for Colgan Creek. These conditions are created or exacerbated by abundant invasive plants such as cattails and blackberry. The channel in the lower reaches of Colgan Creek is surrounded by agricultural fields and is widened to accommodate backwatering from the Laguna during high flows. The low topography encourages sediment deposition and the wide channel with little riparian canopy combine to encourage growth of cattails. California tiger salamander and western pond turtle habitat are supported by Colgan Creek.

Upper Laguna de Santa Rosa Subwatershed

The upper Laguna subbasin is the southernmost drainage area of the Russian River watershed and forms the divide between the Russian and Petaluma river watersheds (Figure C-6). The upper Laguna drainage area encompasses 42 square miles, including the cities of Cotati and Rohnert Park. The downstream border of the subbasin ends at the City of Santa Rosa's Laguna Wastewater Treatment Plant on Llano Road, near the confluence with Colgan Creek.

Land use in the subbasin transition from undeveloped Douglas fir forest high on Sonoma Mountain (at the headwaters of Copeland Creek), to oak woodland and grasslands in the mid- to lower Sonoma Mountain area, to suburban residential neighborhoods in Rohnert Park and Cotati, to then rural residential and agricultural uses in the subwatershed toward the Laguna proper.

Primary drainages in the subbasin include the Bellevue-Wilfred Channel system including Todd, Hunter, Wilfred, Coleman, and Cook creeks (Figures C-64, C-65, C-68); Hinebaugh Creek system including Crane and Five creeks (Figures C-72 and C-68, C-72); and Copeland Creek (Figures C-71, C-72). The Bellevue-Wilfred drainage area exhibits drier ruderal and mixed riparian scrub vegetation, while the Hinebaugh and Copeland drainage areas support dense riparian woodland which provides greater canopy cover in the most of the channel reaches (see Table A-1).

The headwater tributaries of Copeland, Hinebaugh, Crane, and Cook creek descend from Sonoma Mountain. The elevation contours illustrate the decrease in land gradients from the mountain front, to the alluvial fan zone, to the lower alluvial plain of the Laguna. The changes in gradient are important for in terms of stream maintenance and habitat conditions. In the alluvial fan zone near Petaluma Hill Road and Snyder Lane, the steeper stream gradients of the upper mountainous zone become gentler. When this happens, many of the streams become more depositional in nature, dropping their coarser sediment load. This situation is particularly observed at many of the crossings at Petaluma Hill Road and Snyder Lane where culverts are often blocked with accumulated sediment and debris. Because of this situation, several of the upper Laguna channels of Rohnert Park and Cotati require the most frequent and routine maintenance of any channels in the SMP program area. Also of note in this subbasin, is the substantial influence of backwatering from the Laguna system. This effect may extend as far east as Highway 101.

Todd Creek

Todd Creek is the northern most tributary within the Upper Laguna system. Todd Creek is somewhat unusual in the Upper Laguna subwatershed for its north-south alignment. Historically, this channel pattern may have been more northwest/southeast oriented along the general slope of the alluvial plain.

As described in the reach sheets, Todd Creek is noted for its gentle gradient, stagnant flow and poor water quality conditions, and accumulation of sediment at road crossings. Todd Creek continues as a very linear south flowing channel until its confluence with Hunter Creek, whereby it then flows due west, increasing in size to accommodate the larger flow capacity. West of Highway 101, Todd Creek remains as an earthen channel except for the confluence with Wilfred Creek where the channel is entirely concrete. The lower reaches of Todd Creek are located within sensitive California tiger salamander habitat.

Todd Creek does not flow through a particularly urbanized area, but fine sediment-producing activities in its upper watershed (row crops and light grazing) are the largest influence on the quality of habitat in Todd Creek, aside from channel modifications. As opposed to other creeks in the watershed, Todd Creek functions more akin to an agricultural drainage ditch where fine sediment mobilized from upstream accumulates in the gentle sloping channel instead of transporting to areas downstream. Historic modifications to Todd Creek’s alignment may also have cut off its coarser headwater sediment source area. Cobbles and gravels from headwaters east of Petaluma Hill Road no longer reach the channel. However, these coarser sediments are delivered by Hunter Creek.

Hunter Creek

Hunter Creek flows easterly from Petaluma Hill Road west to Santa Rosa Avenue where it joins Todd Creek. It is likely that the current channel is located fairly close to the original stream position prior to being confined in a trapezoidal channel. As shown in Figure C-65, the dominant vegetation type is ruderal with some patches of riparian woodland. Unlike Todd Creek, Hunter Creek is still connected to headwater sediment source areas and it transports a bedload of sand, gravel, and cobbles. Additionally, the channel does not exhibit aggradation from deposited sediment or dense thickets of cattails as noted in Todd Creek. However, stagnant pools and bank sloughing are common in the lower reaches of the creek. Maintenance activities in this channel have been infrequent in the past. However, future land use changes in the upper watershed could influence channel functioning and maintenance needs.

Coleman and Cook Creeks

Coleman Creek is located in the geomorphic transition from alluvial fan to alluvial plain west of Petaluma Hill Road where sediment is prone to depositing in the flood control channel (Figure C-68). As shown on Figure C-68, Cook Creek is a tributary to Coleman Creek. Though not immediately evident in the figure, Cook Creek flows from its headwaters on Sonoma Mountain to the Cook Creek Sediment Basin near Petaluma Hill Road, then the creek flows underground in a culvert (the Cook Creek Conduit) and daylights again in Golis Park west of Snyder Lane. Downstream of Snyder Lane, Coleman Creek passes through the Foxtail Golf Club and then joins the Wilfred Extension channel, which then joins the mainstem of Wilfred Creek (Figure C-68). As noted in Table 10-3, potential habitat for western pond turtle occurs in the subbasin but it is unlikely that habitat for other special-status species is present.

While the combined headwater catchment area for Coleman and Cook Creeks is relatively small, their headwater areas are very erosive and contribute high sediment yields downstream. Mass movement, landslides, and severe streambank erosion have led to abundant sediment yields, particularly in upper Cook Creek. These conditions prompted the 2006 and 2008 Cook Creek erosion control projects. East of Petaluma Hill Road, a sedimentation basin on Cook Creek captures materials discharged from the headwaters and foothills. In the past, this basin was frequently cleared of sediment, but since completion of the erosion control projects in the headwaters upstream, the basin has not required maintenance as frequently. This is an example of successful implementation of the SMP's Maintenance Principles (discussed in Chapter 4) and the mitigation program (discussed in Chapter 11).

Wilfred Creek and Bellevue Wilfred Channel

Wilfred Creek, like Todd Creeks, may have once been more directly connected to headwater source areas east of Petaluma Hill Road. However, development in the area including agricultural use, residential housing, and a golf course resulted in the realignment and straightening of the creek channel and disconnection from their upper watershed (Figures C-67 and C-68). Wilfred Creek has a smaller headwater area than Hunter or Cook creeks, with its primary source of sediment and flow likely originating from runoff from the agricultural fields along the northern half of the drainage area.

Wilfred Creek and the Wilfred Extension are characterized as having abundant sediment accumulation, limited riparian vegetation, and lack of channel complexity. Maintenance activities along these reaches consist of culvert clearing at Snyder Land and Santa Rosa Avenue and bank stabilization. The Wilfred Extension channel conveys runoff from Coleman Creek and the Foxtail Golf Club (Figure C-68). Sediment detention basins within the golf course noticeably improve the quality of water discharged to the Wilfred Extension and Wilfred Creek channels, particularly for reduction of suspended sediment (i.e., turbidity). The lower portion of Wilfred Creek and the Wilfred Extension border a vernal pool wetland preserve where sensitive habitat for many plant and wildlife species is protected. Any maintenance activities along Wilfred Channel near the preserve must considerate the habitat sensitivity of the area.

The Bellevue-Wilfred Channel is the receiving stream for the Todd, Hunter, Cook, Coleman, and Wilfred channels. Numerous sediment depositional bars with cattail growth and flow impedance occur as a result of the modified nature of the channel and receiving waters. The Bellevue-Wilfred channel gradually widens moving downstream eventually leading to the Laguna de Santa Rosa. The widened channel and backwatering from the Laguna propagates sediment deposition throughout the lower Bellevue-Wilfred channel. Though deep pools are present, the downstream reaches exhibit little channel complexity. Ruderal vegetation dominates the banks and there is little to no riparian canopy over the channel (Figure C-67).

As a result, conditions for invasive plants such as ludwigia and cattails are supported by the existing Bellevue-Wilfred channel conditions. As indicated in Table 10-3, there is a high likelihood of presence of California tiger salamander habitat in the area, probably due to the surrounding agricultural fields and earthen banks where rodent burrows offer retreats for salamanders. Opportunities to improve habitat and sediment transport functioning within the Bellevue-Wilfred channel may include installation of targeted sediment capture areas (sediment basins) or low-flow channels within the banks to prevent transfer of sediment to the Laguna and migration of invasive species (ludwigia) from the Laguna to the channel.

Hinebaugh Creek

The Hinebaugh Creek drainage area extends far in to Sonoma Mountain to the east (Figure C-71 and C-72). Crane Creek is the primary tributary in the system, followed by Five Creek and Hinebaugh Creek. Five Creek flows into Crane Creek, which flows into Hinebaugh Creek and then to the Laguna de Santa Rosa. East of Snyder Lane, the three creeks flow through agricultural fields which support grazing and grain production. Rural residences and ranches are located in the upper watershed lands. Patches of oak and Douglas fir trees are found along the stream channels in the upper watershed. As the creeks flow west onto the alluvial plain, the streams transition to engineered channels and the diversity of riparian species reduces while invasive species such as cattail increase. Additionally, sediment texture transitions from the coarser gravels and sands found in the upper watershed to finer sands and silts moving downstream to the lower portion of Hinebaugh Creek. Vegetation in the reaches varies from ruderal to riparian woodland with varying canopy cover (see Figures C-71 and C-72 and Table A-1).

Many of these finer sediments are transported to the lower reaches of Hinebaugh Creek downstream of Highway 101 where they are deposited. This zone between Highway 101 and the Laguna confluence downstream reflects a transition from a fluvial, low gradient system to a very low gradient, lagoon type environment that experiences backwatering from the Laguna system. Depending upon flood conditions, backwatering effects from the Laguna continue upstream to the Highway 101 crossing, as observed during flow events in the fall of 2007. Backwatering from the Laguna causes sediment deposition in the lower reaches of Hinebaugh Creek. Bars within the channel and sections with little riparian canopy creates conditions where cattails thrive and encourage additional entrapment of fine sediment and impede flow through the channel.

To date no steelhead have been observed in the upper reaches of Hinebaugh or Crane Creek during Sonoma Water surveys although other cold-water fish such as sculpin have been observed. As shown in Table 10-3, reaches of Hinebaugh and Crane creeks are identified as supporting migratory habitat for steelhead. The subbasin also supports habitat for California tiger salamander.

Copeland Creek

The headwaters of the Copeland Creek subbasin (5.1 sq. mi.) extend to the east beyond the city limits of Rohnert Park and rise up the slopes of Sonoma Mountain to a peak elevation of 2,463 feet. This headwater area provides the source areas for runoff, groundwater recharge, and sediment yields transported downstream. West of Petaluma Hill Road, were elevations and slope decrease across the alluvial plain, Copeland Creek becomes a straightened engineered flood control channel (Figures C-71 and C-72). Snyder Lane marks a shift toward a more depositional channel environment with cobbles and pebbles being deposited upstream of Snyder Lane and finer sand and silt materials depositing downstream of Snyder Lane.

Sediment deposition is observed throughout the Copeland Creek – SMP reaches. Near the Snyder Lane crossing, sediments consist primarily of gravels (course sands, pebbles, and small cobbles). These coarser sediments are organized into longitudinal bar features, with narrow low flow channels between the bars. Of note, the sediment bars near the Snyder Lane Bridge aggraded over 1-foot in height during the storm events of early January 2008. Moving downstream, sediment texture transitions to finer materials including medium sands and finer silts. As this occurs, the depositional patterns change from the defined gravel bars upstream to a more homogenous filling of the entire channel width.

Downstream of Reach 4, Sonoma Water had previously excavated a low-flow channel during previous sediment maintenance activities at Reach 3 in 2003. As described in the reach sheets for *Copeland 1, 2, and 3* benches and bars have established adjacent to the low-flow channel. In conjunction with the riparian corridor of lower Copeland Creek, these features provide channel complexity, habitat improvement, and an important migratory corridor for fish that pass through the engineered Copeland Creek reaches toward upstream spawning sites. Upper Copeland Creek supports spawning and rearing habitat for steelhead in its upper reaches (Table 10-3). The Copeland Creek channel provides important migratory corridor from the Russian River and Laguna, to the upper Copeland Creek headwaters. The low-flow channel features improve sediment transport functioning and improve channel complexity for the benefit of juvenile salmonids. Vegetation within Copeland Creek is dense, ranging from riparian forest in Reach Copeland 2 (Figure C-72) to riparian woodland providing large canopy coverage in reaches Copeland 4 and 5 (see Table A-1 in Appendix A).

Upper Laguna Channel

The Upper Laguna drainage area forms the southernmost divide between the Russian River and Petaluma River watersheds. The Upper Laguna channel daylights from a culvert at Liman Way and Myrtle Avenue in Cotati. Headwater areas further upstream of the daylighted culvert are disconnected due to development, but flows contained in the uppermost reaches are still supplied by underflow through the alluvial plain and urban surface runoff.

Downstream of East Cotati Avenue, the channel is wider and more sinuous. The increased available width in the channel encourages establishment of a low flow channel and a riparian overstory. Approaching Highway 101, the channel is concrete lined with vertical walls. The channel gradually widens as it continues to flow downstream, most noticeably west of Highway 101 where the channel is slightly wider than the reach upstream and a low flow channel and pools have established. Fine sediments are abundant and because of limited shading and the gentle channel gradient, cattail growth is widespread.

Washoe and Copeland creeks enter the Laguna channel downstream of Highway 101. The reach of Washoe Creek maintained by Sonoma Water is likely a remnant of the original channel's alignment. Headwater flows to Washoe Creek are redirected to Gossage Creek at Derby Lane, north of Highway 116. The remnant channel reach (*Washoe 1*) primarily functions to convey runoff from agricultural activities surrounding the area. During moderate storm events, backwatering extends upstream of the Laguna-Copeland-Washoe confluence.

Downstream of the Laguna-Copeland confluence the channel transitions from riverine processes to a more still water or lagoonal environment. This reach of channel was designed with the capacity to convey flow from the upper drainage area, as well as the Copeland, Gossage, and Hinebaugh drainage areas. The channel widens even further where the Bellevue-Wilfred flows are received. Water is dispersed widely across the channel and the bed is layered with silts and clays. Ludwigia occurs commonly throughout the lower portions of the Upper Laguna channel. In some locations, riparian cover over the channel assists in suppressing growth of ludwigia and cattails.

The Upper Laguna channel supports habitat for steelhead (migratory corridor), California tiger salamander, western pond turtle, and some special-status plants. Unlike most of the major tributaries to the Upper Laguna system which flow from the east, the Gossage Creek tributary joins the Upper Laguna system, flowing from the south and west. Gossage Creek also supports migratory habitat for steelhead. Gossage Creek has experienced ludwigia encroachment in its lower reaches. Improved riparian corridor management to prevent growth and distribution of cattails and ludwigia would ensure this habitat is protected and improved in the future.

3.4.2 Petaluma River Watershed (Zone 2A)

The Petaluma River watershed (146 sq. mi.) lies in both Sonoma County (112 sq. mi. of the watershed) and Marin County (34 sq. mi. of the watershed). The highest elevation in the watershed is Sonoma Mountain (2,295 ft. above MSL) and the lowest elevation is sea level at San Pablo Bay. The northern watershed divide with the Laguna de Santa Rosa basin is subtle and mildly perceptible. Historically, the boundary between the two watersheds would have migrated variably north and south with changes in alluvial fan and stream locations in the area. Also, tectonic uplift, subsidence, or compression along the Rodgers Creek Fault may have altered the basin divide between the watersheds.

In the northeastern Petaluma River watershed, tributaries flow southwest out of the Sonoma Mountains to the Petaluma River and then flow southeast to San Pablo Bay. The Petaluma Valley in the central watershed forms a wide basin with characteristic rolling hills and grasslands that stretches from Cotati southeast to San Pablo Bay. Primary tributaries to the Petaluma River include Willow Brook, Lichau, Lynch, Washington, Adobe, Ellis, Liberty, Marin, and San Antonio creeks.

The Petaluma River experiences tidal fluctuations from San Pablo Bay in the south to 14 miles upstream past downtown Petaluma (Sonoma County 2006). The lower Petaluma River has been modified to enable commercial traffic and is dredged every four years to maintain navigability. Flooding along the Petaluma River and its lower tributaries is exacerbated during high tide events when river base levels are elevated and flows in low-lying storm drains and channels are detained. This tidal condition has maintenance implications for some of the channels maintained by Sonoma Water including lower Washington and Lynch creeks. In these channels, accumulated sediment and debris conditions that might reduce flood conveyance capacity pose an increased flood concern when combined with the potential influence of high-tide backwatering.

The majority of the Petaluma River watershed is in non-intensive agricultural production, including oat hay production and dairy cattle and sheep grazing lands. Vineyard development has occurred throughout the watershed from the 1990's to the present, including on Sonoma Mountain and along Lakeville Highway. Urban runoff from the City of Petaluma, which covers approximately 14 square miles, is directed to the lower Petaluma watershed.

Sonoma Water conducts maintenance activities on the lower sections of the following tributary creeks: Lichau (Figures C-77 thru C-80), Corona (Figure C-80), Capri (Figure C-80 and C-38), Washington (Figure C-84 and C-86), McDowell (Figure C-86), Adobe (Figure C-87), and Thompson (Figure C-88) creeks. Sonoma Water does not conduct maintenance activities in the Petaluma River itself.

Lichau Creek

Three reaches of Lichau Creek are maintained by Sonoma Water between Old Redwood Highway and Stony Point Road (Figures C-77 thru C-80) toward the confluence with the Petaluma River. Land uses draining to Lichau Creek are primarily agriculture (grazing) with some patches of low-density development, and more commercial uses near the Highway 101 corridor. Channel vegetation cover is over 75% near Old Redwood Highway and declines to 5% cover near Highway 101. The middle portion of the maintenance area contain a developed riparian corridor which provides shade over in-channel pools, while the downstream most reach is gentler in gradient and supports emergent vegetation (cattails) in over 70% of the channel width. Lichau Creek supports spawning and rearing habitat for steelhead in the upper watershed. Thus, the lower reaches are the migratory gateway for steelhead moving up the Petaluma River and into Lichau Creek. Maintenance activities in these reaches primarily consist of sediment and vegetation removal.

Corona Creek and Capri Creek

Corona and Capri creeks are small tributaries originating in the foothills of Sonoma Mountain west of Petaluma. The majority of both drainage areas have been developed for residential housing with headwater areas occupied by rural residential and agricultural land uses. The Corona SMP-reaches support an abundance of emergent vegetation (duckweed and cattails) which impedes flow and encourages sediment deposition. As noted in the reach sheets, vegetation removal and riparian corridor enhancement are recommended maintenance activities. Corona Creek is diverted to Capri Creek west of Highway 101. Prior to construction of Highway 101, Corona Creek flowed west directly toward the Petaluma River. Capri Creek is similar to Corona Creek, but the drainage area and creek sizes are smaller. The upper Capri Creek watershed is rural agricultural grasslands at the base of Sonoma Mountain. Moving downstream, Capri Creek becomes a landscape feature through a neighborhood park. Lower Capri Creek maintains a wide easement upstream of Old Redwood Highway. This lower reach provides a good opportunity for additional planting and canopy development, and removing existing cattail stands. Toward the Petaluma River, the riparian canopy cover increases (Figure C-80).

Lynch Creek

Lynch Creek is one of the larger tributaries to the Petaluma River from the Sonoma Mountain side of the watershed. The downstream portion of the creek is managed by Sonoma Water and provides an important migratory pathway to these spawning grounds. This reach includes a coarse sediment bed with pebbles and sands. Patches of duckweed and cattails fill the channel and the banks lack riparian vegetation tall enough to provide channel shading.

Washington and East Washington Creeks

Similar to the other tributaries described above, Washington Creek flows from Sonoma Mountain west to the Petaluma River and is one of the larger drainage areas in the Petaluma subwatershed. The Petaluma Municipal Airport and Rooster Run Golf Course bisect Washington Creek and its parallel tributary, East Washington Creek requiring underground culverts. The upper drainage area is mostly oak woodland and grasslands, while the lower drainage area is urbanized. Patches of riparian woodland are found along both the Washington and East Washington creek reaches. In some places, the riparian vegetation provides full canopy cover (Figures C-84 and C-86). Unlike Lichau, Lynch, and Adobe creeks, Washington Creek does not support steelhead habitat. The lowermost reaches of Washington Creek are influenced by tidal activity.

Upper Washington Creek (Reach 7) is an ephemeral reach with a nearly entirely sandy channel bed. Moving downstream, Washington Creek becomes a roadside adjacent channel to Washington Avenue. In these locations the channel is linear and homogenous with steep banks, typically hardened with sacrete and flanked by Eucalyptus and other non-native species. Washington Creek has previously flooded into the adjacent shopping area near Highway 101. Lower Washington Creek is tidal where it joins the Petaluma River and experiences bi-directional flows. This portion of the creek has been upgraded by the USACE to provide increased flood protection. Sonoma Water and the USACE coordinate their maintenance in the lower Washington Creek reaches near the Petaluma River.

East Washington Creek is maintained by Sonoma Water in five reaches extending from the airport to the confluence with Washington Creek (Figures C-84 and C-86). The wide gently sloping channel banks of provide the space to install low flow channels and in channel sediment basins. The downstream portion of East Washington Creek are narrower than the upstream reaches and experience abundant deposition with areas of bank slumping and in channel vegetation that hinder flow conveyance.

McDowell Creek

The original channel of McDowell Creek is barely distinguishable today due to the intense development in this portion of the watershed. McDowell Creek is directly connected to the Petaluma River and no Sonoma Water maintenance occurs there. Tidal gates at the upstream end of Reach 1 at Lakeville Highway reduce tidal influences from entering upstream reaches. The reaches maintained by Sonoma Water have been heavily modified for flood control and conveyance of stormwater runoff from surrounding development and highways. Numerous storm drain outfalls require that a large portion of the stream banks are armored. The riparian corridor is dense enough in some locations to provide some shading over the channel, but the corridor is sparse or non-existent in most portions of creek upstream of Lakeville Highway

(Figure C-86). The primary maintenance needs in the reaches are vegetation management and some sediment removal.

Adobe Creek

Similar to Washington Creek, the drainage area for Adobe Creek extends to the peak of Sonoma Mountain. The creek descends quickly from approximately 2,000 feet MSL at Sonoma Mountain to approximately 200 feet MSL at Old Adobe Road. The creek flows through the Adobe Creek Golf Course, residential housing, and to the Petaluma River, south of McDowell Boulevard. The lower portions of Adobe Creek are maintained by Sonoma Water. Downstream of Casa Grande Road, the creek transitions from the alluvial fan into the gentler alluvial plain section and is characterized by sand and cobble stream bed which encourages infiltration. The stream channels narrows moving downstream approaching Lakeville Highway but contains an intact remnant riparian corridor. Downstream of Lakeville Highway, the channel is wider and nearly completely covered by a dense riparian overstory (Figure C-87). Many of the sediments transported from the upper watershed and deposited downstream of Lakeville Highway. The lower reaches are tidally influenced from the nearby Petaluma River and have retained some connection to adjacent floodplain areas. Sonoma Water does not conduct maintenance in the tidal portions of the creek.

Sonoma Water removes sediment from the Adobe Channel and instream sediment basin located just upstream of McDowell Boulevard on a regular (generally annual) basis. This instream sediment basin effectively captures sediments transported and deposited from upstream sections. Adobe Creek supports the most intact spawning and rearing habitat for steelhead in the Petaluma River watershed. It also provides important habitat for foothill yellow-legged frogs, which were observed during field work for the reach sheets, as listed in Table 10-3.

Thompson Creek

Thompson Creek is located on the southwest side of the lower Petaluma River watershed (Figure C-88). Thompson Creek provides a narrow corridor of riparian vegetation that becomes thicker towards the lower end of the maintenance reach. This ephemeral reach supports stands of blackberry and some stagnant pools. Though the reach is immediately surrounded by development, the channel easement is wide located in a neighborhood parkway. The maintenance reach is in close to upland habitat for California red-legged frogs. Maintenance activities within this reach typically involve vegetation removal.

3.4.3 Sonoma Creek Watershed

The Sonoma Creek watershed (170 sq. mi.) is located east of the Petaluma River watershed and west of the Napa River watershed of Napa County. As described above, the Sonoma Creek valley is generally symmetrical with dendritic tributaries (small tributaries that feed a single, large tributary) descending from the Mayacamas Mountains to the east and the Sonoma Mountains to the west. Elevations in the watershed range from about 2,500 ft. above MSL at Bald Mountain to sea level at San Pablo Bay. Key tributaries in the watershed include Calabazas, Hooker, Carriger, Fryer, Nathanson, Schell, Rodgers, and Fowler creeks.

The Sonoma Creek watershed contains many creek reaches in the watershed that are identified as modified or natural channels. These reaches are very rarely maintained by Sonoma Water. Additionally, habitat for California freshwater shrimp is present in the Sonoma Creek watershed. As such, maintenance activities are restricted to avoid or minimize potential impacts to the species or their habitat. The only engineered channels maintained by Sonoma Water are Fryer Creek, a tributary to Nathanson and Schell creeks, and the Nathanson Creek bypass (Figure C-115).

Flooding issues in the watershed affect agricultural and rural residential areas in the lower watershed, particularly near Schellville. Tidal action from San Pablo Bay influences Sonoma Creek north of Highway 37 and south of Highway 121. This tidal influence affects flooding conditions in the lower watershed, but does not reach as far upstream into the watershed compared to the Petaluma River.

Land uses in the Sonoma Creek watershed are mixed, but contain a high percentage of both agriculture and ranchland/woodland land uses. Approximately 54 percent of the watershed is in agricultural use, 30 percent is rural and about 11 percent is recreational. Urbanized areas are located in the center of the watershed, within the alluvial plain area. The town of Sonoma forms the main urban center and is located at the lower end of Flood Control Zone 3A.

Fryer Creek

Fryer Creek flows north to south through the southern edge of downtown Sonoma and then through the residential neighborhoods south of downtown. The Fryer Creek system appears to be heavily engineered with the downstream portion flowing through a straightened trapezoidal channel. The East Fork of Fryer Creek still retains some sinuosity and maintains some semblance of a low flow channel with a shallow bench and gentler bank slopes. The Fryer Creek system appears to be completely disconnected from any larger, upstream watershed, with the channel quickly turning to a small swale and then ending at W. Napa Street, upstream of Sonoma Water maintenance activities. Flows into this swale appear to be completely dependent on runoff from downtown Sonoma. The five reaches of Fryer Creek maintained by Sonoma Water are located in the lower alluvial plain portion of the Sonoma Creek watershed, just upstream from tidal marsh areas.

3.5 Biological Resources

This section presents a description of natural communities and channel land cover types in the program area. Land cover and natural communities occurring in the program area were categorized into eight primary types, as follows:

- Riparian Forest and Woodland
- Emergent Wetlands
- Blackberry Scrub
- Ruderal
- Developed
- Aquatic

Invasive species are common in these natural communities in the program area and are commonly characteristic of the surrounding residential and agricultural areas. Seeds and vegetative fragments from these invasive species are carried into the program area by tributary flows, wind, animals, and by residents using the program area for recreation. Monitoring and controlling invasive species is an important ongoing maintenance activity that is necessary to maintain and enhance habitat value and flood control in the program area.

The channels and associated natural communities in the program area provide valuable habitat for many common and special status plant and animal species. Many of the common and special status species with potential to occur in the SMP channels are discussed together with the natural communities in which they are found. A more detailed discussion of the special status species with potential to occur in SMP channels is provided in Section 3.5, Biological Resources, and Appendix D, *Accounts of Special Status Species*.

Table C-1 lists the reach and vegetation maps for the subwatersheds and reaches maintained within Zones 1A, 2A, and 3A. Note that the vegetation maps are provided only for the engineered flood control channels of Zones 1A, 2A, and 3A (mapped as orange and red reaches in the subwatershed maps, and the program area maps in Chapter 1, Figures 1-1 through 1-9). Maintenance activities in Modified and Natural channels (mapped as blue and green reaches in the Chapter 1 maps) only occur on an as needed basis as described in Chapter 7.

Since SMP implementation in 2009, vegetation management has continued along most creeks in the SMP program area. The result has been that canopy provided by upper bank and toe trees has continued to develop in a number of layers and complexity. Many areas mapped originally as open water, emergent wetlands, willow and blackberry scrub can now be classified as riparian woodland and forest. Sonoma Water continues to conduct LIDAR flights every 5 years (approximate) to track canopy development.

3.5.1 Ecosystem Functions

The primary ecosystem functions and functions of drainages in the program area are the following:

- prevent flooding by storing floodwaters;
- maintain surface and groundwater quality through filtration and decomposition of pollutants;
- recharge the groundwater aquifers;
- service floodplain fertility by flooding and deposition of fine sediments;
- provide water for human, animal, and wildlife use; and
- provide wildlife habitat.

The key characteristics of streams that contribute to these functions are intact wetland or riparian vegetation, connectivity with their floodplains, a lack of barriers to wildlife passage, and a natural hydrologic regime.

3.5.2 Stream Maintenance Considerations

Maintenance considerations for vegetation communities in the program areas are discussed below. These maintenance considerations also apply to the drainages where these communities are found. As noted below, Sonoma Water generally encourages the growth of riparian forest and woodland along the channels in the program area. Riparian trees at the top-of-bank and just above the toe-of-slope stabilize the bank and are anticipated to discourage the growth of dense in-channel vegetation.

In addition, Sonoma Water encourages channel form complexity where this is compatible with flood control. For example, a low-flow channel with an angled bed provides both habitat and flood control benefits. Such a channel profile provides greater diversity in water depth. Deep water areas may provide habitat for some species, and also discourage the growth of floating emergent species such as the non-native ludwigia or marsh species like cattails, which thrive in warm, stagnant conditions.

3.5.3 Riparian Forest and Woodland

Riparian forest and woodland in the program area is found on the banks of perennial drainages between the Ordinary High Water Mark (OHWM) and top-of-bank (TOB). This community may include many non-native tree species performing a riparian function. On intermittent drainages, such as Peterson Creek in Zone 1A, riparian forest and woodland is typically found at the top of bank. This community is also found adjacent to the TOB for both perennial and intermittent drainages. Typical riparian forest and woodland in the program area is shown in the photographs of **Figure 3-15**.

Riparian forest and woodland in the program area is dominated by a variety of tree species. Coast live oak (*Quercus agrifolia*) and valley oak (*Quercus lobata*) are the most common species in riparian woodland in the program area. Other common species include Oregon ash (*Fraxinus latifolia*), walnut (*Juglans* sp.), Fremont cottonwood (*Populus fremontii*), white alder (*Alnus rhombifolia*), and cork oak (*Quercus suber*). Larger trees are commonly found at the TOB, while shorter willows, such as arroyo willow (*Salix lasiolepis*), or alders may be found growing near the OHWM. The herbaceous understory of riparian woodland along the flood control channels is typically dominated by non-native species that are also dominant in ruderal areas, such as brome grasses (*Bromus* spp.), Italian ryegrass (*Festuca perennis*), English and Algerian ivy (*Hedera helix, H. canariensis*), periwinkle (*Vinca major*), Himalayan blackberry (*Rubus armeniacus*), Harding grass (*Phalaris aquatica*), bristly ox-tongue (*Helminthotheca echioides*), and sweet fennel (*Foeniculum vulgare*).

The non-native blackberry scrub and periwinkle are frequently interspersed with riparian woodland or present as an understory along the banks in reaches where mature trees are present at the top of the bank.

Riparian forest and woodland was classified into four sub-categories based on the degree of canopy closure over the stream channel. Areas with greater canopy closure provide more shading of the streams, enhancing habitat for fish and other wildlife species and reducing the growth of wetland vegetation in the channel. Greater canopy closure is therefore typically associated with higher quality aquatic habitat for many fish and wildlife species. Riparian habitat quality is also enhanced by more mature trees with greater canopy closure. However, riparian habitat quality also depends on the degree of development of herbaceous, shrub and subcanopy layers. In some cases, riparian woodland with a high degree of canopy closure may consist of one or two rows of mature trees at the top of the bank, without a shrub or subcanopy layer.

Despite the constraints on wildlife habitat in the watershed, a well-developed riparian woodland overstory and dense vegetative cover in the understory provide habitat for species that can tolerate chronic human disturbance. Several species of nesting songbirds utilize riparian forest and woodland. Several commensal species of mammals, including raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), and striped skunks (*Mephitis mephitis*) flourish in riparian forests that are in close proximity to human disturbance. Additionally, many bird species associated with oak woodland habitats, such as oak titmouse (*Baeolophus inoratus*) and acorn woodpecker (*Melanerpes formicivorus*), are also found in riparian woodlands.

Madrone Audubon Society surveys of Santa Rosa's creeks have documented many year round residents, including but not limited to, acorn woodpecker, Anna's hummingbird (*Calypte anna*), black phoebe (*Sayornis nigricans*), California towhee (*Pipilo crissalis*), and belted kingfisher (*Ceryle alcyon*). California Swainson's thrush (*Catharus ustulatus oedicus*) is a summer resident of riparian forests in the program area.

Western toad (A*naxyrus boreas*), Sierran treefrog (*Pseudacris sierra*), ring-necked snake (*Diadophis punctatus*), common garter snake (*Thamnophis sirtalis*), and western terrestrial garter snake (*Thamnophis elegans*) may be found in riparian forest and woodland. California giant salamanders (*Dicamptodon ensatus*) may utilize riparian forest along small streams relatively high in the watersheds of the program area. Riparian forest and woodland also provide habitat for species such as black-tailed deer (*Odocoileus hemionus*) and bats such as long-eared myotis (*Myotis evotis*).

Wildlife habitat is greatly enhanced by riparian vegetation, which provides shade, food, and nutrients for algae and aquatic invertebrates that form the basis of the food chain. Coarse woody debris from riparian trees and shrubs is also an important feature of in-stream habitat, forming scour pools and log jams used by amphibians, insects, and fish. Riparian forests and woodland may be the most important habitat for California bird species, providing breeding and over wintering habitat, migration stopover areas, and movement corridors (Riparian Habitat Joint Venture 2004). The quality of riparian wildlife habitat is enhanced by multilayered, structurally complex vegetation, including canopy trees and a shrub layer, and food sources such as berries and insects.

Special Status Species

Riparian woodland provides nesting habitat for several raptor and migratory bird species some of which are special status bird species, such as white-tailed kite (*Elanus leucurus*) and yellow-breasted chat (*Icteria virens*). Other migratory birds such as yellow warbler (*Setophaga petechia*) and protected subspecies of common yellowthroat (*Setophaga petechia*) and song sparrow (*Melospiza melodia*) may also nest in riparian habitats throughout the SMP area. Bald eagles (*Haliaeetus leucocephalus*) have been observed in the vicinity of Sonoma Water's flood control channels and creeks in the California Department of Fish and Wildlife (CDFW) Wildlife Area north of Occidental Road (Laguna de Santa Rosa Foundation 2006; Cornel Lab of Ornithology

2018). California freshwater shrimp (*Syncaris pacifica*) may be found along creek reaches with riparian woodland or forest, utilizing exposed live tree roots of undercut banks and feeding on detrital material from overhanging vegetation.

Like other communities adjacent to creeks, this habitat provides movement corridors and short-term refugia for California red-legged frog (*Rana draytonii*). Where adequate cover is available and human disturbance is relatively low, riparian forest and woodland provides potential egg laying sites for western pond turtle (*Actinemys marmorata*), which has been documented in several tributaries in the program area. California tiger salamander (*Ambystoma californiense*) has been documented in the vicinity of the program area, and may utilize woodland, if grasses dominate the understory and suitable burrows for aestivation are present. Special status bats, such as the Townsend’s big-eared bat (*Corynorhinus townsendii townsendii*), Western red bat (*Lasiurus blossevillii*) and pallid bat (*Antrozous pallidus*), may utilize mature trees in riparian forest or woodland for temporary roosting sites while foraging and day roost sites. In general, riparian corridors are important foraging areas for bats.

Ecosystem Functions

The primary ecosystem functions provided by riparian forest and woodland are:

- stabilization of streambanks;
- shading of water;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from run-off;
- maintenance of stream flows during summer by promoting groundwater recharge and storing water;
- providing movement areas for wildlife; and
- providing wildlife refugia and breeding habitat and forage through the input of coarse woody debris and detritus into streams and rivers.

Response to Disturbance

Disturbance, whether natural or human-induced, affects different plant species in various ways. Some mature tree species in riparian woodland, such as walnut, Fremont’s cottonwood, and coast live oak, can resprout if they are damaged by flooding or mechanical disturbance. Others, such as valley oak, may be capable of resprouting as seedlings or saplings but lose this ability when mature. In general, mature riparian trees do not resprout as vigorously as riparian scrub species and require longer periods than scrub species or invasive species to recolonize by seed. Therefore, as areas recover from disturbance, they are likely to be dominated initially by herbaceous vegetation, followed by willow scrub and possibly larger willows. Ultimately, in the absence of disturbance, mature riparian woodland and/or forest develops.

Disturbance of riparian woodlands may lead to increases in the relative cover of invasive exotic species including sweet fennel, bristly ox-tongue, English ivy, (French broom (*Genista monspessularia*), Himalayan blackberry, and periwinkle. These species are currently spreading in riparian areas and displacing native vegetation. This shift in riparian species composition can reduce native species diversity and habitat value, and may alter creek hydrology.

Stream Maintenance Considerations

Riparian forest and woodland enhances flood control functions by discouraging the growth of dense emergent vegetation that could otherwise reduce channel conveyance capacity. As described above, it also enhances habitat value. The SMP approach encourages riparian forest and woodland in the program area by planting riparian trees at the top of bank and, depending on channel capacity, at the toe of the slope. Riparian forest and woodland in the program area consists of a mixture of native trees, such as coast live oak, and non-native trees, such as cork oak. Planting native species and controlling invasive shrubs in the understory enhance the habitat value of this community.

3.5.4 Emergent Wetlands

Emergent wetlands in the program area occur as a narrow fringe along the margins of some drainages, or as patches or dense stands in other drainages. Photographs of representative emergent wetland in the program area are shown in Figure 3-16. Some creek reaches in the program area are characterized by dense stands of cattail (*Typha* spp.), with bulrush or tule (*Schoenoplectus* spp.) as a significant but less common component. *Ludwigia peploides montevidensis* (ludwigia), a non-native floating emergent species, is a problem species in emergent wetlands in many creeks in the program area.

The narrow strips and small patches of emergent wetland found along the margins of creek channels in the program area are dominated by a variety of species, including rice cutgrass (*Leersia oryzoides*), giant bur-reed (*Sparganium eurycarpum*), common water plantain (*Alisma plantago-aquatica*), common threesquare (*Schoenoplectuspungens*), river bulrush (*Bolboschoenus fluviatilis*), hardstem bulrush (*Schoenoplectus acutus*), torrent sedge (*Carex nudata),* and cyperus species (*Cyperus* spp.), including red-rooted cyperus (*Cyperus erythrorhizos*). Associated species include mint (*Mentha* spp.), willowherb (*Epilobium ciliatum*), and smartweeds such as waterpepper (*Polygonum hydropiperioides*).

Sierran treefrog and western toad, discussed above, may also be associated with emergent wetland vegetation. Birds such as red-winged black birds(*Agelaius phoeniceus*), Virginia rails (*Rallus limicola*), and soras (*Porzana carolina*) may utilize dense freshwater marsh vegetation. Cattail wetlands are utilized extensively by muskrats (*Ondotra zibethica*). Where muskrat populations are large, foraging may be an important factor in maintaining open water areas. In addition, cattail fruits are utilized by terrestrial birds for nesting material, and their stems may be used by aquatic birds (Motivans and Apfelbaum 2005).

Special Status Species

Special status plants that may occur in freshwater marsh in the program area include Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*) (CRPR 1B), swamp harebell (*Campanula californica*) (CRPR 1B), Sonoma white sedge (*Carex albida*) (Federally Endangered [FE], state endangered [SE], CRPR 1B) and California beaked-rush (*Rhynchospora californica*) (CRPR 1B).

California red-legged frog may utilize emergent wetland vegetation for cover and breeding habitat. Emergent wetlands in creek channels provide suitable habitat for western pond turtle. Tricolored blackbird (*Agelaius tricolor*), common yellowthroat and song sparrow may utilize freshwater marsh vegetation for nesting.

Ecosystem Functions

The primary ecosystem functions provided by emergent wetland are:

- maintenance of water quality through filtration of sediment and nutrients;
- recharging of groundwater by slowing surface flows;
- prevention of flooding by storing floodwaters; and
- providing wildlife habitat directly.

Response to Disturbance

Emergent wetland vegetation responds to disturbance by rapid regrowth from rhizomes or recolonization from seed sources upstream. Habitat quality typically decreases while emergent wetlands recover from disturbance. Lack of disturbance and accumulation of sediment may lead to conversion of emergent wetlands to communities dominated by willows.

Stream Maintenance Considerations

In some cases, emergent wetland in and along channels in the program area is compatible with flood control needs. A fringe of emergent wetland vegetation along the channel banks or relatively sparse patches of vegetation within the channel typically does not lower channel conveyance capacity below safe thresholds. Emergent wetland vegetation of this sort is encouraged in the SMP because of the habitat and water quality benefits it provides. However, dense emergent wetland vegetation (often composed of cattails and ludwigia) is found in many channels in the program area. These stands are incompatible with flood control because of their association with increased sedimentation rates. In the short term, vegetation and sediment removal is necessary to maintain conveyance capacity in these channels. Additionally, from an ecological viewpoint, excessive buildup of sediment in program area channels causes a succession of the instream habitat toward monocultural stands of cattail marsh. Removing the sediment has the beneficial effect of providing a varied habitat that supports a more diverse species mix until increasing aggradation triggers the need for sediment to be removed again. In the long term, Sonoma Water is encouraging the development of riparian woodland along these channels to reduce the growth of emergent wetland vegetation. Much of the emergent wetland vegetation in the program area is of low habitat value for many species, because it consists of dense monocultures of cattails or ludwigia.

Where vegetation removal is necessary to increase conveyance capacity, patches of emergent wetland or a wetland fringe may be maintained when feasible. Wetland patches or a wetland fringe provide habitat and enhance water quality, as well as preserving the diversity of vegetation communities along the reach.

Reducing the proportion of emergent wetlands characterized by dense monocultures of cattails would enhance habitat heterogeneity and conveyance capacity. Planting of trees just above the toe of slope in the channel and at the top of bank may be necessary to help control cattails in the long term. These trees mature and create a canopy over the active channel, providing shade and discouraging cattail growth. Cattails may also be controlled by completely removing the plant and root structure. This is achieved through sediment removal (removing cattails along with the sediment) in reaches where sediment has settled in the channel and been populated by cattails combined with the strategic planting of potential competitors to reduce available habitat.

3.5.5 Blackberry Scrub

Blackberry scrub is located on the banks of some intermittent and perennial drainages in the program area. Photographs of representative blackberry scrub in the program area are shown in **Figure 3-17**. In a few cases, such as in some reaches of Cotati Creek, blackberry scrub fills drainage channels. In some cases, blackberry scrub forms the understory in open riparian woodlands. It is characterized by a dense growth of Himalaya blackberry, which is native to Eurasia.

As noted in the discussion of mixed riparian scrub above, areas with dense blackberry patches often attract species such as red-winged blackbird, common yellowthroat and song sparrow. Also, this habitat is favored by Norway rats (*Rattus norvegicus*) for food and shelter.

Special Status Species

Tricolored blackbird (*Agelaius tricolor*) has been documented using blackberry scrub in the central valley (Hamilton 2004), though there are no documented cases of this occurring in Sonoma County.

Ecosystem Functions

The primary ecosystem functions provided by blackberry scrub are:

- Stabilization of streambanks;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from run-off;
- maintenance of stream flows into summer by promoting groundwater recharge and storing water; and
- providing wildlife refugia and foraging habitat.

Response to Disturbance

Blackberry scrub responds to minor disturbance by rapid regrowth. Himalaya blackberry is effective at expanding into disturbed areas. While increased cover of Himalaya blackberry may improve habitat quality for some species, particularly bird species, habitat quality for other species is reduced by the reduced diversity of the community. In addition, increased cover of Himalaya blackberry may reduce conveyance capacity of the flood control channel.

Stream Maintenance Considerations

To the extent possible, Sonoma Water endeavors to control the spread of blackberry scrub in the program area in order to encourage greater cover of native species and to prevent loss of flood control functions. Encouraging the development of riparian forest and woodland is anticipated to reduce the overall cover contributed by Himalayan blackberry, which is observed to generally be intolerant of shade. In the short term, vegetation removal is necessary to maintain channel conveyance capacity in some areas where Himalaya blackberry has occupied the channel.

3.5.6 Ruderal

Ruderal vegetation in the program area is found in the channels of smaller intermittent drainages, and on and above the banks of many intermittent and perennial drainages. Ruderal vegetation is an assemblage of plants, often a mixture of both native and non-native weed species that thrive in waste areas, heavily grazed pastures, cultivated and fallow fields, roadsides, parking lots, footpaths, residences and similar disturbed sites in towns and cities and along rural roadways. In areas of frequent human disturbance, typical of the SMP area, the majority of wild plants are often introduced weeds rather than natives. However, ruderal species may at times be integrated into other communities (Holland and Keil 1995). Within the SMP, ruderal vegetation frequently forms the understory of riparian woodland in the program area. Photographs of representative ruderal vegetation in the program area are shown in **Figure 3-18**. Ruderal vegetation in the program area varies depending on the site hydrology. In more mesic areas, such as the creek banks of perennial drainages, ruderal vegetation is dominated by Harding grass, Italian rye grass, various brome grasses, wild oat (*Avena* spp.), star thistle (*Centaurea solstitialis*), Italian thistle (*Carduus pycnocephalus*), poison hemlock (*Conium maculatum*), Bermuda grass (*Cynodon dactylon*), bristly ox-tongue, velvet grass (*Holcus lanatus*), and Fuller's teasel (*Dipsacus fullonum*). In drier areas, adjacent to intermittent drainages or on the outer edges of access roads, ruderal vegetation is dominated by species such as sweet fennel, wild oats, Mediterranean mustard (*Hirschfeldia incana*), and wild radish (*Raphanus sativus*).

Ruderal vegetation may be used for movement and foraging by wildlife species discussed above that are tolerant of chronic human disturbance. In addition, ruderal areas may provide foraging areas for raptors. Openings in the riparian forest or woodland canopy in the program area are typically characterized by ruderal vegetation. Maintaining some open areas in riparian woodland enhances habitat function by increasing structural heterogeneity and providing foraging and basking areas for some wildlife species.

Special Status Species

Burrowing owl (*Athene cunicularia*) may use ruderal areas where ground squirrel activity is sufficient to provide burrows, though Klute, et al. (2003) listed the species as nearly extirpated as a breeding species in Sonoma County. Western pond turtle may use ruderal areas adjacent to water for egg-laying sites. California tiger salamander has been documented in the vicinity of Sonoma Water-maintained channels, and may utilize ruderal areas if suitable burrows for aestivation are present. All of these species could move through ruderal areas during local or long distance migration.

Ecosystem Functions

The primary ecosystem functions provided by ruderal vegetation are:

- stabilization of streambanks;
- maintenance of water quality through soil retention and by filtering out sediment and nutrients from runoff;
- maintenance of stream flows during summer by promoting groundwater recharge and storing water; and
- prevention of flooding and minimization of channel erosion by slowing surface runoff.

Ruderal areas provide lower amounts of functions than riparian woodland and forest.

Response to Disturbance

Ruderal areas respond to disturbance such as mowing or flooding by rapid colonization and regrowth.

Stream Maintenance Considerations

The SMP generally encourages the growth of perennial grassland, willow scrub, riparian forest and woodland in the place of ruderal vegetation. Where ruderal areas are present as small openings within a matrix of riparian woodland, they may provide valuable foraging or basking areas for native wildlife. Native herbaceous species could be planted in these areas, maintaining them as open areas.

Developed

Developed portions of the program area include access roads, v-ditches, in-channel structures including culverts, bicycle trails, and supporting infrastructure located adjacent to drainages. These areas are largely unvegetated, although some canopy from trees lining the road may be present. Along many reaches some landscaping may also be present. V-ditches may be bare, but are also sometimes support ruderal grasses. Developed land covers provide low quality habitat for species that are adapted to chronic human disturbance. Photographs of representative developed land covers adjacent to streams in the program area are shown in Figure 3-19.

Stream Maintenance Considerations

The main maintenance consideration for developed land covers is the need to keep roads and v-ditches clear of woody vegetation so that maintenance vehicles have access to channels. Access roads may be treated with herbicides to prevent vegetation from growing. V-ditches must also be kept clear of excessive vegetation and sediment so that the drainage function is maintained.

3.5.7 Aquatic

Aquatic communities are discussed in terms of intermittent and perennial drainages. The many hydrologic and geomorphic processes that influence streamflow and sediment conditions in the aquatic environment are discussed above in Sections 3.2 and 3.3. A key process for understanding aquatic environments in the program area is the relationship between in-channel sedimentation and the growth of marsh or willow vegetation. In areas of abundant in-channel sedimentation, particularly areas with medium and finer sediments (finer than coarse sands), cattail marsh or willow vegetation often colonize. This typically happens in locations where the channel gradient has lessened (perhaps just upstream or downstream of a crossing or in-channel structure) and sediments collect either as in-channel bars, or as a broad depositional wedge across the entire channel width. Under such depositional conditions, and especially when there is little shade and the area is very sunny, the marsh and willow vegetation establish quickly. The positive feedback between low gradient reaches creating a depositional environment, which then attracts and fosters aquatic vegetation, which in turn traps more sediment, has several management implications. This feedback process is also described in Chapter 4, Section 4.8, "Maintenance Principle 6: Integrate Maintenance Activities toward Sustainability".

Intermittent Drainages

Smaller intermittent drainages with lower flows, such as Ducker Creek and Forestview Creek, support primarily ruderal vegetation in their channels and along their banks. Larger intermittent drainages, such as Austin Creek, support in-channel emergent wetland vegetation. Emergent wetlands in intermittent drainages with little or no canopy cover, such as Airport Creek, may be dominated by dense stands of cattails. The location and extent of in-channel vegetation in intermittent drainages varies depending on the nature of the channel and the nature and timing of vegetation management activities in the channel. In-channel vegetation may be limited to a narrow fringe of wetland vegetation along the low-flow channel, or it may form a dense to open stand filling the channel. The upper banks of larger intermittent channels support ruderal vegetation. Vegetation communities at and adjacent to the top-of-bank in intermittent drainages include ruderal vegetation and riparian woodland.

Perennial Drainages

As is the case in intermittent drainages, the location and extent of vegetation within the channels of perennial drainages vary. In channels with steeper gradients, more rapid flows and more scour, vegetation may be limited to a narrow fringe of wetland vegetation along the low-flow channel. This is generally also the case for channels in which recent maintenance activity has removed vegetation. In channels with gentler gradients, vegetation often forms a dense stand that fills the channel.

Smaller perennial drainages, such as Abramson Creek, and upper reaches of larger perennial drainages, such as the east fork of Windsor Creek, are characterized by low flows at the end of the dry season. Vegetation in and along these channels is similar to the vegetation described above in larger intermittent drainages.

Many large perennial drainages lack significant in-channel vegetation. In-channel vegetation in some perennial drainages, such as Colgan Creek, consists of stands of cattails or water plantain. In other drainages, such as lower Santa Rosa Creek and Spring Creek, sand and gravel bars have formed. These features support a variety of vegetation communities. Recently established gravel bars support ruderal vegetation, much of which is not hydrophytic, dominated by species such as white sweetclover (*Melilotus alba*). Older sand and gravel bars are typically characterized by willows. Many large perennial drainages, such as Windsor Creek, support a band of small willows located at and above the OHWM and often have a good compliment of riparian forest trees. Other perennial drainages, such as lower Santa Rosa Creek, support riparian forest on their banks. Riparian forest in these drainages shades a portion of the open channel, reducing the growth of in-channel vegetation.

Sediment Basins

The program area has two sedimentation basins at Cook Creek and Adobe Creek. The Cook Creek sedimentation basin is located on Cook Creek just east of Petaluma Hill Road and consists of open water with a narrow fringe of emergent wetland (Figures C-30 and C-35). The Adobe Creek basin is found in the Petaluma River watershed on Adobe Creek, just upstream of South McDowell Boulevard (Figures C-42 and C-46). Periodic maintenance of these basins, including removal of sediment and any vegetation that has established in the sediment, is necessary to maintain the sedimentation basin's function.

3.5.8 Special Status Species

A list of federally endangered and threatened species that may be affected by maintenance activities within the SMP program area was obtained online from the USFWS website (USFWS 2019), the California Natural Diversity Database (CNDDB) (CDFW 2019) and the CNPS electronic inventory (California Native Plant Society [CNPS] 2018) and is contained in the Biological Assessments prepared for the SMP. Figure 3-20 through **Figure 3-26** depict all CNDDB occurrences within the SMP area (CDFW 2019). In the manual update, updated USFWS, CNDDB, and CNPS searches were conducted to evaluate whether additional species should be included as potentially occurring within the SMP. In evaluating the occurrence potential of special status plant and wildlife species in the SMP area, relevant literature, knowledge of regional biota, and observations made during the field investigations were applied as analysis criteria.

Special Status Plants

Several special status plant species have the potential to occur in the program area. Figure 3-20 through Figure 3-26 show special status plant species that have potential to occur in the program and are organized by dicot species and monocot species. It should be noted that habitats of some of these listed plant species have existed historically in the SMP or only exist in isolated areas of adjacent quadrangles. Much of the historical habitat no longer exists in the SMP due to agricultural, residential and commercial development, infrastructure and road development. It should also be noted that reaches and their access roads within the SMP area have, in most cases, been altered due to flood control management. This alteration along with the prevalence of weedy native and non-native plant species may reduce the potential for special status plant species to occur in the SMP area. However, in some locations, small areas of suitable habitat for listed plants do persist adjacent to Sonoma Water rights-of-way.

Generally, SMP activities do not affect these species as most work is accomplished during the dry season. Focused surveys for these species have failed to reveal their presence along Sonoma Water channels.

Special Status Fish

Some of the channels within the program area are known to support the federally threatened Central California Coast steelhead trout (*Oncorhynchus mykiss*) and federally threatened

California Coastal Chinook salmon (*Oncorhynchus tshawytscha*) (National Oceanic and Atmospheric Administration [NOAA] 2004). After careful consideration and discussion with the NMFS, Sonoma Water removed all creeks and/or creek reaches from the SMP area known to support the federally endangered Central California Coast coho salmon (*Oncorhynchus kisutch*) (**Figure 1-12**). The Russian River has been designated critical habitat for these three species, though the Laguna de Santa Rosa subwatershed was excluded from the final critical habitat designation for the Central California Coast Steelhead Distinct Population Segment (USFWS 2005b). **Figure 3-27**, Figure 3-28, and Figure 3-29 depict critical habitat for steelhead trout, Chinook salmon, and coho salmon, respectively. Information regarding special status fish habitat conditions are available through the SMP Database as new information is collected.

Special Status Wildlife

Special status wildlife that may be found in aquatic habitats include California freshwater shrimp, California red-legged frog, foothill yellow-legged frog, and western pond turtle. Although perennial and intermittent drainages typically do not support breeding California tiger salamanders due to high velocities and the presence of predators, cracks or burrows in the upper banks and adjacent uplands of these drainages could provide underground refugia for salamanders during the non-breeding season. Each of these species is discussed in detail in Appendix D, *Accounts of Special Status Species*, including the natural history of the species, occurrence in the program area, and applicable stream maintenance considerations.

Sonoma County Water Agency

Stream Maintenance Program

Figure 3-1

Topography

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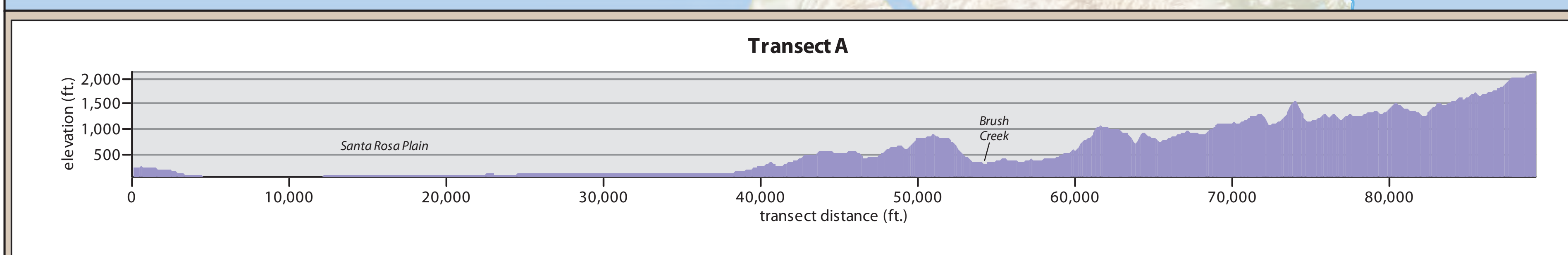
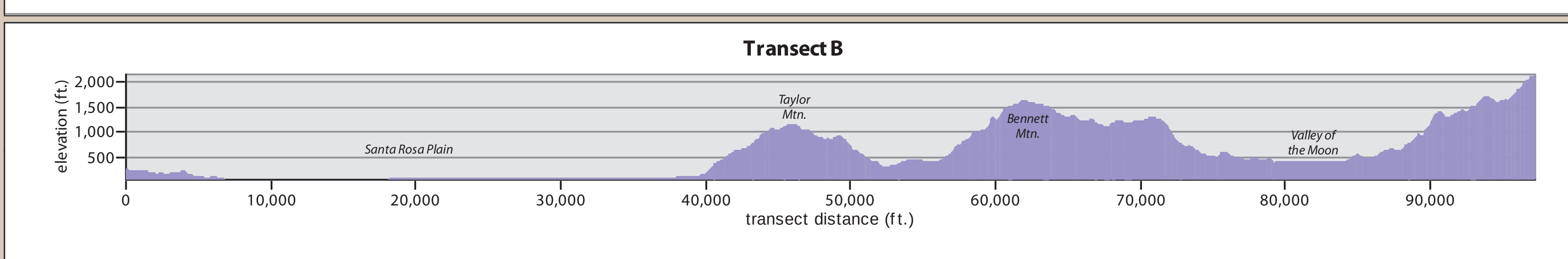
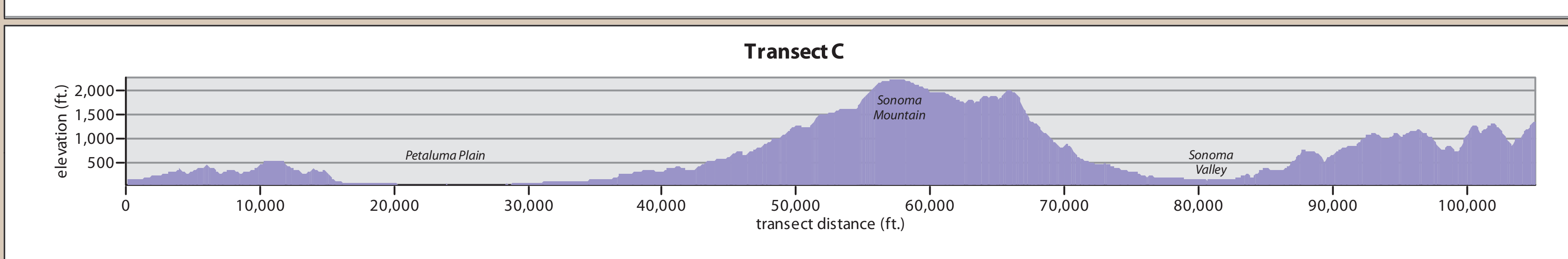
Sonoma County Water Agency

Stream Maintenance Program







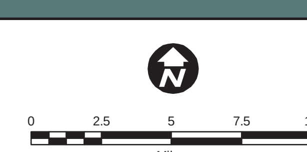
Elevation (feet)

- Below Sea level
- 0 - 25
- 25 - 50
- 50 - 75
- 75 - 100
- 100 - 250
- 250 - 500
- 500 - 1,000
- 1,000 - 1,500
- 1,500 - 2,000
- 2,000 - 2,500
- Above 2,500

- Transect
- SCWA Flood Zone Boundary

Figure 3-2

Elevation Profiles



Sources:
Sonoma County Water Agency
County of Sonoma
California Spatial Information Library
U.S. Geological Survey

Horizon WATER and ENVIRONMENT

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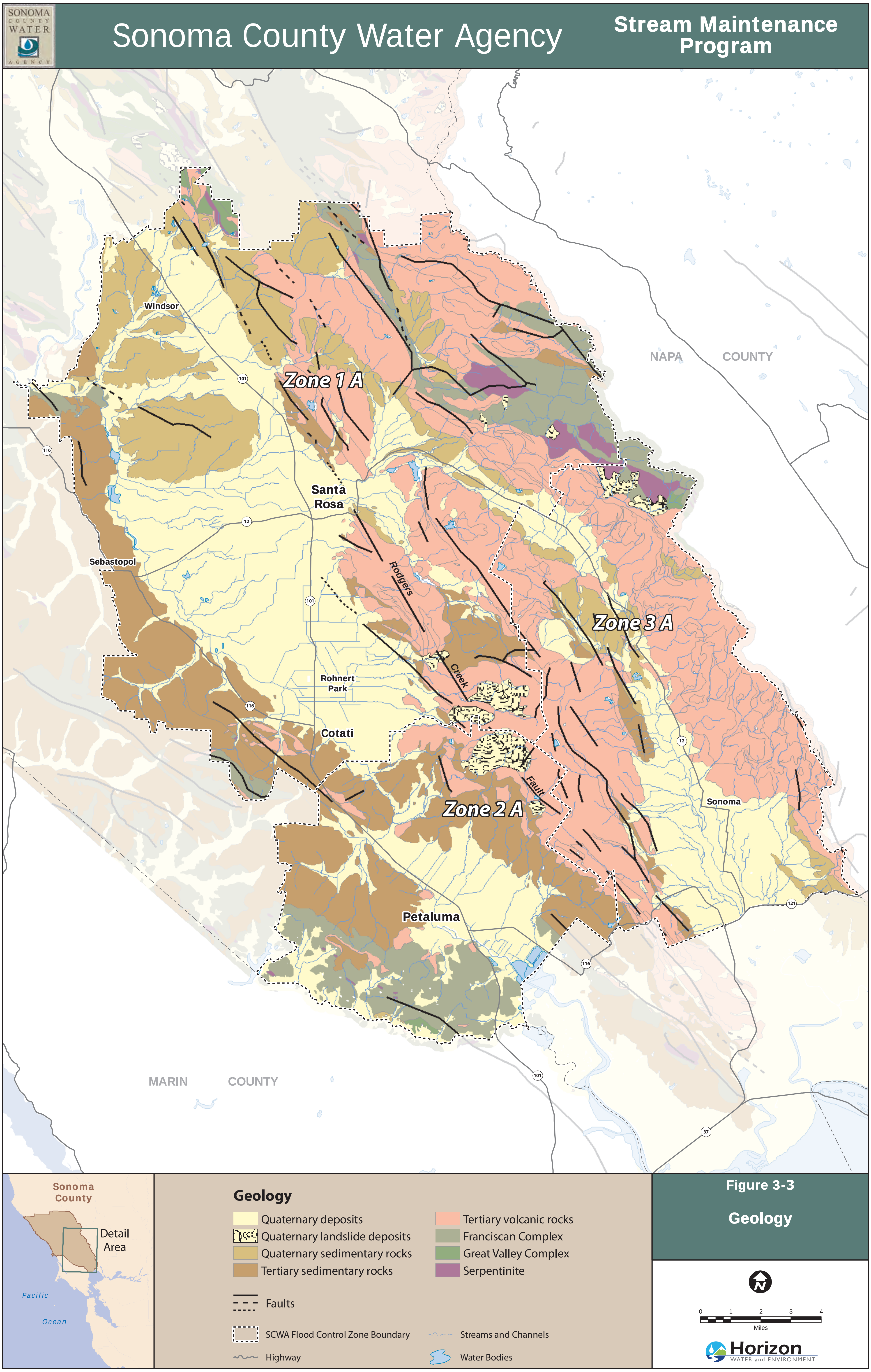

Figure 3-3
Geology

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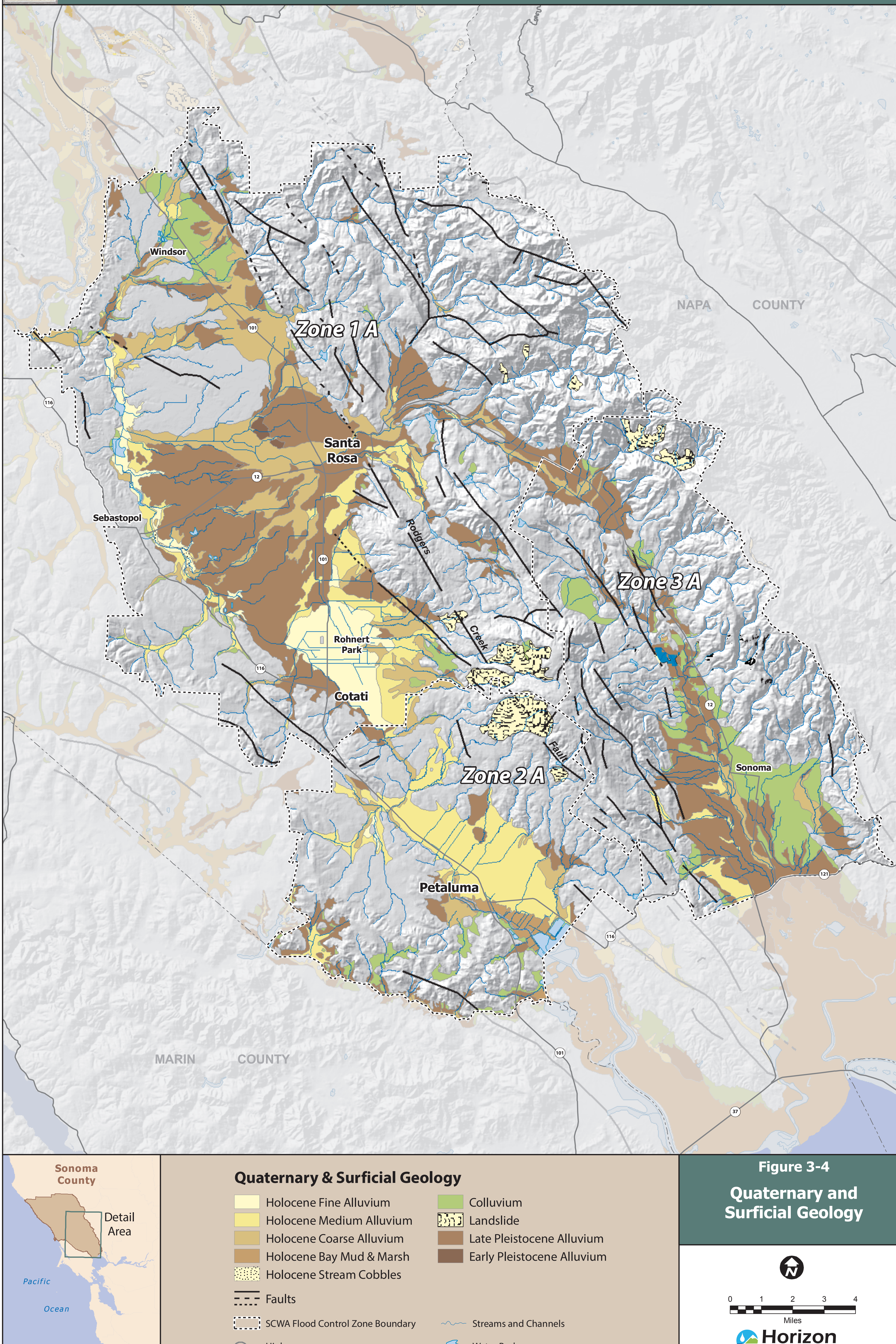
Sonoma County Water Agency

Stream Maintenance Program



Quaternary & Surficial Geology

- Holocene Fine Alluvium
- Holocene Medium Alluvium
- Holocene Coarse Alluvium
- Holocene Bay Mud & Marsh
- Holocene Stream Cobbles
- Colluvium
- Landslide
- Late Pleistocene Alluvium
- Early Pleistocene Alluvium
- Faults
- SCWA Flood Control Zone Boundary
- Streams and Channels
- Highway
- Water Body

Figure 3-4

Quaternary and Surficial Geology

0 1 2 3 4

Miles

Horizon WATER and ENVIRONMENT

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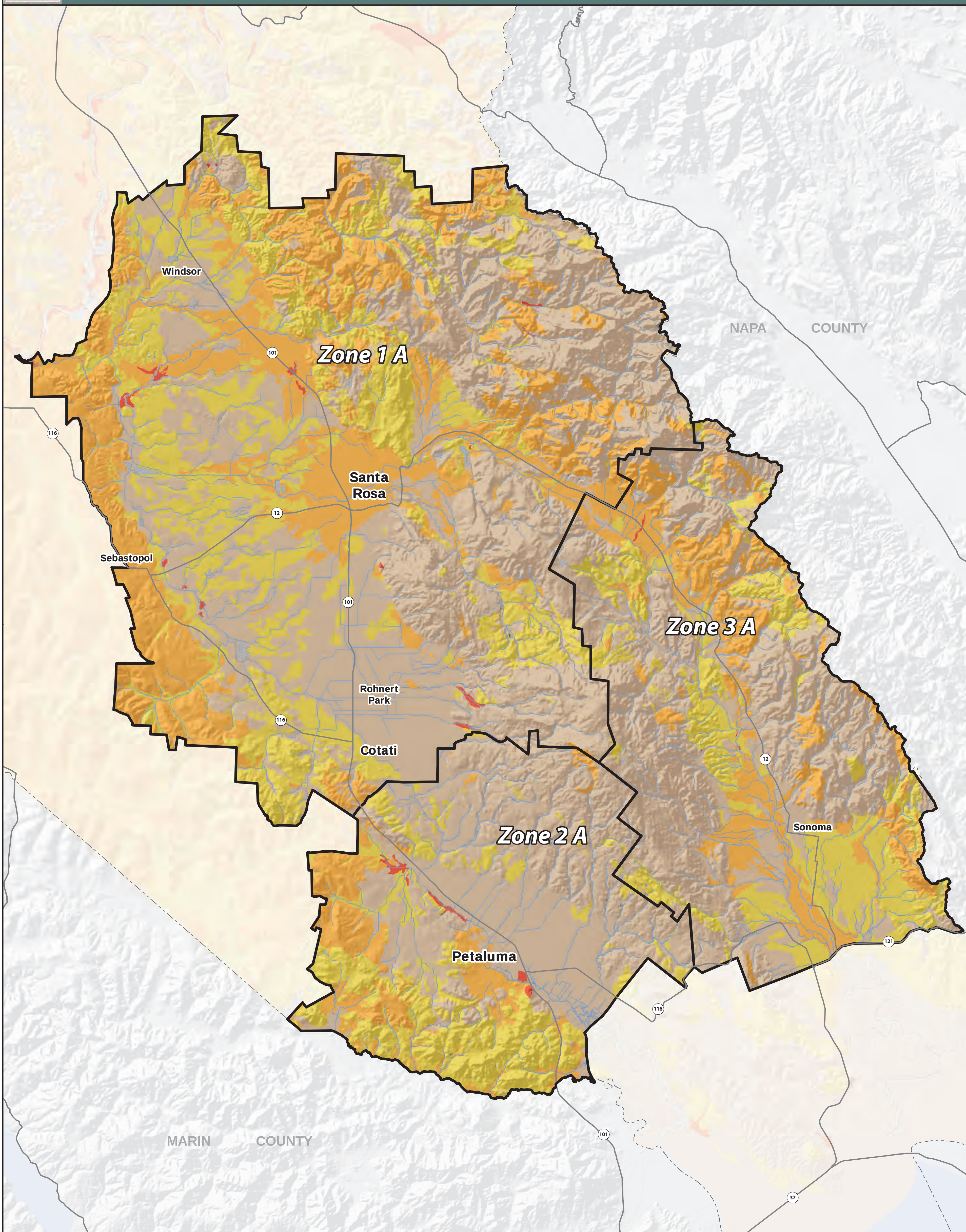
Sonoma County Water Agency

Stream Maintenance Program



Hydrologic Soils Group

A B C D

SCWA Flood Control Zone Boundary

Streams and Channels

Highway

Water Bodies

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size. (NRCS, SSURGO 2004)

Figure 3-5

Hydrologic Soil Group

0 1 2 3 4

Miles

Horizon WATER and ENVIRONMENT

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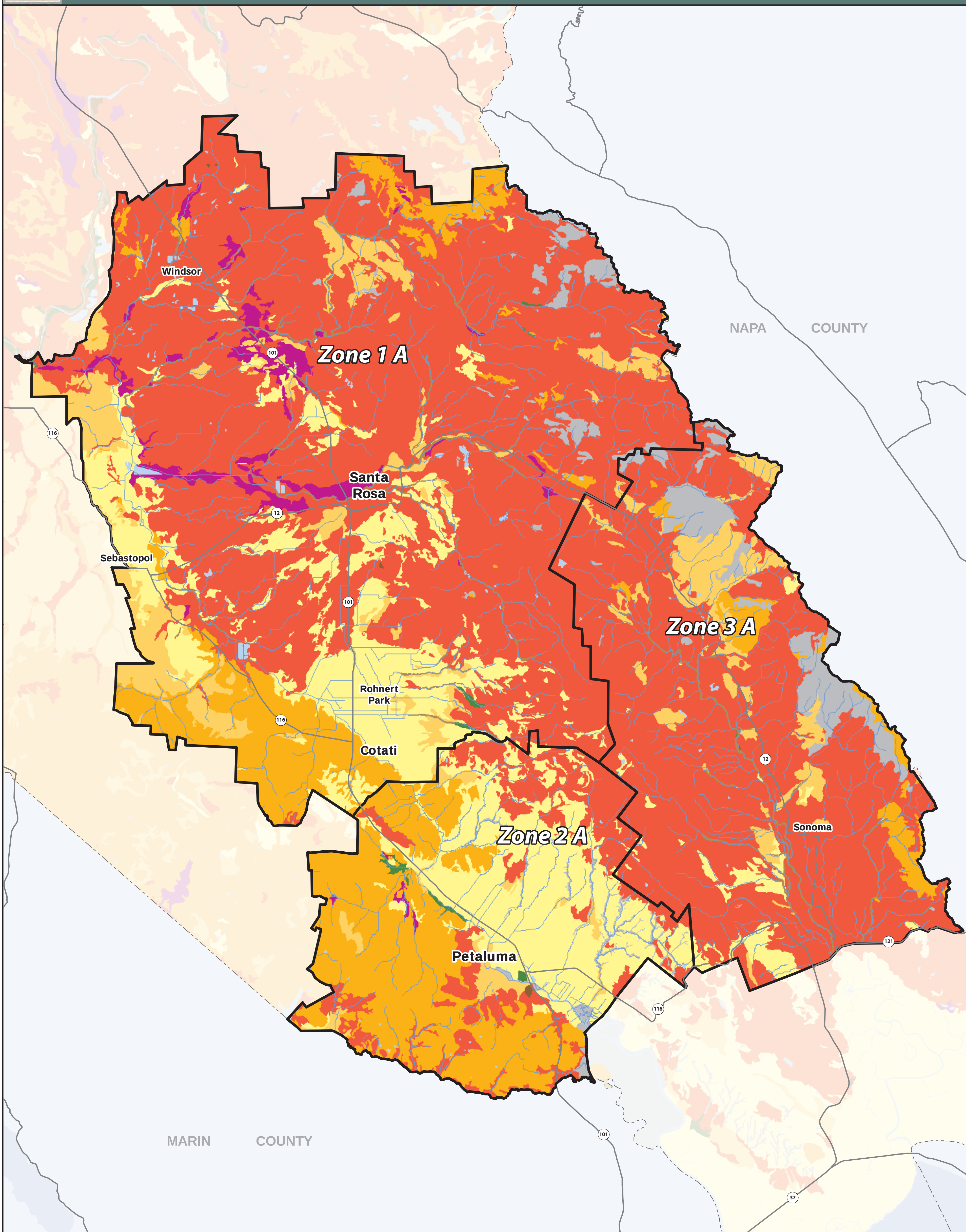
SONOMA COUNTY WATER AGENCY

Sonoma County Water Agency

Stream Maintenance Program



Erosion Potential

- .02
- .05
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- Unclassified

- SCWA Flood Control Zone Boundary
- Highway
- Streams and Channels
- Water Bodies

Erosion factor Kf indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size. (NRCS, SSURGO 2004)

Figure 3-6

Erodibility

0 1 2 3 4
Miles

Horizon WATER and ENVIRONMENT

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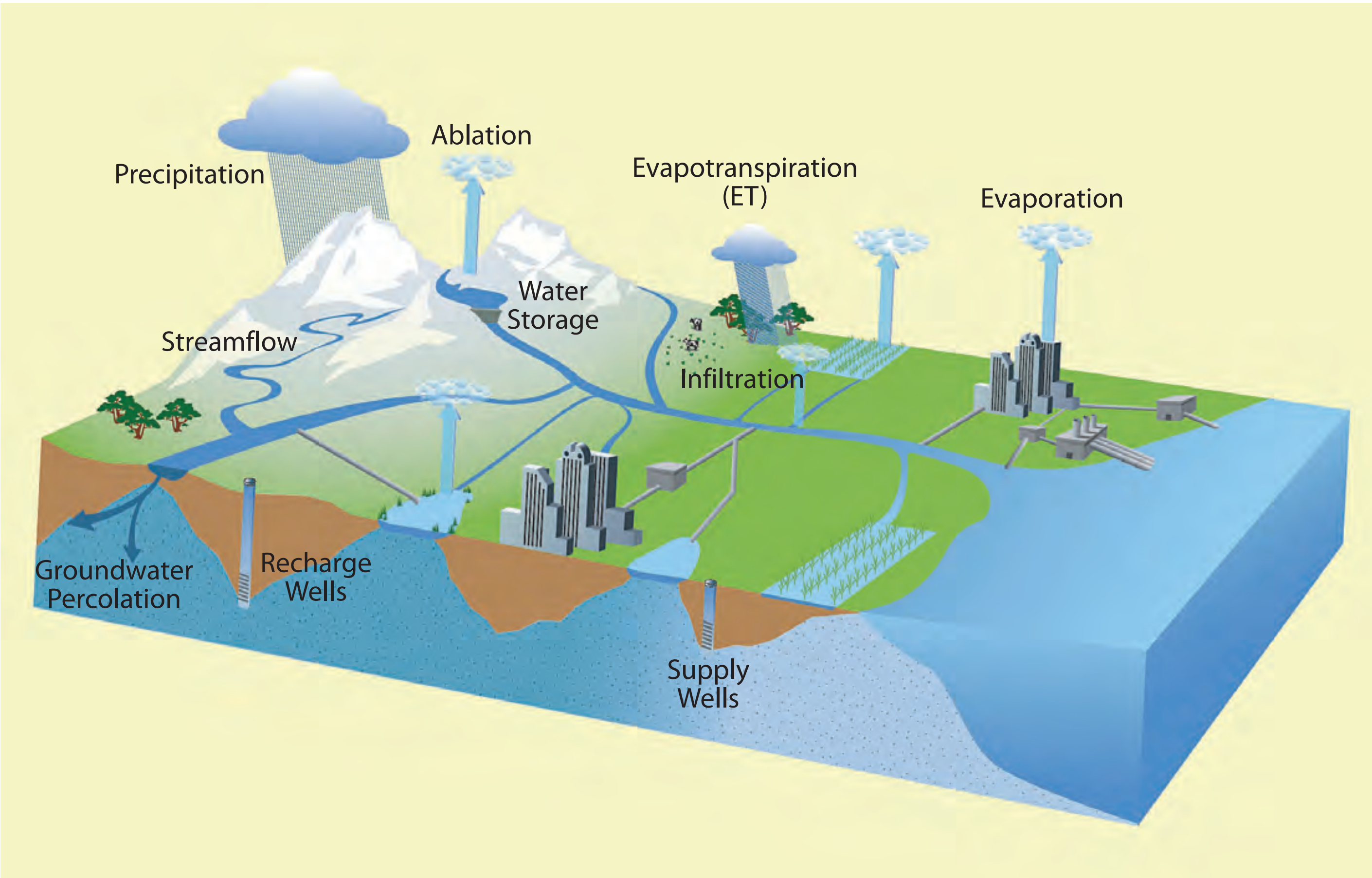

Source: Department of Water Resources. 2005. California Water Plan Update 2005. Sacramento, CA.

Figure 3-7
Hydrologic Cycle

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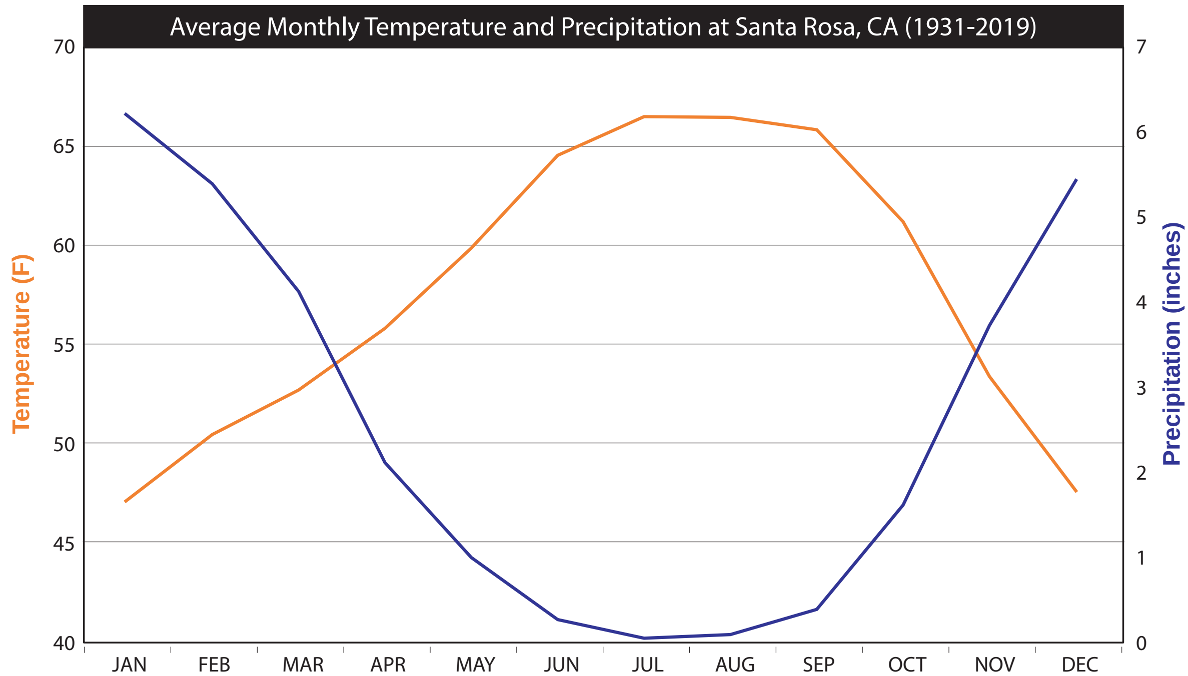
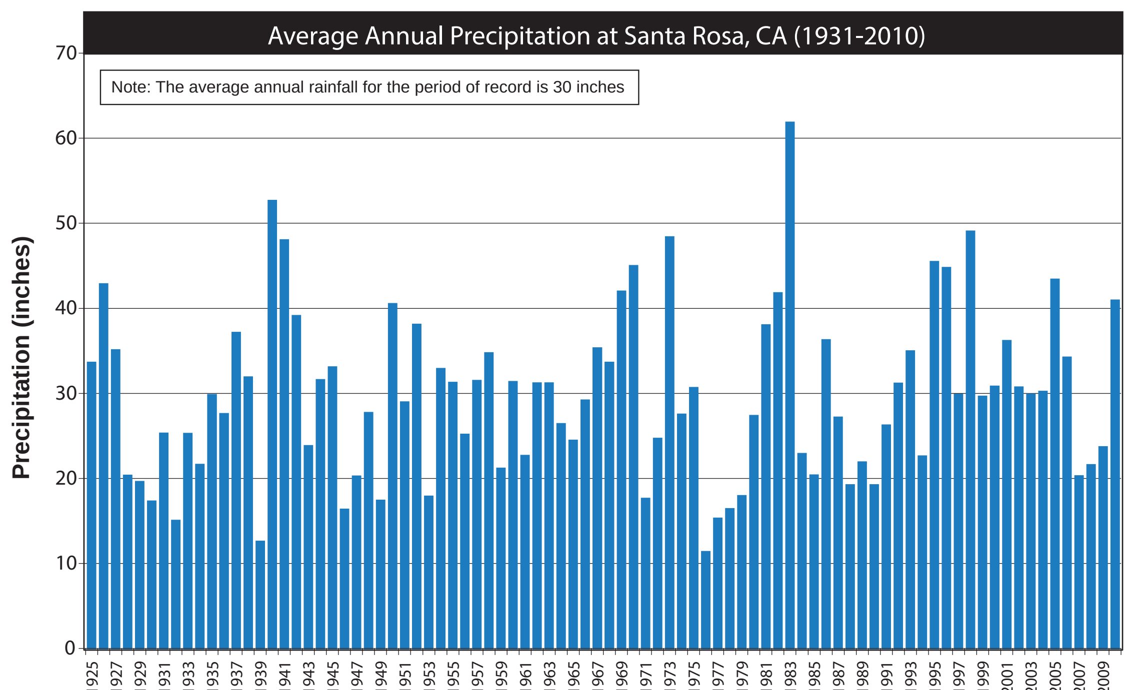


Source: Western Regional Climate Center 2019



Source: Western Regional Climate Center 2019

Figure 3-8
Precipitation and Temperature

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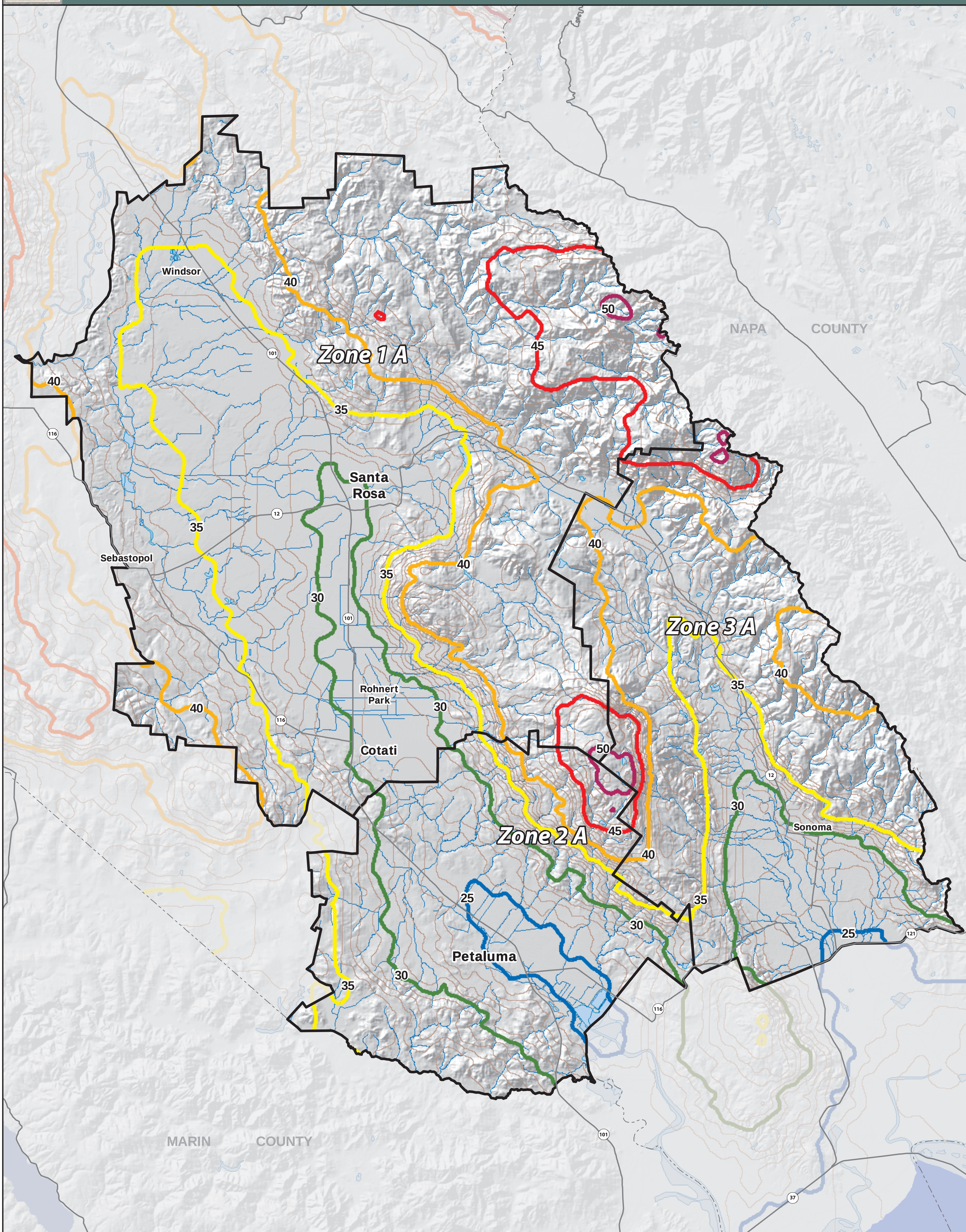
Sonoma County Water Agency

Stream Maintenance Program



Average Annual Precipitation (in.)

25 30 35 40 45 50

1-inch Precipitation Interval

SCWA Flood Control Zone Boundary

Streams and Channels

Highway

Water Body

Figure 3-9

Annual Rainfall Distribution

0 1 2 3 4

Miles

Horizon WATER and ENVIRONMENT

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Sonoma County Water Agency

Stream Maintenance Program

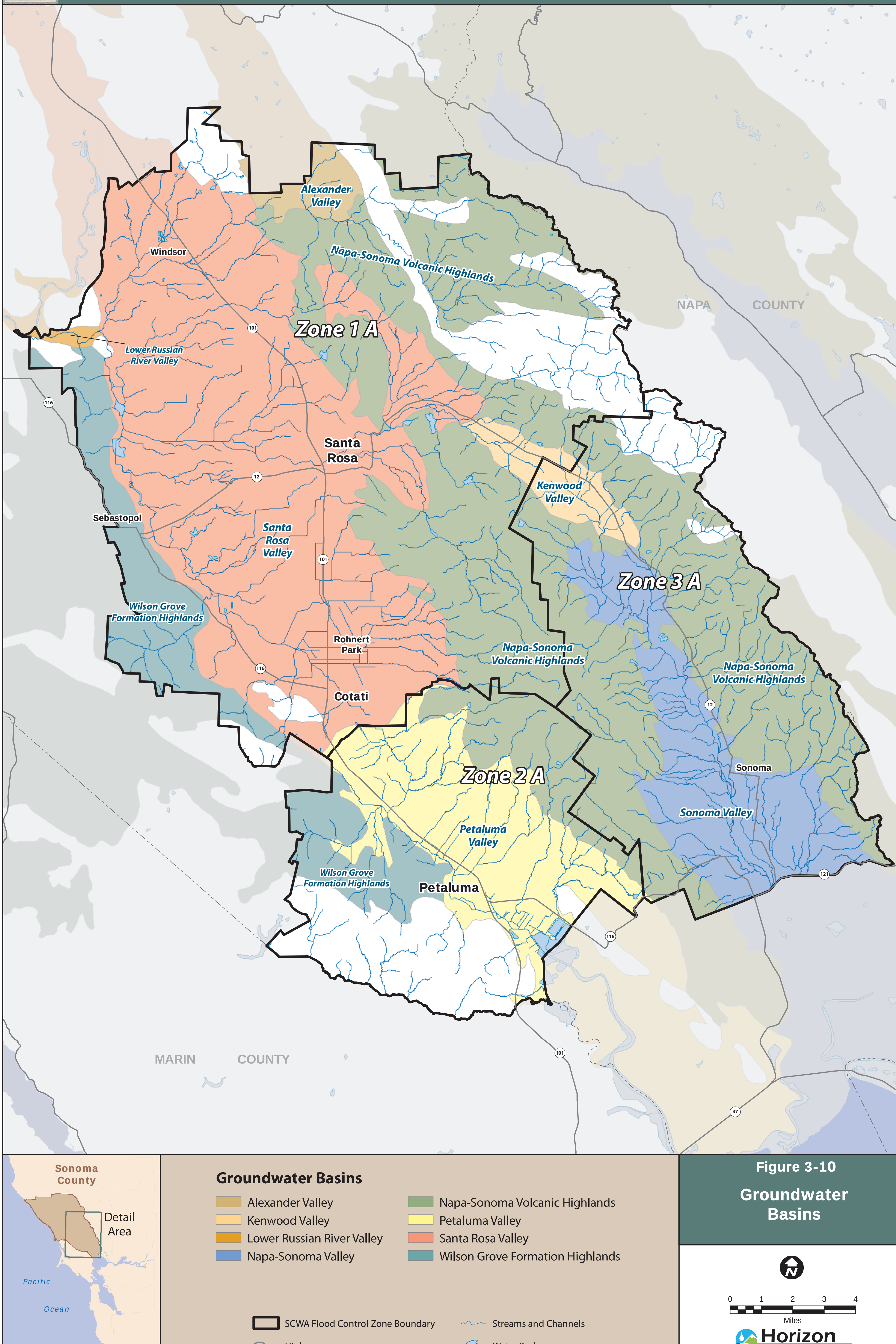

Figure 3-10

Groundwater Basins

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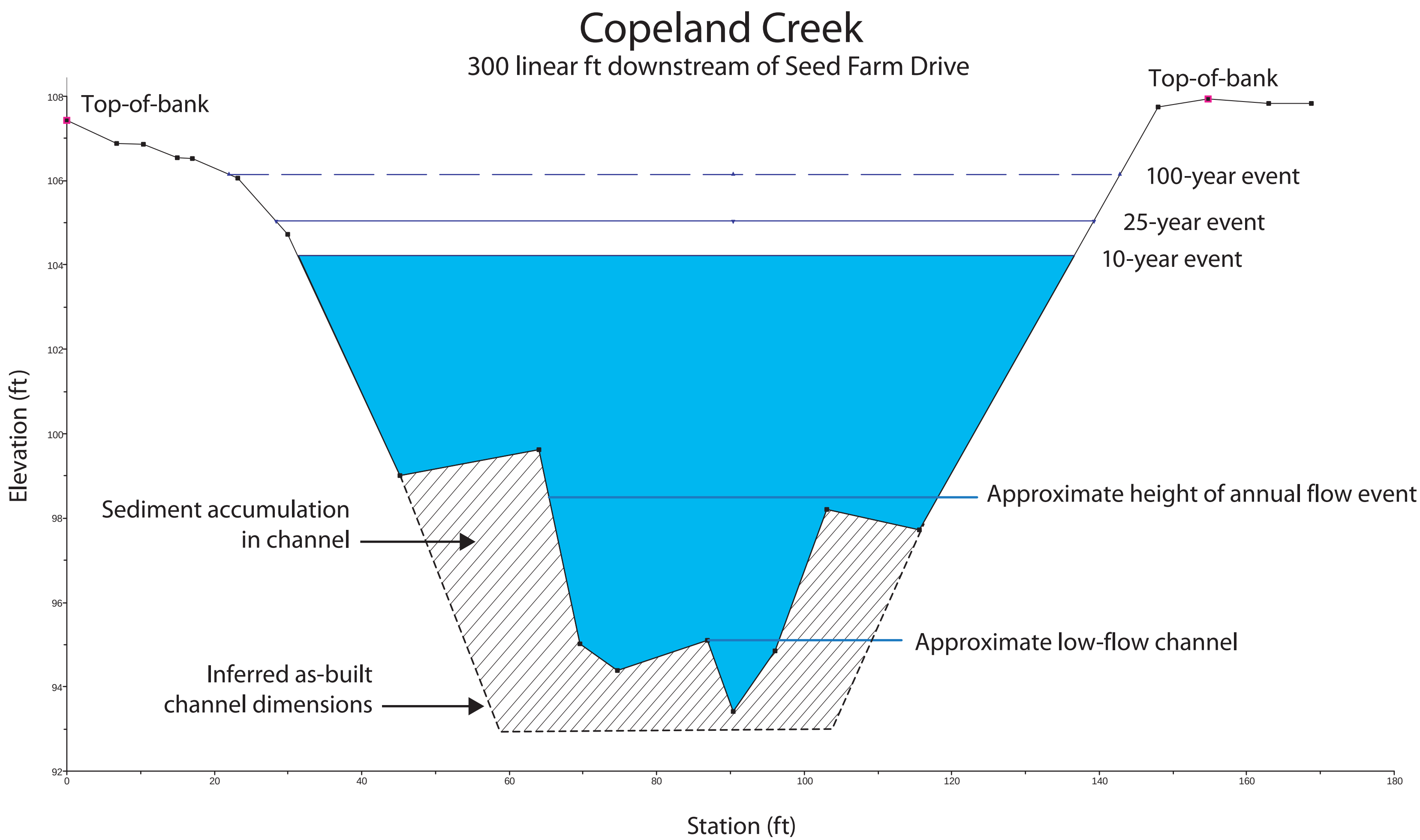

Figure 3-11
Typical Channel Cross Section with Estimated Water Surface Elevations

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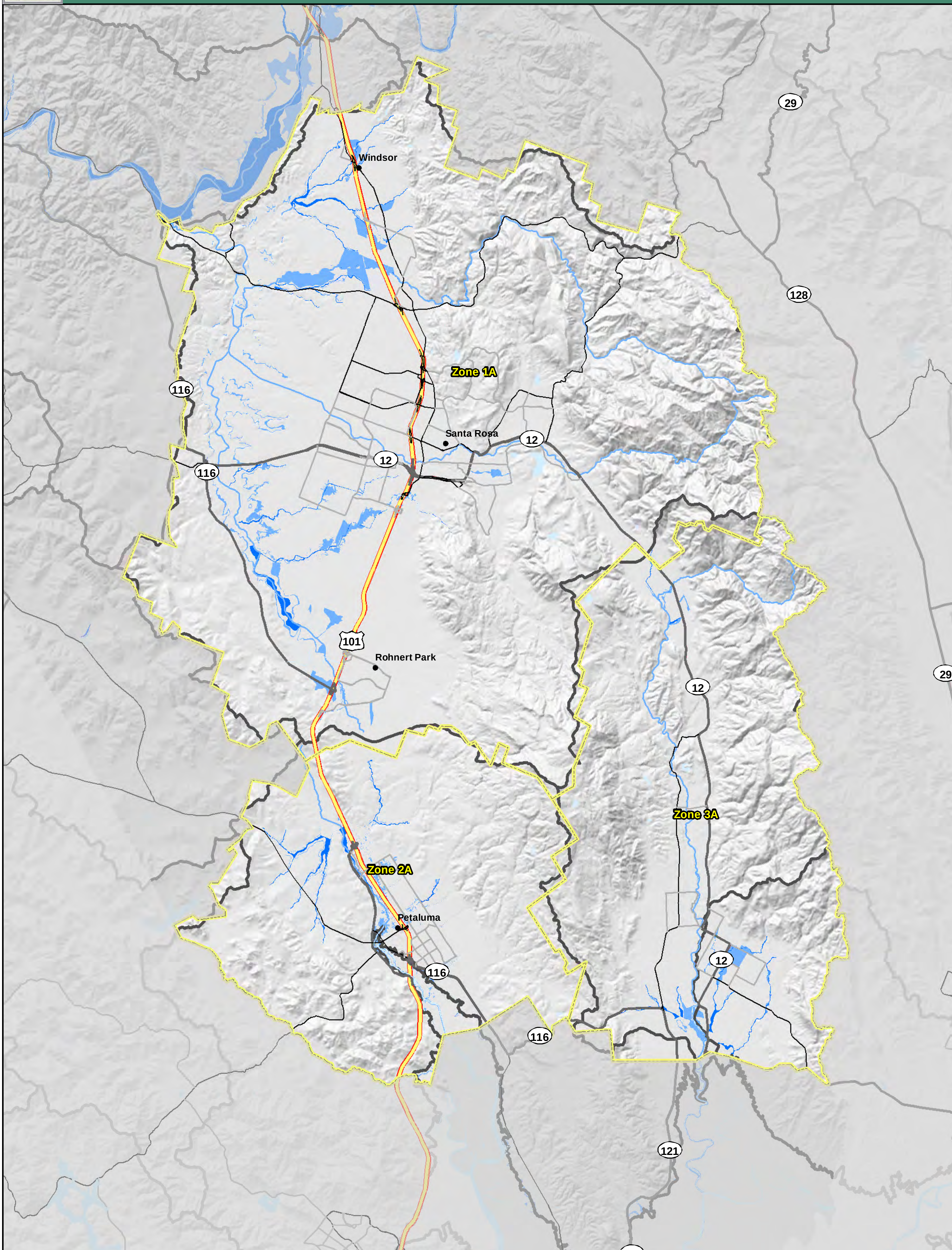
Sonoma County Water Agency

Stream Mantenance Program



FEMA Flood Zones

- 0.2 PCT ANNUAL CHANCE FLOOD HAZARD
- FLOODWAY
- FLOODWAY CONTAINED IN CHANNEL

- SCWA Flood Control Zones
- Freeway
- Secondary Road
- Local Connecting Road
- Important Local Road

Figure 3-12
FEMA Floodplains

0 0.5 1 2 3 4
Miles

Horizon

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Sonoma County Water Agency

Stream Maintenance Program

Figure 3-13
Major Sub-basins of the Laguna de Santa Rosa Watershed

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Sonoma County Water Agency

Stream Mantenance Program

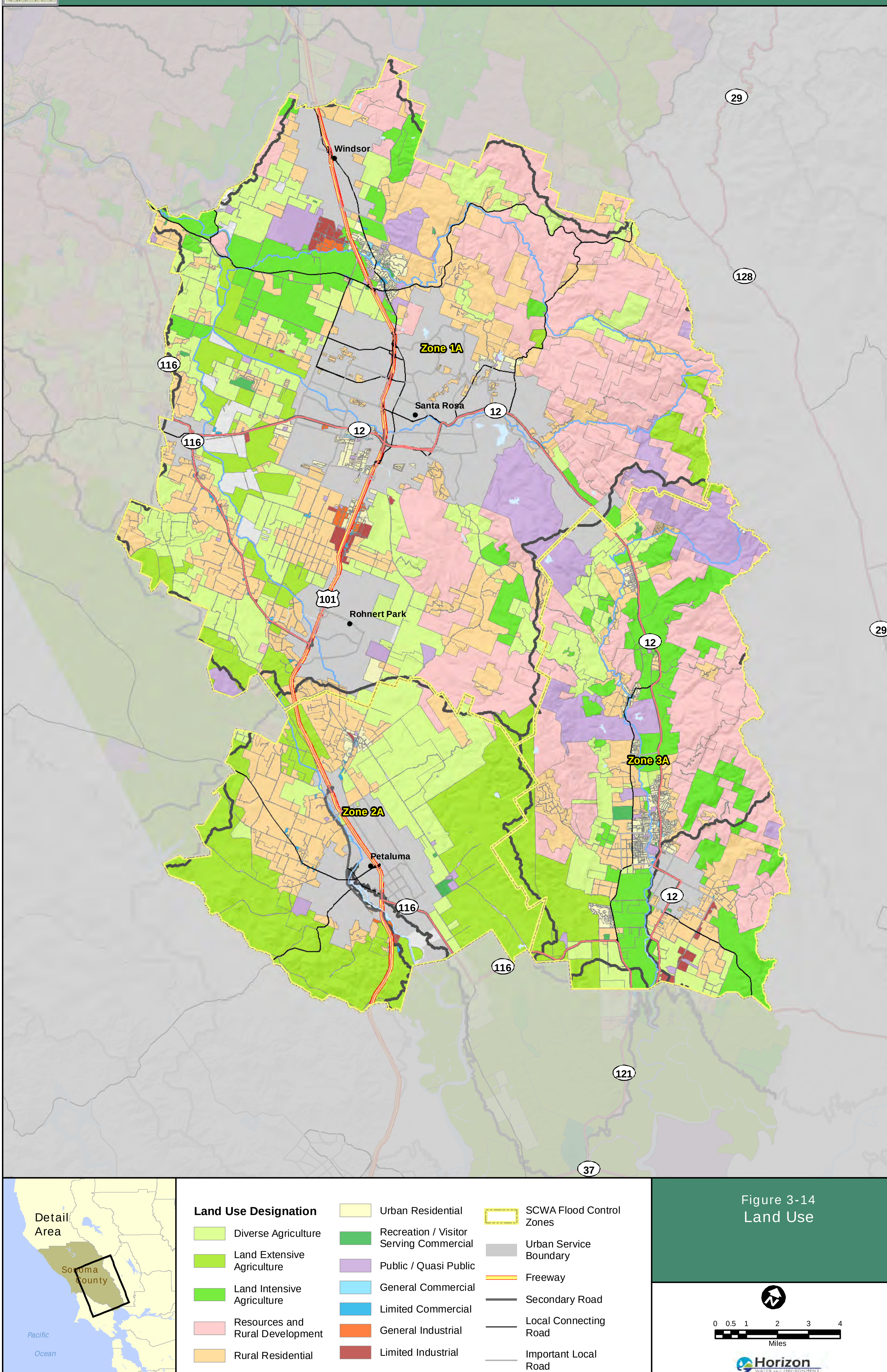

Figure 3-14
Land Use

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Photo a. Looking east at riparian forest on Santa Rosa Creek.

Photo b. Riparian woodland along Crane Creek.

Figure 3-15
Examples of the Riparian Forest and Woodland Community

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Photo a. Looking north at dense cattail emergent wetland in Spivok Creek.

Photo b. Looking south at South Fork Copeland Creek with narrow fringe of emergent wetland.

Figure 3-16
Examples of the Emergent Wetlands Community

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Photo a. Looking south at blackberry scrub in Cotati Creek west of Redwood Hwy.

Photo b. Looking southeast at blackberry scrub along the Laguna de Santa Rosa.

Horizon WATER and ENVIRONMENT

Figure 3-17

Examples of the Blackberry Scrub Community

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Photo a. Ruderal vegetation along Roseland Creek.

Photo b. Looking south at ruderal vegetation on east bank of Wilfred Creek Extension.

Figure 3-18

Examples of the Ruderal Community

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Photo a. Developed access road and v-ditch adjacent to Paulin Creek, drop inlet culvert seen in mid-ground on left.

Photo b. Looking west at Santa Rosa Creek with developed pedestrian trails on both banks.

Horizon WATER and ENVIRONMENT

Figure 3-19

Examples of the Developed Land Cover

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

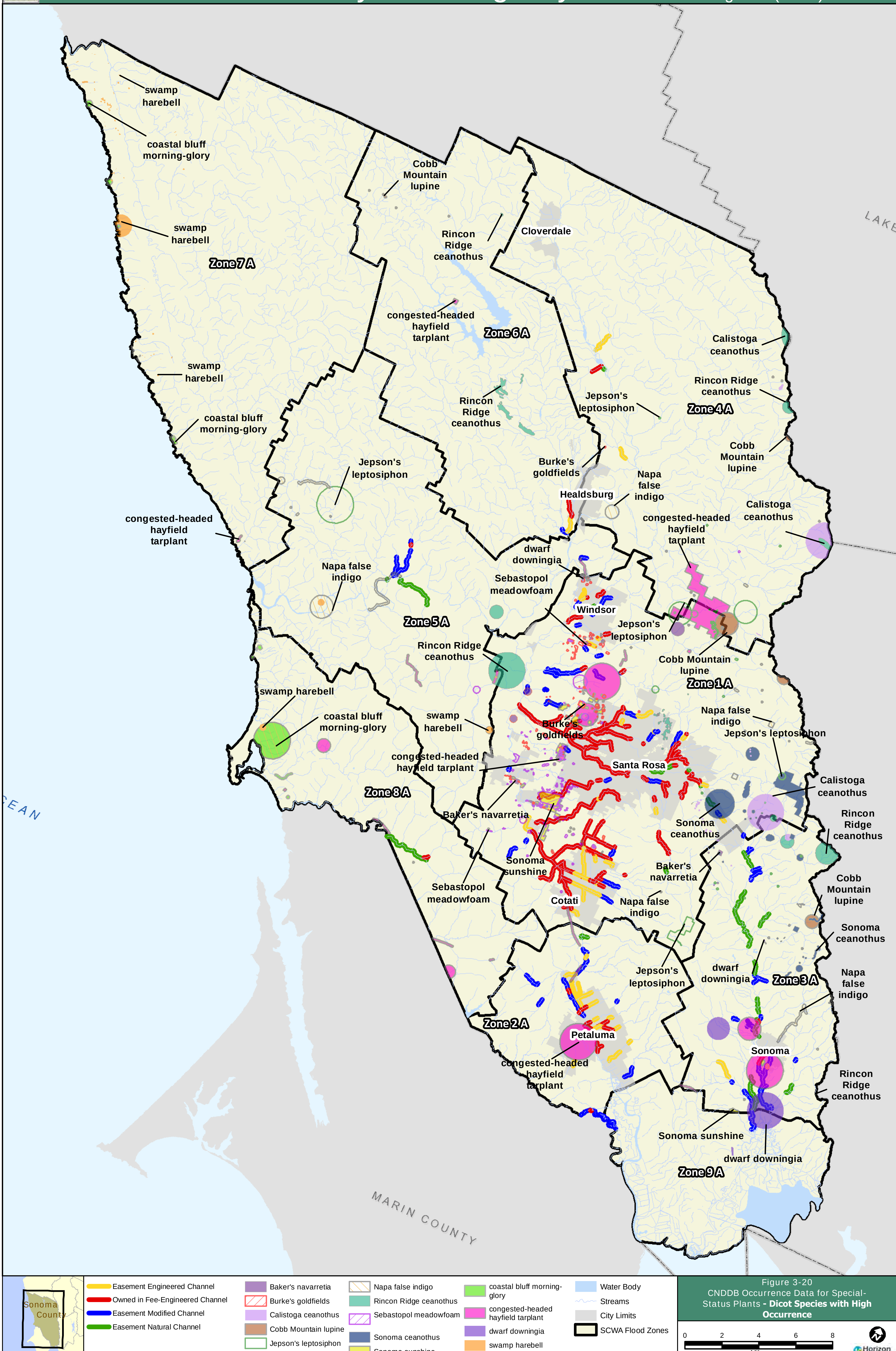

Figure 3-20
CNDDB Occurrence Data for Special-Status Plants - **Dicot Species with High Occurrence**

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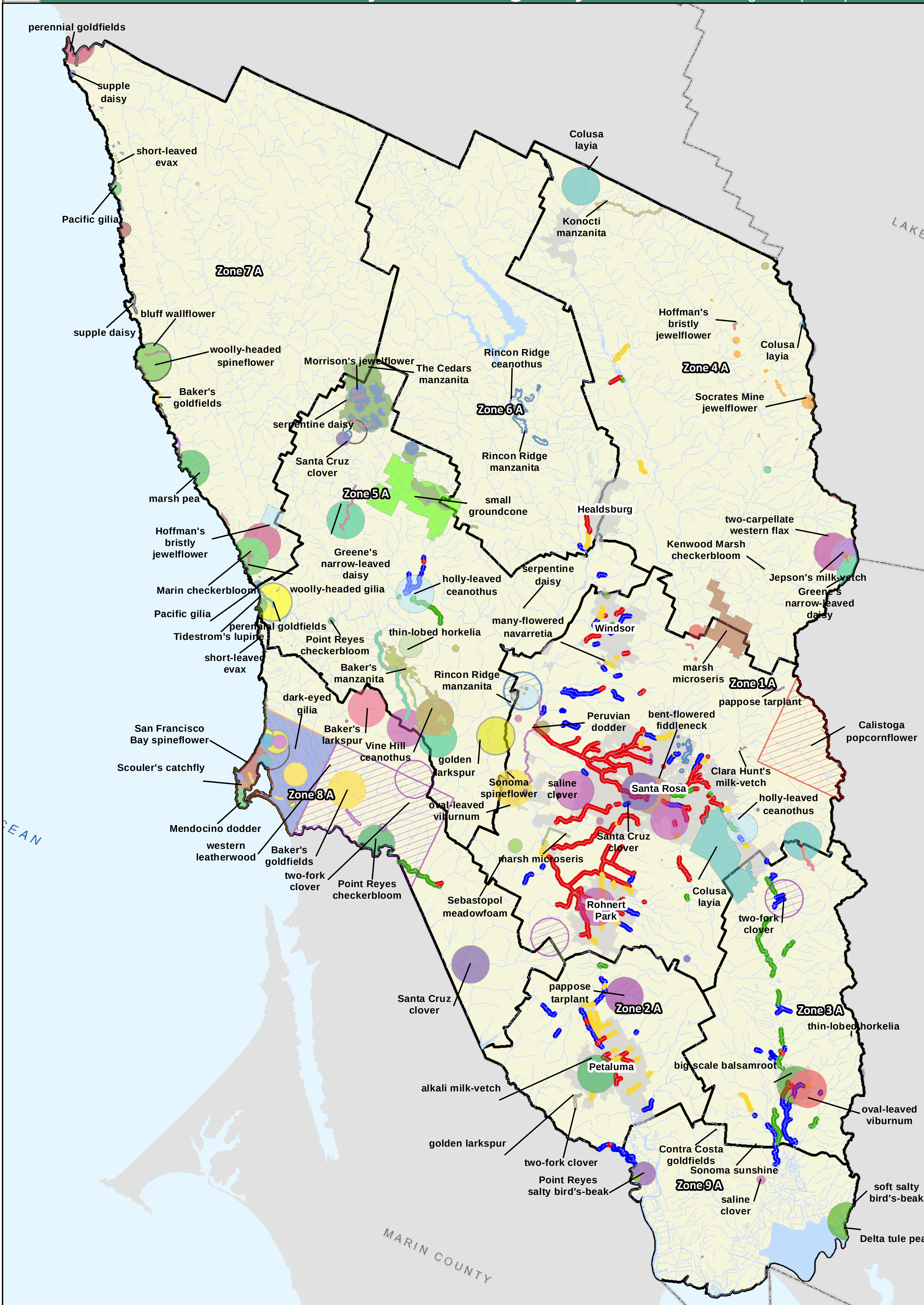
Sonoma County Water Agency

Stream Maintenance Program (SMP)



Sonoma County

Easement Engineered Channel

Owned in Fee-Engineered Channel

Easement Modified Channel

Easement Natural Channel

Water Body

Streams

City Limits

SCWA Flood Zones

Figure 3-21
CNDDB Occurrence Data for Special-Status Plants - **Dicot Species with Low Occurrence**

0 2 4 6 8
Miles

Horizon

Sources: Sonoma County Water Agency; Sonoma County GIS; California Natural Diversity Database (CNDDB), September 2019; US Fish & Wildlife Service

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

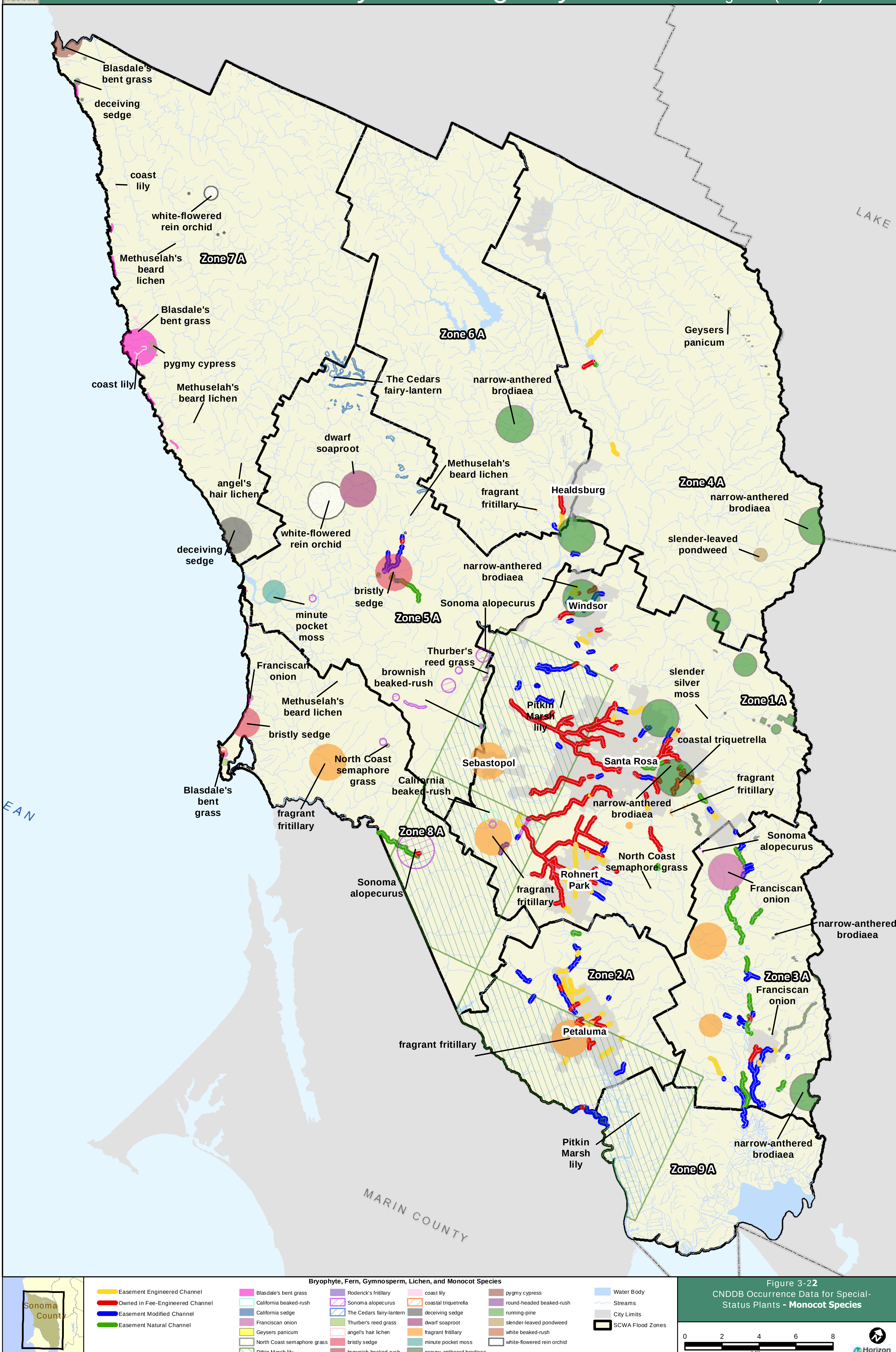

Figure 3-22
CNDDB Occurrence Data for Special-Status Plants **- Monocot Species**

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Sonoma County Water Agency

Stream Maintenance Program (SMP)

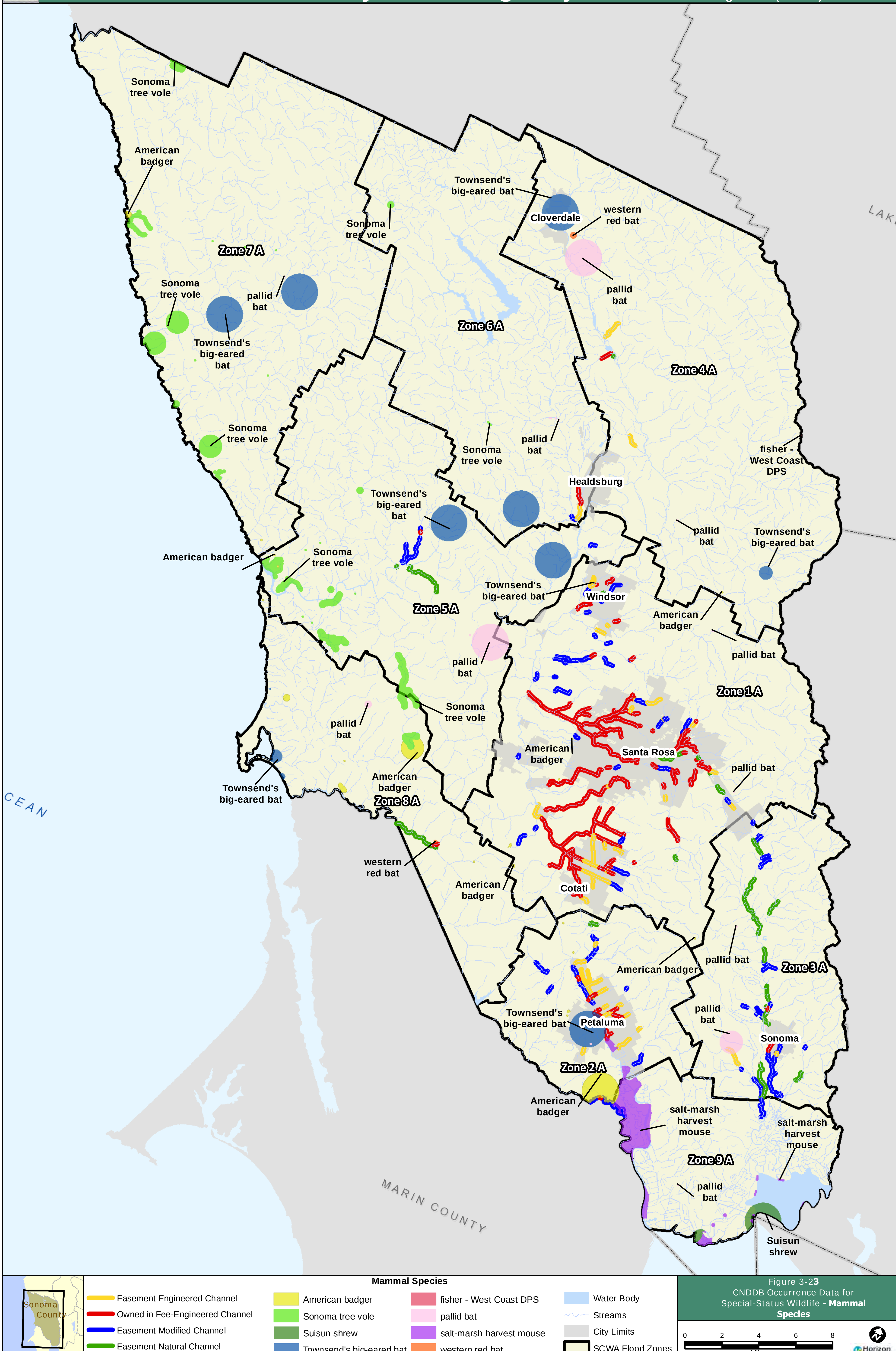

Figure 3-23
CNDDB Occurrence Data for Special-Status Wildlife - **Mammal Species**

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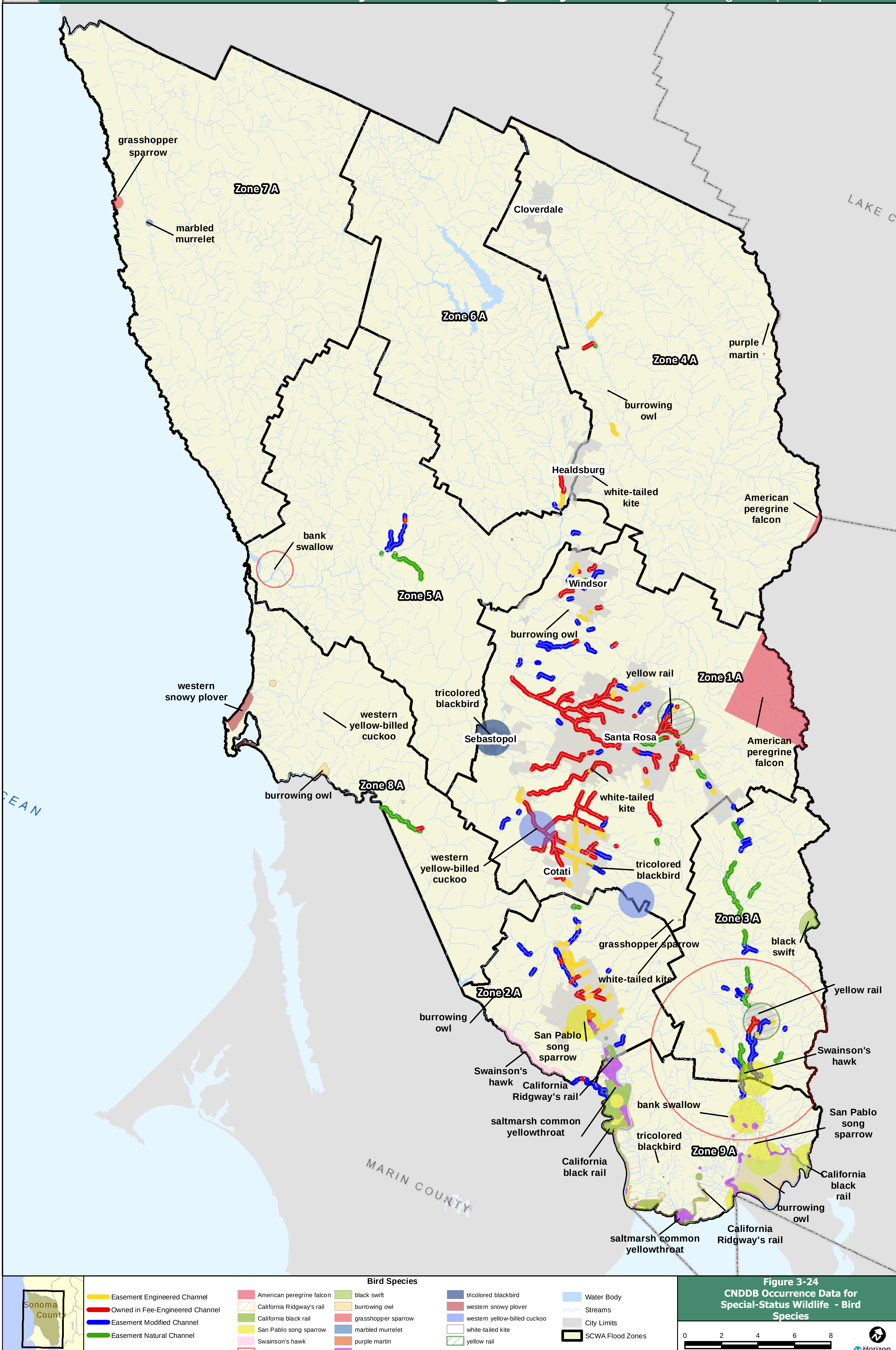

Figure 3-24
CNDDB Occurrence Data for Special-Status Wildlife - Bird Species

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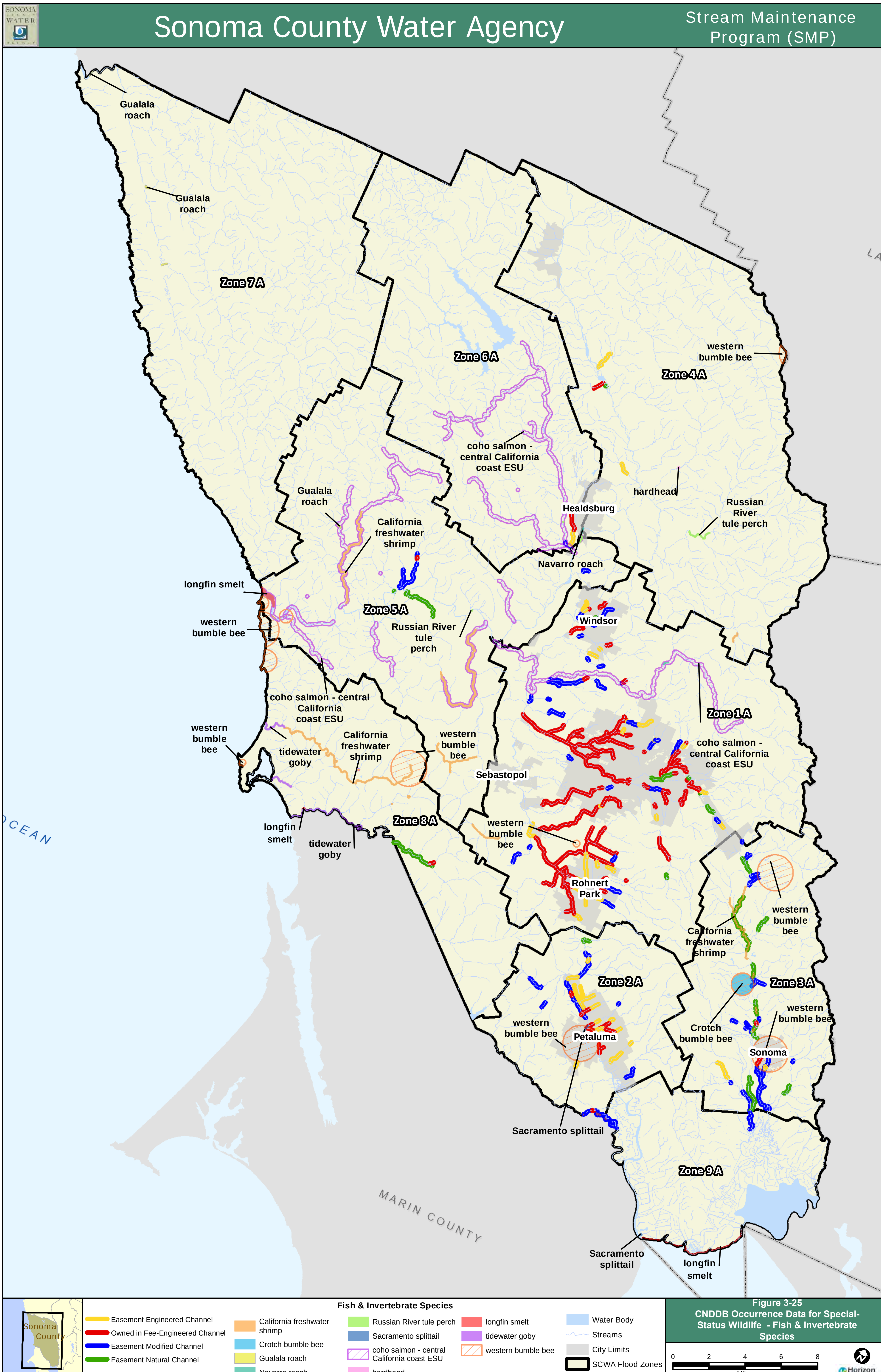

Figure 3-25
CNDDB Occurrence Data for Special-Status Wildlife - Fish & Invertebrate Species

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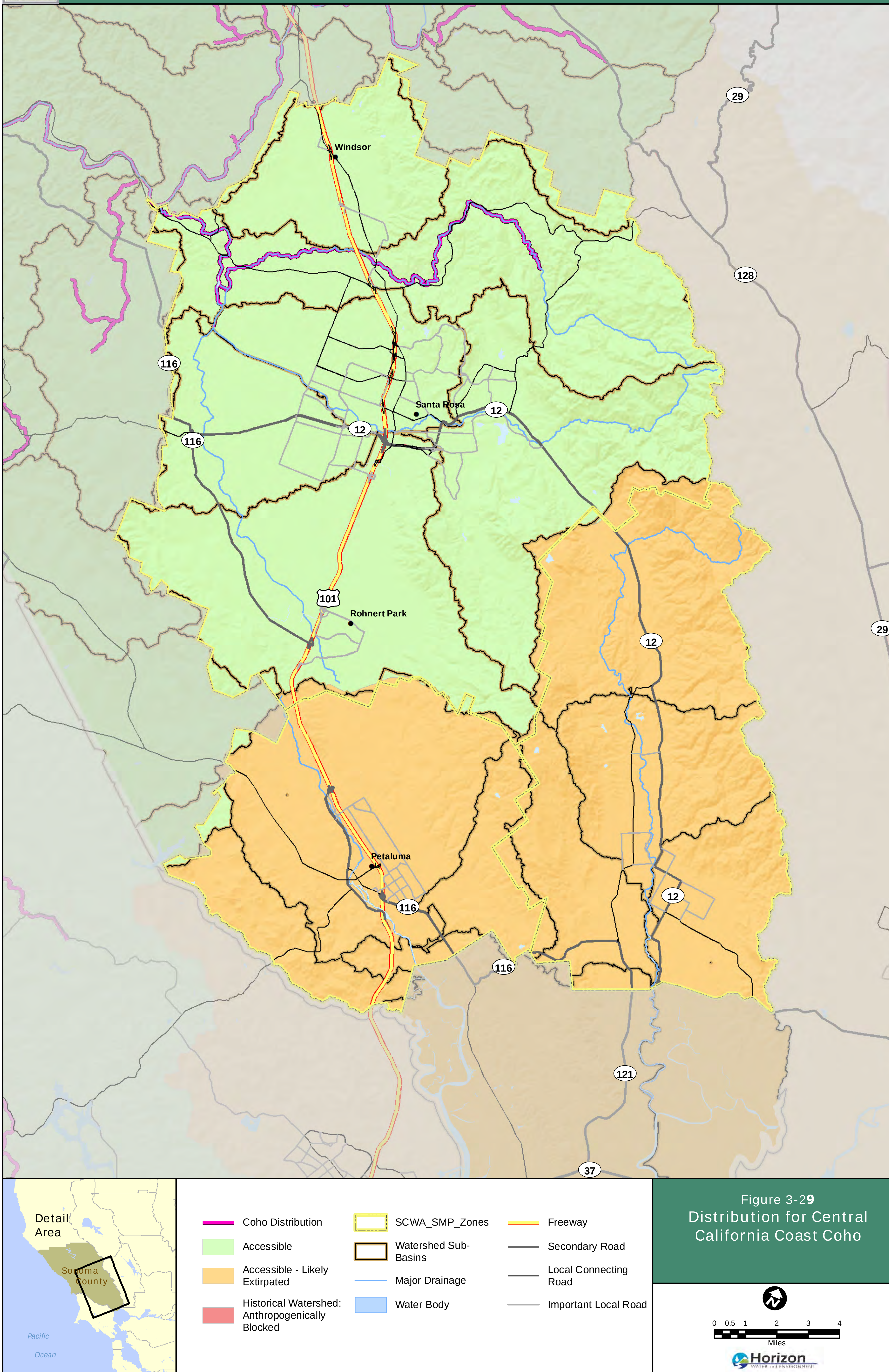
Sonoma County Water Agency

Stream Mantenance Program



Coho Distribution
Accessible
Accessible - Likely Extirpated
Historical Watershed: Anthropogenically Blocked
SCWA_SMP_Zones
Watershed Sub-Basins
Major Drainage
Water Body
Freeway
Secondary Road
Local Connecting Road
Important Local Road

Source: California Department of Fish and Wildlife, Coho Distribution 2016

Figure 3-29
Distribution for Central California Coast Coho

0 0.5 1 2 3 4
Miles

Horizon

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Sonoma County Water Agency

Stream Mantenance Program

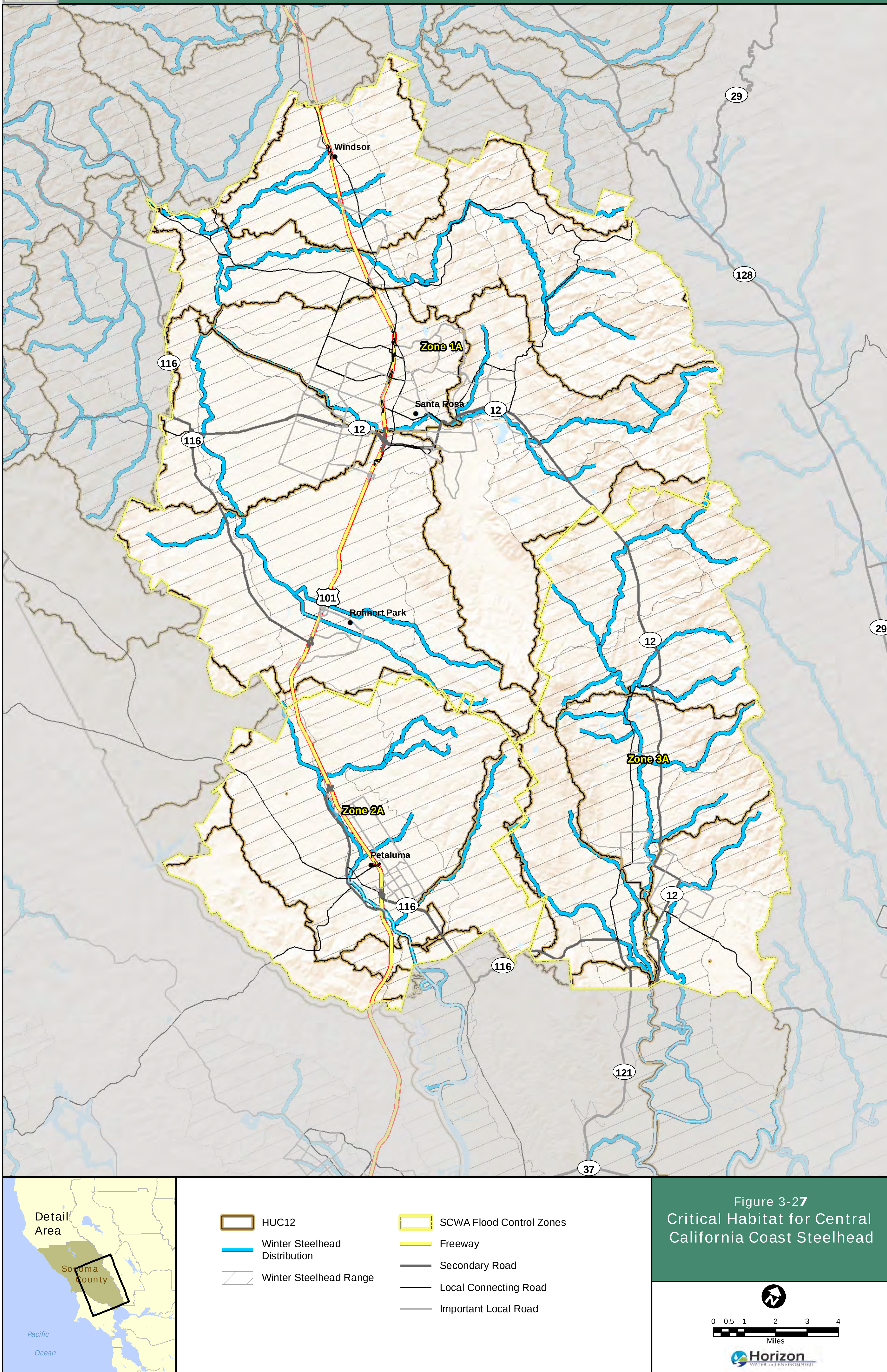

Figure 3-27
Critical Habitat for Central California Coast Steelhead

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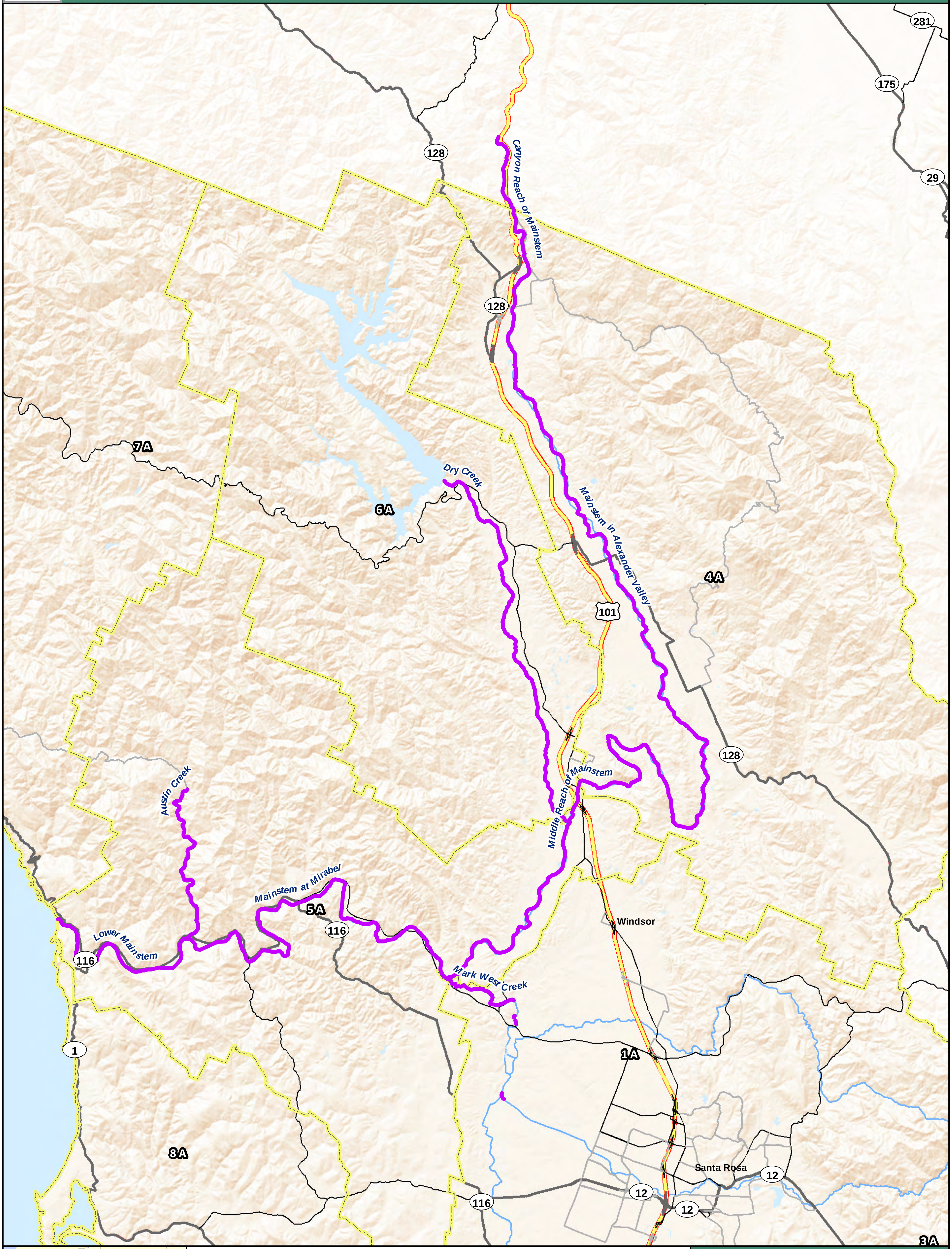
Sonoma County Water Agency

Stream Mantenance Program



California Coastal Chinook Critical Habitat
SCWA Flood Control Zones
Major Drainage
Water Body
Freeway
Secondary Road
Local Connecting Road
Important Local Road

Note: This view depicts the only Chinook critical habitat in the SWCA Flood zones
Source: National Marine Fisheries Service (NOAA Fisheries) Southwest Regional Office (SWR) 2019

Figure 3-2**8**
Distribution and Critical Habitat for California Coastal Chinook

0 0.5 1 2 3 4
Miles

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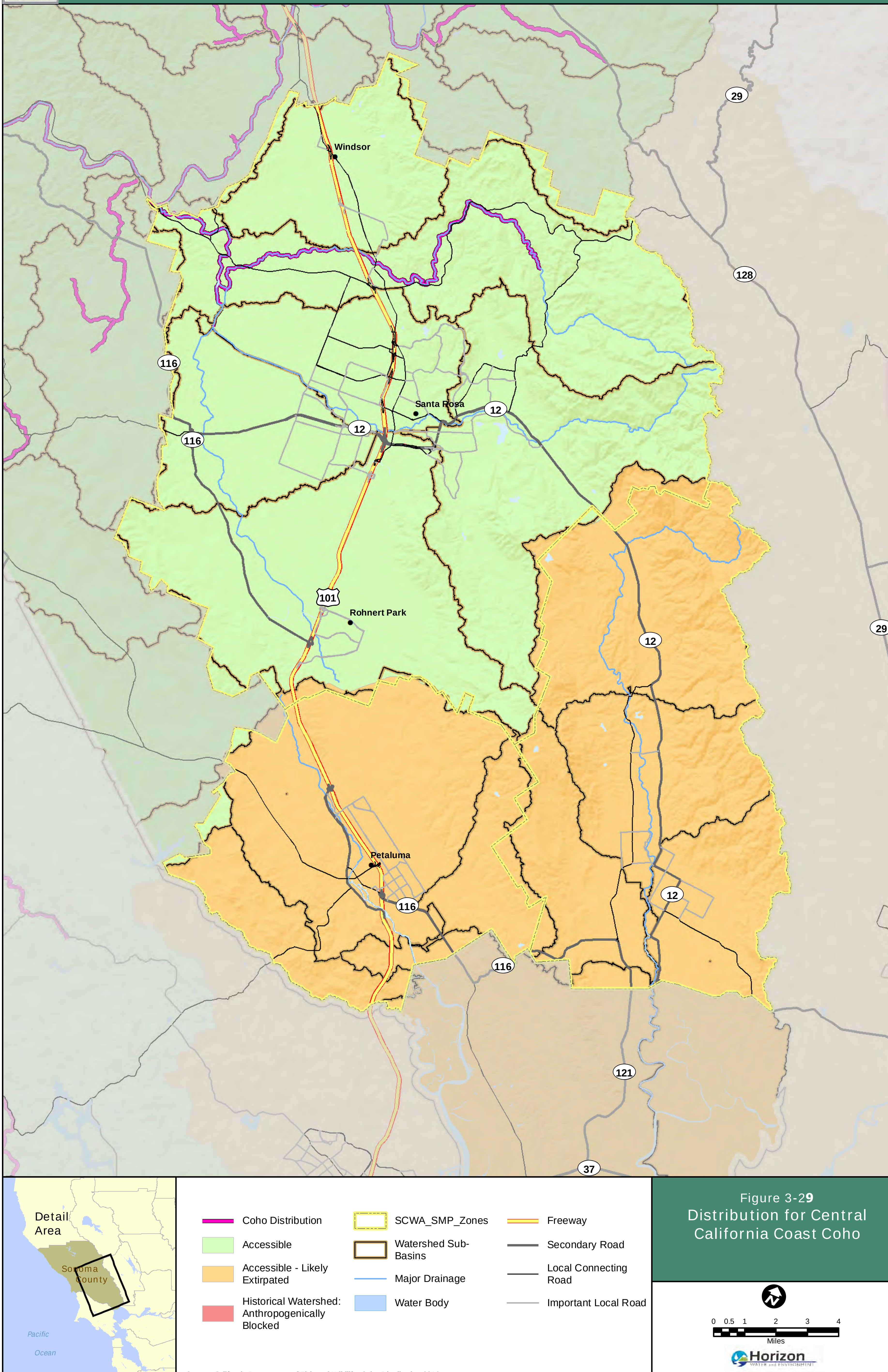
Sonoma County Water Agency

Stream Mantenance Program



Source: California Department of Fish and Wildlife, Coho Distribution 2016

Figure 3-29
Distribution for Central California Coast Coho

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Chapter 4
MAINTENANCE PRINCIPLES

4.1 Introduction

The implementation of maintenance activities is guided by the maintenance principles described throughout this chapter, whereby work in the channel will not occur unless the conveyance capacity is considered reduced such that a flood hazard exists, or other public safety concerns are present such that maintenance is needed.

The following overarching maintenance principles guide the Stream Maintenance Program (SMP):

1. No unnecessary intervention
2. Understand the system and its processes
3. Consider adjacent land uses and public safety
4. Apply system understanding to inform maintenance activities
5. Manage for incremental ecologic improvement (lift)
6. Integrate maintenance activities towards sustainability (reducing maintenance frequency)
7. Maintain adequate conveyance capacity of channels and other facilities to prevent flooding or reduce the potential scope and impact of flooding

4.2 Maintenance Principles

The maintenance principles guide the SMP's maintenance approach while considering existing conditions, maintenance needs, natural processes, and ecological health. **Figure 4-1** provides a diagram outlining how this process is applied at the reach scale. The maintenance principles discussed below are used to identify opportunities at the reach depending on the existing conditions, constraints, and maintenance needs. Based on this approach, opportunities to provide long-term ecologic lift are sought as shown in **Figure 4-2**. The questions described in the maintenance principles below are incorporated into the annual stream assessment process described in Chapter 12, *Program Management*.

4.3 Maintenance Principle 1: No Unnecessary Intervention

This basic principle is foundational to the SMP; that no unnecessary intervention in stream processes should occur and that maintenance is restricted to necessary and appropriate activities. The following questions help guide implementation of Principle 1:

- Has overbank flooding occurred at the reach threatening or causing damage to property or resulted in the area being designated as a flood hazard zone[8]?
- Has observed flooding been caused by reduction in channel conveyance capacity due to in-channel sedimentation, excessive vegetation growth, or bank failure?
- Have channel bed, bank, or vegetation conditions changed such that flooding in the coming rainy season, and associated safety hazards and property damage, are now more likely under typical or average flow conditions?
- Is there a clear and specific flow impediment (e.g., trees or shrubs blocking culvert, or a downed tree diverting flow directly into a streambank causing bank erosion, etc.) that will increase or likely cause a flooding hazard under typical or average flow conditions?
- Has streambank erosion or a bank failure occurred that has led to (or may lead to) the loss of adjacent structures such as bridges, roads, or homes?
- Has streambank erosion or a bank failure occurred that reduces the strength and integrity of adjacent streambank areas and increases potential flood hazard?
- Has streambank erosion or bank failure occurred that leads to increased sediment yields into the channel and downstream receiving waters?
- Are vegetation conditions consistent with SMP vegetation guidance (as shown and described in Chapter 7, *Vegetation Management*), or have triggering conditions been met that require vegetation management?

If answers to any these questions are "yes," then maintenance may be necessary but is not necessarily obligatory. Sonoma Water staff would further evaluate the site for potential maintenance activities if answers to the above questions are yes.

4.4 Maintenance Principle 2: Understand the System and its Processes

Prior to conducting sediment, vegetation, or bank stabilization maintenance activities, the watershed and channel processes that control or influence the site or reach conditions should be understood. This understanding helps guide the implementation of maintenance activities. The following questions help illustrate Principle 2:

- What are the governing hydraulic and geomorphic conditions at the reach? Is the reach primarily depositional or erosional? Are there observed depositional features such as mid-channel bars, point bars, or other deposits? Are there observed erosional features such as undercut banks or a channel incision? Does the channel slope represent a significant change from either upstream or downstream conditions? Are hardened

[8] The Federal Emergency Management Agency (FEMA) defines "flood" as a general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties from the overflow of inland or tidal waters or the rapid accumulation of runoff of surface waters from any source (FEMA 2019).

structures such as channel crossings, bank protection, or drop structures present that strongly influence channel conditions?

- Do the existing channel cross-section form, in-channel features (such as bars, benches, back channels, etc.), and reach slope indicate a channel in dynamic equilibrium (a graded stream); where the channel form reflects a relative balance of erosional and depositional forces as appropriate for the reach's location in the watershed? Or, is the reach strongly depositional or erosional, suggesting a non-equilibrium condition?
- What is the relationship between this reach and upstream and downstream conditions? In particular, what are upstream sediment inputs to this reach and how are those inputs either stored in the reach or transported further downstream? Is there a hydraulic constriction that dictates flow above or below this reach?
- Have historic maintenance activities at this reach strongly influenced its current functioning? Do such influences affect conditions either upstream or downstream?
- Has past maintenance at this reach been on-going in recent years indicating a chronic issue?
- What is the ecologic condition of this reach? What is the foreseeable ecological progression in this reach? What ecologic conditions or succession stage should be managed for in this reach?

This principle of understanding the stream system and its processes was first demonstrated by the channel characterization sheets ("reach sheets") that were initially developed to describe baseline conditions for each engineered channel. Since the development of the initial reach sheets in 2008-2010, the SMP has added many additional data collection activities that further characterize site and reach conditions. These include additional site assessments, pre-construction surveys, wetland assessments, post-maintenance monitoring, and the documentation of past maintenance activities. These many data sources are housed and organized in the SMP's data management system ("SMP Database"). The SMP Database is further described in Chapter 12. The SMP Database has become an essential tool in managing channel maintenance, enabling Sonoma Water to understand key resource conditions and maintenance trends over time.

As part of its management of natural resources, Sonoma Water conducts annual monitoring and surveying of salmonids, amphibians, and a variety of birds and other wildlife. These species surveys are integrated into the SMP Database so that information on resource conditions can be evaluated together with impact avoidance measures and best management practices (BMPs) and other monitoring requirements to inform the maintenance planning process. Integrating this information into the maintenance planning process helps avoid and minimize potential impacts.

In addition to the multiple data sources in the SMP Database, to comply with the Sonoma Water's Regional Water Quality Control Board (RWQCB) Waste Discharge Requirements (WDR) Order No. R2-2016-0020, for maintenance activities planned to occur in modified or natural channels (aside from clearing impediments), Project Specific Notifications (PSNs) are developed annually and included in the annual work notification report. PSNs provide a detailed description of site conditions, including special status species use and BMPs needed to be implemented for the work. Also, where available, channel as-built designs, streamflow records, historic maps and cross sections, photographs, and hydraulic modeling results may all be used to address the above questions during the annual channel maintenance assessment process (see Chapter 12).

4.5 Maintenance Principle 3: Consider Adjacent Land Uses and Public Safety

Where channels are bordered by developed lands, flood protection requirements may constrain stream management options or require more attentive maintenance. The needs of adjacent land uses define the types of activities that can, or should, be conducted within the actively managed stream corridor. For instance, the width of the managed channel corridor influence the risk of flooding, the ease of access for maintenance activities, and the potential to manage for ecologic enhancement (as shown in Figure 4-2 and discussed in Maintenance Principle 5). Similarly, how narrow a channel corridor is in relation to its adjacent land uses may constrain the maintenance activities or treatments, access, or ecological improvements that are possible. As a result, each reach presents management needs, based on current channel functioning and habitat conditions. In parallel, each reach also presents constraints, due to adjacent land uses and their risk to flooding. For each reach, the adjacent land use needs and constraints are considered to identify the suitable maintenance approach. Additionally, each maintenance site is evaluated for other public safety concerns to prioritize maintenance activities. These include the fire risk, presence of hazard trees, visibility, the presence of encampments, graffiti, or a history of past criminal activities at the site.

4.6 Maintenance Principle 4: Apply System Understanding to Inform Maintenance Actions

If maintenance work is necessary (Principle 1), Sonoma Water uses its understanding of the stream system (Principle 2) and land use and public safety considerations (Principle 3) to inform and prioritize an appropriate maintenance approach for each site or reach. The SMP Database helps this evaluation process by providing the record of past maintenance activities and natural resource conditions. Understanding the stream system can lead to a more comprehensive and longer-term maintenance approach at the reach or stream scale. For example, instead of removing sediment bars from a maintenance reach all at one time, it may be better to remove sediment in phases over several years so that only a portion of the reach is disturbed at any one time, thereby minimizing near-term impacts while satisfying longer-term maintenance needs over time. Similarly, the SMP has taken a long-term approach to developing and increasing riparian canopy cover along the SMP's channels. Canopy cover is also a good indicator of habitat function (see Figure 4-2). As further described below under Maintenance Principle 5 and presented in **Figure 4-3**, since the SMP was initiated, riparian canopy cover over the program area channels has increased significantly.

4.7 Maintenance Principle 5: Manage for Incremental Ecologic Improvement (Lift)

The vision for Sonoma Water's engineered channels is to provide a balance between flood protection and habitat support whereby over time, channels provide both functions with reduced maintenance needs. The management approach to achieve this vision recognizes each site or reach's existing functional condition, but also looks forward toward improving each site's ecologic condition.

The following questions help integrate maintenance principle 5 into the SMP and are included in the stream assessment and restoration development protocols that guide the SMP (see Chapter 12).

- What are the existing natural habitats and aquatic resources at the reach?
- Are particular in-channel features such as large woody debris (LWD) or gravel bars present in modified and natural channels that provide valuable habitat?
- Does the presence of habitat features or resources influence how, where, and when maintenance activities might occur?
- Which habitat features and functions can be preserved while still providing adequate hydraulic capacity?
- Are there known occurrences of threatened or endangered species at the reach?
- Can habitat conditions at the reach be further improved or enhanced to improve the existing habitat?
- Can vegetation succession be advanced toward a desired climax community?

Figure 4-2 illustrates this process of managing the channel toward reaching an improved ecologic condition. Figure 4-2 shows channel conditions at several sample reaches presenting a spectrum of habitat conditions. Some reaches are relatively poor in habitat quality (toward Reach A), while other reaches provide healthy functioning creek corridors (toward Reach G). The principle of incremental habitat improvement emphasizes gradual adjustment of maintenance actions through adaptive management. In this way, creek management provides incremental habitat improvement, lifting the reach toward an improved longer-term condition. This management approach recognizes the key physical and biological processes at the reach and considers what can be done over the long-term to improve conditions. Some reaches have more opportunities for improvement and others less so. For instance, creeks that are depositional (lower in the watershed or lower on the floodplain) may need to have sediment removed more frequently whereas creeks higher in the watershed or on the floodplain may only accumulate sediment at road crossings or near channel constrictions. Greater aquatic habitat complexity may be achieved in less depositional areas that require less maintenance over the longer-term.

Figure 4-3 through **Figure 4-6** show comparison photographs from SMP locations and documents how long-term ecologic improvement has occurred at SMP channels.

The SMP includes follow-up monitoring of restoration and mitigation activities. SMP monitoring is more specifically described in Chapter 11, *Program Mitigation*. Monitoring is used to evaluate the effectiveness of the gradual stepwise ecological improvement approach described above.

4.8 Maintenance Principle 6: Integrate Maintenance Activities toward Sustainability

The approach for channel maintenance integrates steps that over time should reduce the overall need for maintenance. As an example, a feedback cycle can develop whereby: (1) the accumulation of fine sediments favors the growth of emergent vegetation such as cattails; (2) this in turn encourages additional sediment trapping; (3) which ultimately reduces habitat quality and flood conveyance capacity. Preventing or breaking this cycle through reducing fine sediment loading is desired versus the continual removal of accumulated sediment and emergent vegetation. As another example, erosion control practices in headwater and upper watershed areas can reduce the sediment delivery downstream to flood control channels. Reducing upstream sediment loading reduces the need for in-channel maintenance activities in general. Watershed erosion control and off-site mitigation efforts are an important strategy of the SMP and are discussed in more detail in Chapter 11, *Program Mitigation*.

To further aid the goal of longer-term reduction in maintenance needs, Sonoma Water formed the Watershed Partnerships Program (WPP) that includes other watershed stakeholders, local non-profit agencies, and Resource Conservation Districts to fund and implement regional projects that improve water quality and restore habitats and ecosystem functions. These funded projects support overall watershed health and sustainability.

Although beyond the scope of the SMP, capital projects implemented by Sonoma Water may consider measures to reduce in-channel maintenance needs, particularly for sediment management. One approach is to develop more instream sediment collection basins, similar to the Cook Creek or Adobe Creek basins. Such basins, when located appropriately (typically at the base of the foothills and upstream of the alluvial plain) can be very effective in capturing sediment before it enters Sonoma Water's maintenance channels downstream. Similarly, a very effective means to manage sediment is targeting sediment removal at key locations where sediment is known to collect. Repeat sediment removal at targeted instream locations (such as Copeland Creek at Snyder Lane and the Adobe Creek basin) has proven an effective means to reduce the need for larger and longer reach scale sediment removal projects downstream of the instream basin.

4.9 Maintenance Principle 7: Ensure Adequate Conveyance Capacity of Flood Control Channels

In parallel with the above maintenance principles, Sonoma Water is mandated to provide adequate flood protection for the communities it serves. While no unnecessary maintenance activities occur under the program (Principle 1), Sonoma Water acknowledges that delaying or postponing stream maintenance can increase the need for maintenance in the future. If maintenance needs are deferred channel conveyance capacity may be reduced and the flooding risk could increase. When conducting annual channel assessments, Sonoma Water monitors sediment accumulation and vegetation conditions to confirm whether flood conveyance capacity has been substantially reduced. If the answer is “yes,” then maintenance is necessary. Even if flood conveyance capacity is somewhat reduced such that maintenance may not be needed in the coming year, Sonoma Water makes note of potential future maintenance needs in the program’s SMP Database. By doing so, this helps Sonoma Water prioritize future maintenance needs in the coming years to ensure adequate conveyance capacity of its flood control channels.

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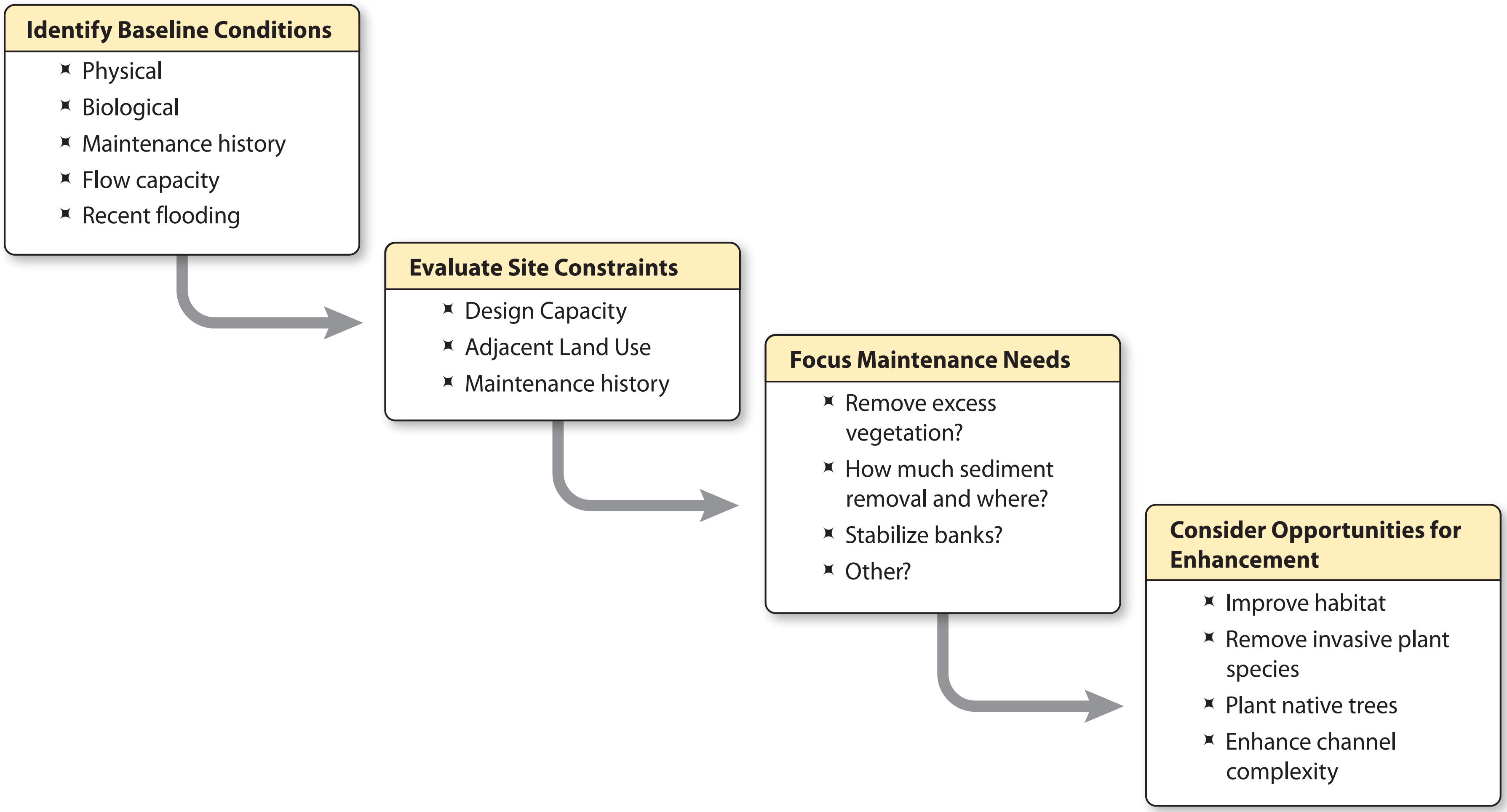
Integrated Maintenance Approach at a Reach Scale



Horizon WATER and ENVIRONMENT

Figure 4-1

Integrated Maintenance Approach

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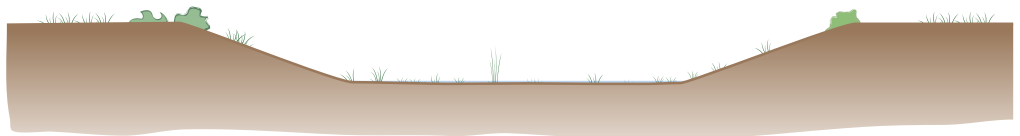
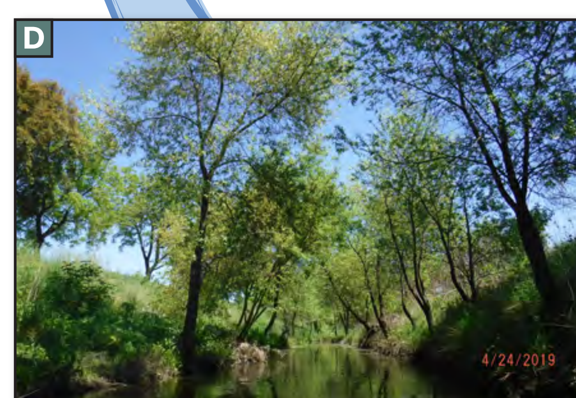


Cross-section of trapezoidal flood control channel with minimal in-channel complexity or riparian vegetation. Overall habitat function is low.

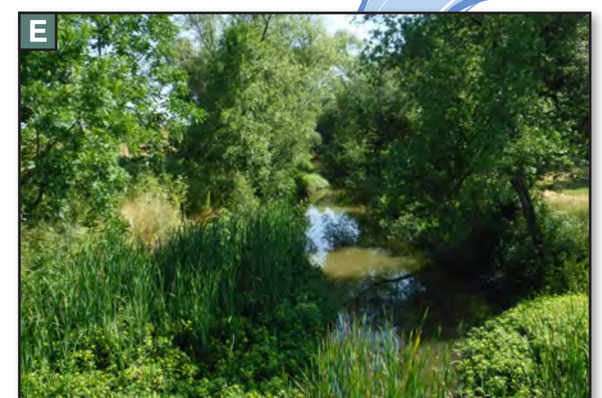
Straightened channel, minimal vegetation (Corona Creek)

Straightened channel in-channel cattail/willow vegetation (Lynch Creek)

Straightened channel, in-channel complexity, low canopy closure (Wilfred Creek)

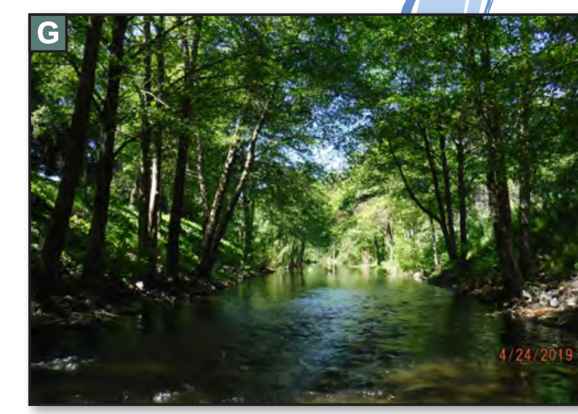


Increased in-channel complexity, riparian woodland with low canopy cover (Roseland Creek)

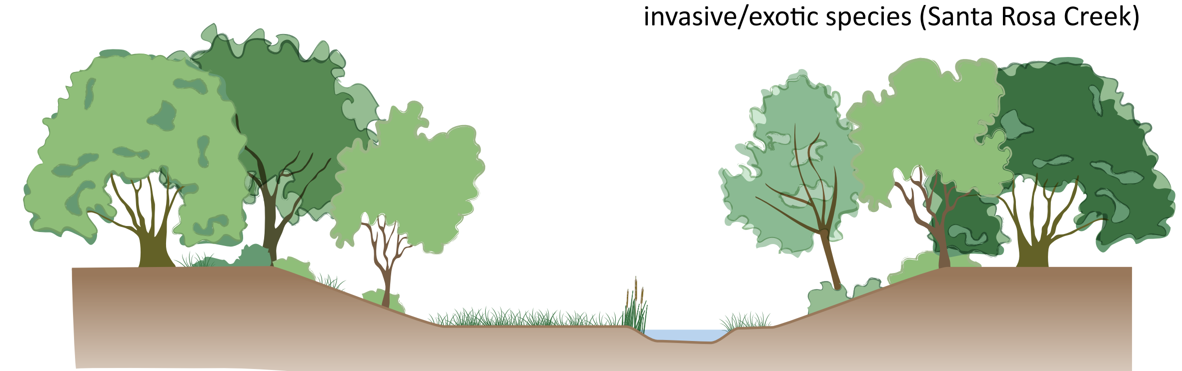


Increased in-channel complexity, (riffle-bar-pool sequence), riparian forest with high canopy cover (Hinebaugh Creek)

Increased in-channel complexity, (alternating bar features, low flow sinuosity, woody debris, pools), riparian forest with moderate canopy closure (Santa Rosa Creek)



High in-channel complexity, (pool-riffle sequence), mature riparian forest with closed canopy, few invasive/exotic species (Santa Rosa Creek)



Cross-section of trapezoidal flood control channel with managed in-channel complexity (low-flow channel sinuosity, in-channel bars/benches, occasional in channel woody debris, riffle-pool sequences with mature riparian forest and closed canopy. Overall habitat function is improved

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Photo a. Aerial image of Corona Creek (Reach 5) in 2007.

Photo b. Aerial image of Corona Creek (Reach 5) in 2018.

Figure 4-3

Canopy Cover Conditions of Corona Creek - 2007 vs. 2018

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Photo a. Hinebaugh Creek, 2007 downstream from the big bend in creek (north of Rancho Verde Circle).

Photo b. Hinebaugh Creek, 2019 downstream from the big bend in creek (north of Rancho Verde Circle).

Figure 4-4

Hinebaugh Creek in 2007 and 2019

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Photo a. Todd Creek, 2007, looking upstream from Hunter Creek confluence.

Photo b. Todd Creek, 2019, looking upstream from Hunter Creek confluence.

Figure 4-5
Todd Creek in 2007 and 2019

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Photo a. Corona Creek, 2008, looking upstream from pedestrian bridge.

Photo b. Corona Creek, 2019, looking upstream from pedestrian bridge.

Horizon WATER and ENVIRONMENT

Figure 4-6
Corona Creek in 2008 and 2019

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Chapter 5
SEDIMENT MANAGEMENT AND REMOVAL

5.1 Sediment Management Approach & Goals

Sediment management refers to the removal of excess sediment from constructed flood protection facilities.

5.1.1 Sediment Sources to SMP Channels

Three primary mechanisms are observed to explain abundant sedimentation in some Stream Maintenance Program (SMP) channels: watershed sediment sources, channel geometry, and flow conditions.

Sediment is delivered to a reach as transported material from upstream areas. This source material may be derived from upland areas (including landslides, gullies, or sheet wash erosion) or may be eroded directly from the channel bed or banks upstream. Upstream sediments are transported downstream through the drainage network of joining tributaries.

In terms of channel geometry components, gradient, channel width, and depth of flow are the key controlling factors. A low gradient stream may favor sediment to fall out of suspension or result in bedload transport. A wide channel cross section may cause the dispersion of flows and reduced flow velocities resulting in net deposition and bed aggradation. The lack of a defined channel that can contain small and medium sized flows (approximately less than the 2-year return interval) within the broader cross section can also be a cause for sedimentation. In such cases, shallow diffuse flows are not adequate to transport sediment downstream. This results in deposition and aggradation across the entire width of the channel bed. This process is observed repeatedly in several of the channels in the program area such as Copeland Creek (**Figure 5-1**).

Hydrologic processes including intensity and duration of precipitation, infiltration, runoff, shallow throughflow, and recharge determine the water balance of the watershed and how much flow is carried in the channel system. Such hydrologic processes determine the magnitude, duration, and frequency of flows arriving to a reach. The in-channel hydraulic conditions determine whether sediment is deposited in a given reach, eroded from the reach, or transported through the reach. Sediment transport processes are complex and a combination of any or all three of these processes could occur in a given reach.

5.1.2 Framing Considerations that Guide Sediment Removal

Six key considerations frame the context and approach for sediment management activities.

- The natural function of streams is to convey sediment from headwater source areas (or upstream in-channel source areas) to downstream reaches, lowlands, or basins where the sediment ultimately deposits. In all streams, sediments are variably eroded, transported, or deposited. The movement of sediment along the stream system represents a beneficial natural function. Chapter 3 describes geomorphic and sediment transport processes in the program area. However, natural sediment transport processes are also strongly affected by historic and current land use conditions, urban development, past engineering and alterations to the channel network, and other modifications. As a result of these influences, sediment transport processes and loadings may be augmented or depleted depending upon the reach. In a system already largely impacted through such conditions, additional maintenance is required to manage sediment and ensure the protection of streamside land uses.

- **Sediment transport is an inherently dynamic process.** Channel sediment conditions are not stable or static, there is high variability including episodic high-magnitude events. Target outcomes for sediment management should reflect an acceptable range of conditions rather than a static prescribed form.
- **Sediment loading and vegetation growth are intimately related in a feedback loop.** Sediment supports the growth of vegetation and vegetation in turn benefits habitat quality by shading the channel, reducing water temperatures, and improving oxygen exchange in the water column (National Marine Fisheries Service [NMFS], 2008). However, excessive vegetation growth can reduce flood conveyance capacity; contribute to elevated nutrient loading and decrease water quality; increase sediment deposition rates; and reduce habitat quality and complexity by creating shallow, diffuse flow conditions across the channel bottom.
- **Sediment accumulation can reduce the channel's ability to convey floodwaters.** Where streams were historically broad, or part of a braided multi-channel system, they deposited their sediment across a wider floodplain area. Today's channels that were historically wider and are now constrained and narrow may still be inherently depositional. When flood control channels no longer have the opportunity to deposit sediment across floodplains, they deposit sediment in the channel itself. In engineered systems, sediment is likely to deposit in reaches with relatively gentler gradients or where the channel cross section is wider than necessary to convey expected loads. SMP stream managers recognize that some degree of sedimentation or erosion occurs in a healthy stream, even in an engineered stream, however engineered streams cannot be counted on to store excessive sediment in an adjacent floodplain. So, what is essential is to identify and address reaches where deposition or erosion is excessive and continued accumulation would cause urban flooding and the loss of aquatic resources and function. Sediment management triggers described below provide guidance on when sediment management should be initiated.
- **Accumulated sediment can obstruct infrastructure such as culverts and bridge underpasses.** This can lead to backwater conditions that cause additional deposition and blocking, alter habitat, contribute to flooding, and potentially cause damage to instream and channel bank structures.
- **Sediment removal can be restorative for aquatic habitat.** Removing accumulated sediment, particularly in reaches with excessive vegetation growth, improves water quality by reducing nutrient loads. Sediment removal can improve habitat quality for aquatic resources by creating a more defined channel flow condition, rather than shallow and diffuse flow. Creating a defined flow path, rather than shallow diffuse flow

across the entire engineered channel width is particularly important in streams that are known fish corridors, where providing deeper and cooler water is an objective. Removing sediment at culvert crossings also helps retain aquatic resources in the channel.

5.1.3 Sediment Management Goals

Consistent with the Maintenance Principles and Framing Considerations described above, the SMP's sediment management goals are to:

- understand the way each reach functions as a sediment conduit within its stream, its subwatershed, and its land use context;
- identify an appropriate maintenance target condition that balances flood protection needs, economizes maintenance activities, and avoids and minimizes environmental impacts for that reach;
- improve water quality conditions through nutrient removal, invasive plants removal, and hydraulic improvement;
- implement treatments that enhance the stream's function toward the desired condition while minimizing the need for repeat maintenance; and
- where channels are incised or undercut, undertake management actions to promote a less erosive channel profile.

Target conditions for each reach are identified according to management needs, reach functioning, and other opportunities and constraints. Constraints to maintenance include when there is limited access to the depositional areas that require sediment removal, or when adjacent land uses are contributing to sedimentation but Sonoma County Water Agency (Sonoma Water) has no ability to improve or manage that situation. As is feasible by Sonoma Water, the reach and stream are managed to maintain and enhance sediment conveyance, water quality, and habitat.

Sediment is managed for the following specific outcomes.

- adequate flood conveyance capacity;
- a general balance between channel aggradation and channel erosion;
- development and preservation of the desired vegetation condition for the reach; and
- as possible, preservation and enhancement of beneficial instream bed forms and habitat features (including large woody debris [LWD]) that support in-channel complexity, diverse cover, and local/micro habitats to the extent feasible while providing adequate conveyance capacity.

To achieve these goals without impacting stream function, sediment management is implemented incrementally. This prevents sudden, drastic alterations in sediment load within individual reaches, which could accelerate further aggradation or incision. Incremental implementation allows time for monitoring, evaluating channel conditions, and adaptively adjusting the maintenance approach as needed. The incremental maintenance approach has a spatial component and a time component, in that activities occur in focused reaches at a given time and not throughout an entire stream system in any given year. Therefore, sediment removal activities for particular reaches are prioritized annually with only the reaches in most need being treated.

5.2 Sediment Management Activities

Sediment management activities are generally conducted from June 15th to October 31st when streams are typically at their driest. In dry years, work may begin earlier than June 15th and carry over longer than October 31st provided that Sonoma Water has received approval from the appropriate regulatory agencies.

The SMP involves only sediment removal within the as-built design of the engineered channel. The SMP does not include the expansion of channel capacity beyond the original channel design.

The number of sediment removal projects undertaken and the quantity of sediment removed in a given year depend on the frequency and extent of past maintenance activities, and the weather and hydrologic conditions during recent years. Sediment removal requirements are generally greater following a wet winter with higher than usual runoff, slope erosion, and sediment delivery compared to an average or dry winter when sediment yields are less.

Sonoma Water anticipates that on average, the SMP involves removing between 20,000 and 25,000 cubic yards (cu. yds.) of sediment per year. A summary of sediment removal volumes for the 2008-2018 maintenance years is presented in Appendix A, Table A-2.

All channel sediment removal activities follow the impact avoidance and minimization approach and principles described in Chapter 4 and incorporate the best management practices described in Chapter 10 and presented in Table 10-1.

The following sections further describe the program's sediment removal approach, including: reach scale sediment removal projects (Section 5.2.1); localized sediment removal including at culverts and crossings (Section 5.2.2); and sediment management at other facilities including reservoirs and sediment basins (Section 5.2.3).

5.2.1 Reach Scale Sediment Removal

Channel reaches in the program area are generally defined at their upstream and downstream ends by hardened crossings or culverts. When in-channel deposited sediment aggrades throughout an entire reach such that flow capacity is significantly diminished along the entire reach; then reach scale sediment removal may be required.

Individual reach scale projects are generally 1,000 to 3,000 feet long and might typically involve the removal of between 2,000 and 7,500 cu. yds. of sediment. Table A-2 in Appendix A summarizes the number of reach-scale sediment removal projects conducted by the SMP during the period 2008-2018. Sonoma Water conducts 1-3 reach scale projects annually.

Sonoma Water generally only conducts reach-scale sediment removal once within a given reach over a general period of 5 years depending on sedimentation rates. However, if and when large stream discharges occur (e.g. equaling or exceeding the 10-year magnitude flow event), Sonoma

Water may review reaches to evaluate the need for additional reach-scale sediment removal activities.

Since the inception of the SMP, Sonoma Water has favored implementing smaller and more focused sediment removal projects (see Section 5.2.2 below) in place of the larger reach scale projects. In general, the Program favors focusing sediment collection efforts at targeted locations like specific road crossing or culverts and removing a smaller amount of sediment more frequently rather than conducting more impacting larger reach scale sediment removal projects.

A reach scale sediment removal project may typically involve the following activities:

- mechanized sediment removal along a 1,000–3,000 feet (ft.) reach of channel;
- removing approximately 2,000 to 7,500 cu. yds. of sediment, with average depths of removal between 1.0 to 2.5 ft. from the channel bed;
- installing temporary access ramps if/as needed;
- removing vegetation from channel bottom;
- removing or limbing selected trees growing at the toe of channel banks;
- creating a low-flow channel to convey flows and transport sediment for smaller sized flow events (if appropriate and feasible); and
- dewatering the channel using temporary coffer dams if/as needed.

These methods to mechanically remove sediment and provide access, staging, vegetation thinning and clearing, and dewatering are described below in Section 5.3, “Sediment Removal Methods.” Reach scale sediment removal projects integrate several vegetation management actions. Vegetation activities closely associated with sediment removal projects are introduced below in this section, and described in more detail in Chapter 7.

5.2.2 Localized Sediment Removal

Localized sediment removal activities are much smaller in size than reach scale projects and typically occur at sites where sediment collects or deposits creating potential blockages. Localized sediment removal projects typically involve the following activities:

- at channel locations outside of culverted crossings - typically involves removal from 400-1,000 linear ft. of channel, with 500-1,000 cu. yds. of sediment removal;
- sediment removal focused at a particular depositional feature such as a mid-channel bar, point-bar, or another instream feature;
- geomorphic shaping of instream feature to reduce flow deflection into streambanks and causing bank erosion;
- dewatering if/as necessary; and
- selective removal or thinning of vegetation as needed to provide access.

Localized sediment removal activities may occur at bridges, other facilities, or other depositional features along the channel. For example, sediment may be collecting as a point-bar along the inside bend of a channel or may be collecting as a mid-channel longitudinal bar. Such features may be up to a few hundred feet long in distance. Sediment management approaches for such features may involve bar grading or geomorphic shaping activities that are more site-specific, and much shorter in length typically 200-400 ft., than the full reach scale sediment removal approach described above.

Localized instream bar grading might involve removing sediment from the top of the bar but not altering the overall shape or dimension of the bar, thus maintaining the low-flow channel and flow sinuosity around the bar. Bar grading activities may require some degree of vegetation removal or thinning from the bar surface to allow for equipment access. Vegetation that is considered important in providing channel stability or anchoring the bar in place is retained. In certain reaches, mid-channel bars may be very developed and solidified with mature willows that further anchor the bar in place.

Localized sediment management may also include targeted geomorphic shaping and minor contouring of existing channel features including the low-flow channel, in-channel bars, or toe-of-slope bars (or sediment wedges). Such minor shaping is undertaken not so much to provide more conveyance capacity (as in the bar grading activities above) but to reduce flow deflection by such features, where the features are directing flows into the stream bank and causing erosion. Geomorphic shaping activities maintain the low-flow channel and other features in their basic form but may alter their alignment to reduce the bank erosion potential. As such, geomorphic shaping is similar to bar grading; but generally less sediment is removed. Geomorphic shaping activities are focused on realigning the low-flow channel and adjacent bars more than increasing channel capacity.

The methods to mechanically remove sediment, provide access, staging, vegetation thinning and clearing, and dewatering are described below in Section 5.3, “Sediment Removal Methods.” In general, the same activities used for reach scale sediment removal are also used for the localized sediment removal activities. The key distinction is the scale and extent of the activities. Whereas reach scale projects are typically 1,000-3,000 linear ft., localized sediment removal projects are typically 400-1,000 ft. long. Access, vegetation thinning, and dewatering activities all scale down accordingly for the localized sediment removal activities.

5.2.3 Sediment Removal at Instream Sediment Basins

Sediment removal at instream sediment basins typically occurs at culverted stream crossings. These types of project typically involve the following activities:

- removing accumulated sediment from box culverts or corrugated metal pipes (CMP) and the channel areas up to 200 linear feet upstream and downstream of the culverts or crossings (400 ft. of combined work length at culverted crossings);
- installing temporary access ramps if needed to enter the culvert crossings;
- dewatering if/as necessary; and
- selective removal or thinning of vegetation as needed to provide access.

Removal of sediment from instream sediment basins at culvert crossings is one of Sonoma Water's most common sediment management activities (**Figure 5-2**).

Since Program inception, targeted sediment removal at instream sediment basins has been used to manage and reduce the need to remove sediment over the length of an entire reach. Experience has demonstrated that areas with high sediment loads like Hinebaugh, Copeland, Wilfred, Coleman, Laguna de Santa Rosa and Adobe creeks are best managed by capturing the sediment at a targeted location, usually immediately upstream or downstream of a culverted road crossing, prior to the sediment being deposited along the whole downstream reach (**Figure 5-3**). **Table 5-1** lists the sediment management areas targeted at culvert crossings.

Using these targeted sediment removal areas, sediment is removed in predictable areas and sustainably managed. Smaller localized projects implemented more routinely, and often annually, effectively reduces the need to do larger and more impacting reach-scale projects. In this way, Sonoma Water manages instream sediment basins at culverted road crossings as targeted sediment management areas to reduce the need to do full length sediment removal across an entire reach segment. If Sonoma Water returns to a particular site every 1-3 years and the sediment removal occurs at a bridgehead or road crossing, the work is classified as an "instream sediment basin" site.

Table 5-1. Targeted Sediment Management Areas at Culvert Crossings

Zone	Targeted Sediment Management Areas at Culvert Crossings
1A	Brush 2B/2C & Austin 1 Instream Sediment Basin
	Colgan 3 & 4 Instream Sediment Basin
	College 1 & 2 Instream Sediment Basin
	Copeland 1 & 2 Instream Sediment Basin
	Copeland 2 Instream Sediment Basin
	Copeland 3 & 4 Instream Sediment Basin
	Copeland 4 & 5 Instream Sediment Basin
	Copeland 5 Instream Sediment Basin
	Ducker 2 Instream Sediment Basin
	Five 1 Instream Sediment Basin
	Hinebaugh 3 & 4 Instream Sediment Basin
	Hinebaugh 4 & 5 Instream Sediment Basin
	Laguna 4 & 5 Instream Sediment Basin
	Laguna 6 Instream Sediment Basin
	Paulin 2, 3, 4 Instream Sediment Basins
	Paulin 5 & 6 Instream Sediment Basin

Zone	Targeted Sediment Management Areas at Culvert Crossings
	Piner 4 & 5 Instream Sediment Basin
	Piner 6 Instream Sediment Basin
	Piner 7 Instream Sediment Basin
	Roseland 1 Instream Sediment Basin Clearing
	Russell 1 Instream Sediment Basin
	Santa Rosa 1 & 2 Instream Sediment Basins
	Santa Rosa Creek Diversion 1 Instream Sediment Basin (Santa Rosa Diversion Structure)
	Santa Rosa Creek Reach 2 Instream Sediment Basin
	Santa Rosa Diversion 2 Instream Sediment Basin
	Starr Creek Tributary 1 Instream Sediment Basin
	Todd 5 Instream Sediment Basin
	Todd 5B Instream Sediment Basin
	Wilfred 1C Instream Sediment Basin
	Windsor 1B Instream Sediment Basin
	Windsor 3 & 4 Instream Sediment Basin
2A	East Washington 4 & 5 Instream Sediment Basin
	Jessie Lane 1 Instream Sediment Basin
	Lichau 2 & 3 Instream Sediment Basin
	Washington 1 Instream Sediment Basin
	Washington 2 Instream Sediment Basin
	Washington 3 Instream Sediment Basin
	Washington 4 & 5 Instream Sediment Basin
	Washington 5 & 6 Instream Sediment Basin
3A	Rodgers 0A & 1 Instream Sediment Basin
4A	Wood 1 Instream Sediment Basin
5A	Fife 2 & 3 Instream Sediment Basin
	Fife 4 Instream Sediment Basin
6A	West Slough 1 Instream Sediment Basin
8A	Bloomfield 1 Instream Sediment Basin

Such projects typically involve removing accumulated sediment and debris from approximately 200 ft. above and 200 ft. below and inside culverts. Culverted crossings often accumulate sediment and debris either due to their design conditions (size and slope) or due to debris or vegetation obstructions. Typical maintenance at the culvert crossings listed in **Table 5-1** involves removing sediment in the culvert and upstream and downstream of the crossing. The excavated zone then effectively captures future deposited sediment and provides easy access for removal. In this way, the targeted sediment removal area functions as an “instream basin”.

Several examples of blocked or partially occluded culverts are described and shown in the channel descriptions presented in Appendix C, *Channel Characterization*.

Most of the culvert crossings that Sonoma Water maintains are concrete box culverts. Culverts greater than 36 inches in diameter tend to require use of an excavator from the road crossing above or directly inside the culvert if space allows. Large box culverts with cement bottoms and enough space for a person to enter may be cleared with a small Bobcat®, skid-steer, or walk-behind power-shovel as shown in Photos b and c of Figure 5-2. A vacuum truck is also used to remove sediment from culverts.

In addition, Sonoma Water conducts targeted sediment removal at many smaller culverts (12 to 36 inches) made of CMP (see Section 8.4, “Culvert Maintenance, Repair and Installation,” in Chapter 8, *Other Maintenance Activities*). These culverts are generally private culverts that drain from adjacent properties. Sonoma Water is not responsible for maintaining such local drainage culverts beyond Sonoma Water’s property or maintenance easement, but Sonoma Water does maintain the outlet of such culverts when they enter flood control channels that Sonoma Water is responsible for maintaining. A culvert outlet blocked with sediment or vegetation does not drain properly. Removing sediment from a small culvert outlet may require similar techniques as described above for culvert crossings, but may also simply require digging out the culvert outlet by hand.

5.2.4 Sediment Management at Other Facilities

Other facilities requiring sediment maintenance activities include in-channel structures, reservoirs, and sediment basins. Sediment removal from these types of facilities is described below.

In-Channel Engineered Structures

In-channel structures are concrete-lined portions of channel with hardened and non-earthen bed or banks. In-channel structures maintained by Sonoma Water include the following:

- Concrete-lined or grouted rip-rap channels – including sections of Colgan, Cotati, Bloomfield, Santa Rosa, and Lornadell creeks (**Figure 5-4**, Photos a through d).
- Spring Creek Diversion Structure- designed to manage flows from Spring Creek into Spring Creek Reservoir. (Figure 5-4, Photo e)
- Santa Rosa Creek Diversion – a complex structure designed and operated to divert flows from Oakmont Creek and Santa Rosa Creek into the Spring Lake Reservoir. The diversion structure includes a weir-controlled basin where sediments become deposited (Figure 5-4, Photo f).

These in-channel structures can collect large volumes of sediment and require routine and frequent sediment removal to maintain conveyance capacity through the structure. Maintenance of these facilities involves the removal of all accumulated sediment and returning the structures to their as-built conditions.

As these structures become filled with sediment, emergent wetland and riparian vegetation usually establishes on the accumulated sediment. This vegetation is removed at the time of sediment removal. Due to regular maintenance and limited root depth, it is unlikely that mature vegetation can establish in these structures. Mature vegetation is not desirable in these structures as the root can penetrate the concrete and compromise the integrity of the structure.

For sediment removal activities at in-channel structures, placement and use of equipment in the channel is limited to the area of the structure that is concrete-lined and does not extend into any earthen channel bed areas. Sediment is removed from these locations in such a manner that the transition from the concrete structure to the natural channel bottom is smooth and does not create a sudden and sharp ledge or wall of sediment.

Reservoirs

Sonoma Water operates four reservoirs including: Brush Creek, Matanzas Creek, Piner Creek, and Spring Lake reservoirs. Brush Creek and Matanzas Creek reservoirs are flow-through reservoirs, designed to detain and store peak flood flows during storm events and provide controlled release of flows following the storm peak. These reservoirs are generally dry throughout the year, with some perennial flow occurring in the creeks that flow through the reservoir. Brush Creek Reservoir currently supports recreational uses of baseball and soccer and contains infrastructure to support such uses (e.g., fields, restrooms, and unpaved parking lots). Matanzas Creek Reservoir does not currently have any recreational facilities. Spring Lake reservoir maintains water throughout the year. Spring Lake Reservoir provides recreational uses of swimming, boating, fishing, hiking, and biking and contains infrastructure to support such uses (e.g., restrooms and paved parking lots). Piner Creek Reservoir does not currently have recreation facilities and does not maintain water through the year.

Sediment removal around reservoir dam inlet structures is required periodically. This maintenance is typically conducted every one to two years to maintain flow-through capacity from the reservoir to the outfall and creek downstream. However, sediment removal needs at reservoirs may be higher following wet years than in dry years. **Figure 5-5** shows the inlet structures at Brush Creek and Piner Creek reservoirs. The inlet structure area may be inundated with pool storage at the reservoir and contain some emergent wetland and/or riparian vegetation, particularly at the point where the reservoir flows into the inundated area. Managing inflow of sediment may be more effective at reservoirs if instream sediment removal basins are established at the upstream end (where the creek enters the reservoir). This technique may help avoid the inlet structure becoming blocked by rapidly accumulating sediment mid-season.

Sediment removal at flood control reservoirs offers an opportunity for aggressive non-chemical control of aquatic non-native, invasive weeds such as *Hydrilla verticillata* which has been a problem at Spring Lake and has been successfully controlled by sediment removal in the past. It is important that sediment removal and grading activities at reservoirs do not contribute to the spread of species such as Eurasian watermilfoil (*Myriophyllum spicatum*), which propagate by fragmentation.

Engineered Sediment Basins

Sonoma Water currently maintains two engineered sediment basins in the program area at Cook Creek, and at Adobe Creek. The Cook Creek basin was constructed in 1998. At the time of its design and construction, the expected frequency for maintenance and sediment removal was approximately 5 years. Since the 2002/2003 winter, the presence of an active landslide upstream in the headwaters areas of Cook Creek resulted in abundant sediment loads being delivered downstream to the basin. As a result, the Cook Creek basin was dredged five times between 2004 and 2007. Erosion control practices were implemented in the summer of 2006 to reduce sediment loadings to the Cook Creek Basin. Following the upstream erosion control activities, the volume of sediment accumulating in the basin on an annual basis has decreased substantially. The Adobe Creek Sediment Basin is located on Adobe Creek upstream of South McDowell Dr. (Figures C-42 and C-46 in Appendix C). This is an "in-line" basin meaning that the basin is formed directly in the flow path of the creek. Sediments collect in abundance in the Adobe Creek sediment basin. A summary of sediment removal activities from Cook Creek and Adobe Creek basins is presented in Table A-3 in Appendix A.

When maintaining sediment basins, all accumulated sediment is removed and the structure is returned to as-built conditions. **Figure 5-6** includes photos of the Cook Creek sediment basin before and after sediment removal activities in 2006. Sediment removal from the Cook Creek basin requires the use of heavy equipment such as an excavator and/or bulldozer. Access to the project site and staging of equipment and vehicles takes place from the access road that circumnavigates the sediment basin. During sediment removal activities, bulldozers and loaders are used inside the basin and excavators (positioned on the perimeter road at the top of the basin) are used to remove and load the sediment in 10- or 20-cubic-yard dump trucks also located on the access road.

5.3 Sediment Removal Methods

5.3.1 Mechanized Sediment Removal

Aggraded sediment is removed with a long-reach excavator, bulldozer, scraper, or front loader. When using a long-reach excavator, sediment is excavated from the channel bed, collected, and removed with the excavator usually positioned on the maintenance roads located along the top-of-bank. If the channel shape or the presence of large mature vegetation along the channel banks prevents working from the top-of-bank, then the excavator may be positioned lower on the channel banks using an access ramp. Use of access ramps are described below. When working near the upstream or downstream limit of the reach the excavator may be positioned on the stream road crossing or culvert.

Once excavated, sediment is either placed directly into dump trucks parked on the access road or stockpiled into central locations along the channel and then subsequently lifted to the adjacent dump trucks. **Figure 5-7** demonstrates the use of excavators, front loaders, and bulldozers in removing sediment from the 2007 reach scale project at East Washington Creek. Approximately 1,432 cubic yards of accumulated sediment (average depth 1.2 ft.) was removed during this project and the before and after photos of the site are presented in Figure 5-7 photos.

BMPs and avoidance and minimization measures are applied to sediment removal activities based on equipment used, site conditions, and access to the site. If equipment is operated in such a way that loose sediment may possibly enter the active channel, erosion control fabric is installed at the toe-of-slope or along the edge of the active channel to avoid delivery of any dislodged sediment into the channel and/or low-flow channel. If equipment is used within the channel, or if activities conducted from top-of-bank may affect the active channel, the work area is isolated from flowing stream segments using silt fences, wattles, and/or cofferdams (see the Dewatering sub-section below for more details). Additional BMPs are identified in Table 10-1 and are applied as appropriate to all sediment removal projects.

5.3.2 Channel Access and Staging

Access to the maintenance site and staging of equipment and vehicles take place on existing access roads adjacent to the channel. The engineered channels have at least one access road running along the top-of-bank on one side of the channel. Most channels have an access road on either side of the channel. Where feasible, work is conducted from the north side of the channel to avoid needing to remove vegetation (and the accompanying shade reduction) from the south side. Many of the program area channels also have additional access roads at a lower level along the banks, and not just at the top-of-bank location.

When the channel shape, bank height, or the presence of large mature trees prevents the use of the top-of-bank access roads, an access ramp (earthen or hardened if already existing) is used to move the equipment lower on the bank of the channel, or move the equipment into the channel. A pad may be placed halfway down the bank slope so that an excavator can work from that point, reaching down to the channel bed to collect sediment and then placing the sediment in a dump truck above on the access road. This approach could be used in locations where placement of a pad is feasible or where there is a low-flow access road (e.g., lower Santa Rosa Creek where the bank has a built-in shelf above the channel bed).

When necessary, sediment removal activities can be conducted from within the channel bed. This approach is favored where top-of-bank or side-bank access is unavailable, or would require unnecessary damage to trees along the riparian corridor. In-channel sediment removal activities would only occur under dry channel conditions. Scrapers, skid loaders, bulldozers, and smaller Bobcat® type loaders are used when working directly in the channel bed (Figure 5-2).

Access ramp locations are selected to avoid impacts to vegetation, while providing efficient, safe equipment access to the work area. If used, access ramps are temporary and are regraded and replanted following the sediment removal activities. The ramps are seeded with native grasses and erosion control fabric is installed.

All removed sediment, whether working from top-of-bank, mid-bank, or in channel is placed in 10- or 20-cubic-yard dump trucks located on the access road or within the staging area. As appropriate, exposed soil on streambanks that remains after sediment removal activities is either seeded with grass and covered with erosion control fabric or planted according to the on-site restoration planting designs described in Chapter 11, *Program Mitigation*.

5.3.3 Vegetation Thinning or Removal for Sediment Removal Projects

Sediment removal projects often require some degree of vegetation removal or thinning in order to access a project site or begin conducting sediment removal work on the channel bed or bar surface. Cattails, willows, Himalayan blackberry, and various non-native grasses are the plants most typically thinned or removed in combination with reach scale sediment removal projects.

Whenever possible, access points are sited to avoid trees and shrubs and are established in locations where vegetative cover is minimal. If vegetation must be removed to provide short-term equipment access, removal of non-native species or less desirable species such as arroyo willow (*Salix lasiolepis*) is prioritized. Other vegetation characteristics such as age/size of tree, local vegetation diversity, and if the vegetation is providing a particular habitat value is also taken into consideration when prioritizing removal of vegetation for channel access. In areas where routine or repeated sediment removal is needed (once every three years or more often), an access route to the channel is maintained free of woody trees and shrubs. These access points are stabilized with native grasses and fabric. To reduce effects on habitat quality, the width of the access point should be the minimum needed to provide safe access for equipment. Please see Chapter 7 for additional discussion regarding tree removal.

Sonoma Water makes an effort to maintain and not remove vegetation that provides channel stability, anchors in-channel bars, or provides habitat benefits through the presence of LWD. Vegetation located on in-channel bars is particularly important at the bar’s downstream tip (head) and/or along the bar’s periphery. Allowing this vegetation to remain also provides shading benefits to the adjacent low-flow channel. Similarly, the presence of LWD is evaluated for the opportunity to leave such material in place. Key determinants include whether the LWD is deflecting flow toward banks and the proximity to a channel crossing or other facility. While the habitat benefits of LWD are sought in the program area, these benefits are evaluated in balance of the potential flooding or erosion effects, or threats to infrastructure downstream due to the presence of LWD. Invasive vegetation such as blackberry or fast-growing multi-trunked species such as arroyo willow are targeted for removal. Chapter 7 describes vegetation management approaches in more detail.

5.3.4 Creation of Low-Flow Channel or Channel Notch

Developing a low-flow channel that can successfully transport sediment under lower flow conditions (annual flows and smaller) is an important strategy to reduce sediment deposition in certain channel types and location in the watershed. This approach can be advantageous in terms of preserving channel capacity (if excavation is accomplished below design grade and reflects a geomorphic “bankfull” dimension), but also provides important water quality, habitat, and fish migration benefits. The general approach is to design a smaller conveyance channel (designed to approximate bankfull flow level) nested inside the overall channel width (**Figure 5-8**). This smaller nested channel has hydraulic geometry conditions adequate to convey and pass sediments under lower flow conditions, while also maintaining a deeper and cooler channel that provides aquatic resource benefits. This approach directly supports the multi-objective goals for sediment management introduced at the beginning of this chapter.

To the extent possible, excavation of a low-flow channel should follow the channel thalweg (low point or bottom) or the location of the existing (or pre-existing) low-flow channel. If the low-flow channel has been fully aggraded, a new channel is designed and excavated to an appropriate width, depth, and slope for the reach. Sediment removal and low-flow channel excavation activities do not exceed the depth of the original channel design. Where the thalweg has incised below design and effort is made to retain this configuration as a beneficial channel form. To the extent possible, the low-flow channel form and alignment are based on channel forms and sinuosity in the existing channel or of natural streams observed in the project area. The approach to maintaining or developing a low-flow thalweg channel directly supports the sediment management goals introduced at the beginning of this chapter.

If the reach easement and channel cross section is too narrow for a sinuous low-flow alignment, alternatives are considered including; establishing a notch on the shady side, creating a tilted bottom, or other alternatives that provide for thalweg development. In east-west aligned channels, this would be on the south side of the channel where the low-flow channel would receive the most shade from any vegetation present on the south bank. If the channel does not have much existing vegetation, either on the south or north sides, tree planting is integrated with the project during the following planting season, as with all channels receiving maintenance that have planting opportunities (see Chapter 7) for additional detail on tree planting program).

The selection and design of a low-flow channel, notch, tilted channel bed, or pool strategy to improve low flow hydrology and drainage, improve water quality, and improve habitat conditions are made depending on the hydrology, geomorphic conditions and relative stability of the channel. There can be constraints to implementing these strategies. In some cases, since the work zone is saturated silt and clay, equipment has difficulty accessing and constructing these low-flow channels while still retaining beneficial trees. In other cases, the two-stage morphology would be below the summer water level and would be expected to fill in because it is not in contact with channel forming flows. Finally, many flood control channels are narrow and deep and simply do not have the physical space to support a low-flow channel with dimensions approximating the bankful capacity. Examples of low-flow channels that require excavation are shown in **Figure 5-9**.

5.3.5 Dewatering

Dewatering of the stream may be required in order to conduct sediment removal in the channel. Many program area creeks are intermittent or ephemeral and are dry in the summer maintenance season. Other creeks are perennial and carry flow year-round. Several of the channels in urbanized areas, or downstream of urbanized areas that were historically dry in summer, now receive flows from urban runoff and contain water year-round.

If the channel is conveying water or ponding at the time of maintenance, dewatering techniques are used. After several years' experience, Sonoma Water has developed a flexible dewatering approach for use in program area channels. Typically, a coffer dam, pump, and re-routing pipeline are used together to dewater a short section of channel at a time. The coffer dams are typically constructed using sand or gravel bags or if conditions require, an inflatable rubber cofferdam. Pumping rates are set to match inflows to the coffer dam with the downstream release of the diverted flows. Pump intake lines are protected with screens according to NMFS and California Department of Fish and Wildlife (CDFW) criteria to prevent the entrainment of aquatic species. The diverted flows are released back into the channel as near as possible to the downstream end of the project area. Silt bags are used at the end of the diversion pipe to reduce any sediment discharge downstream and to dissipate flow velocity and prevent scour at the discharge site. **Figure 5-10** illustrates the typical dewatering method in plan and profile view. **Figure 5-11** provides an example of dewatering from a recent project at Hinebaugh Creek.

If needed, the coffer dam, pump, re-routing pipeline method can be sequenced to dewater a longer reach of channel. Up to three coffer dams may be operated at a time (45 cu. yds. of sandbags and gravel), using a phased approach that allows one section to be dewatered while another section is being excavated. If used in sequence, the upstream dam and the middle dam are used to surround either end of the active project site (i.e., where sediment removal is occurring), and the middle dam and the downstream dam form the stilling basin which receive water pumped around the active work site. Pumped water is held in the stilling basin to reduce turbidity and is slowly released through the downstream coffer dam which is constructed of sandbags surrounding a central pipe equipped with a filter sock. The coffer dam(s) and pump system(s) are moved downstream along the project area as needed during sediment removal. Following project completion, the dewatering system is removed.

Channels are only dewatered to the extent necessary to conduct sediment removal activities while protecting water quality and avoiding impacts to aquatic species. Specific BMPs for channel dewatering are described in Table 10-1, Biological Resources Protection. As stated in Regional Water Quality Control Board (RWQCB) permits, water quality monitoring is required before, during, and after installation and use of water diversion structures.

5.4 Sediment Management Triggers

In general, sediment management or removal activities are appropriate when any of the triggering conditions described below applies.

- SR-1: The channel has aggraded such that flood conveyance, channel capacity, and/or freeboard requirements are compromised.
- SR-2: Where nomographs or hydraulic model results exist, channel conditions indicate a 50% loss of freeboard or greater.
- SR-3: Accumulated sediment is blocking or filling culvert outfalls or box culverts, limiting functionality and threatening to cause flooding.
- SR-4: Sediment is blocking or covering drop-inlets in V-ditches or culvert outlets, limiting functionality and threatening to cause flooding.
- SR-5: Significant sediment has accumulated around reservoir outlet, limiting functionality and threatening to cause flooding.
- SR-6: Significant sediment has accumulated at road crossings, threating to cause flow outbreaks on to road.
- SR-7: Sediment has filled in-stream basin such that facility function is compromised for the upcoming storm season.

- SR-8: Sediment accumulation is deflecting flows and causing significant side bank scour.
- SR-9: Instream sediment (or debris) deposition has created a flow constriction leading to excessive upstream deposition or downstream erosion.
- SR-10: Gravel bar surfaces have aggraded above Ordinary High Water Mark (OHWM) to the point that they can no longer be effectively inundated for a sufficient duration to recharge underlying groundwater stores. The grading down of bar surfaces would occur in consideration of the presence of an existing low-flow channel and what is the width, depth, and orientation of such a low-flow channel.
- SR-11 Sediment is accumulating in a way that supports excessive vegetation growth, threatening channel capacity or creating undue roughness.
- SR-12: Sediment accumulation is impeding fish passage.
- SR-13: Instream flood management or other hardscape facilities require sediment removal to maintain as-built functions.

Sediment management or removal is unlikely to be needed if none of these trigger conditions are present. The degree to which channel capacity has been reduced is determined based on visual assessment (during annual channel maintenance reconnaissance), cross section comparisons to the as-built channel condition, and/or any past record of flooding conditions. Any one of these assessments may trigger the need for sediment management. One exception is if there is a nomograph or hydraulic modeling results that can be used to indicate whether there has been at least a 50% loss in freeboard. If such information is available it is used in addition to the other assessment methods described above.

In addition to these specific sediment management triggers above, the work evaluation and prioritization process also considers:

1. What other maintenance work may be required at the reach. Chapters 6 through 8 include additional management triggers for vegetation management, bank stabilization, and other public safety required maintenance activities.

2. Overall consistency with the approaches and methods described in this SMP Manual.

3. Channel form and type, and the channel's designed capacity (10- to 100-year channel);

4. Current channel cross-section, vegetation, and habitat conditions;

5. Adjacent land use and flooding history;

6. Potential for special status species or habitat; and

7. Other significant public safety concerns or exceptional circumstances.

The trigger evaluation process may determine that no management action is necessary.

5.5 Design Guidance for Sediment Removal Projects

The guiding questions and assessments described above are used to understand the channel's function and design an appropriate sediment removal project that achieves flood management and ecosystem objectives while minimizing impacts. The additional issues and questions below are used to further refine the maintenance approach and provide design guidance.

- Did the reach in question historically function as a depositional zone? Or, was the reach historically more of a transport zone and only recently has it become more depositional? Based on the historic trend of the reach, the extent of sediment removal can be targeted for the project.
- Is sediment accumulating throughout the reach, depositing broadly across the entire channel cross section as a homogenous sediment wedge? Based on the situation, the need and size for an instream low-flow channel can be refined.
- Is sediment collecting in particular locations along the longitudinal profile such as the upstream and downstream ends of crossings and culverts? Are such culverts undersized or otherwise designed in a way to encourage sediment deposition instead of transport? Known collection spots are used to target sediment removal locations.
- Is sediment being deposited in particular features within the channel such as mid-channel bars, sediment benches and wedges along the edge of the channel, or in sinuous alternating bars along the longitudinal axis? Understanding these situations allows the sediment removal project to work with natural processes and to preserve natural forms as much as possible.
- What is the dominant texture of the sediment accumulating in the reach and is there a pattern observed? Sediment patterns indicate the depositional environment and can be used to refine the extent and location of sediment removal activities.
- What is the net rate of sedimentation at the reach (either measured as a depth or a volume over a certain period of time)? Understanding the sediment rate informs how frequent sediment removal activities shall occur.
- Is there an existing low-flow channel operating within the wider channel cross section?
- If a low-flow channel is present, is this channel adequately transporting sediment under medium and lower flow conditions through the reach? Monitoring the existing low-flow channel is useful if adjustments are necessary to either enlarge or deepen the low-flow channel.
- Is sediment accumulating to a point where typical high flows would cause a breakout? Would sediment removal benefit aquatic resources by allowing them to remain in channel?

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Photo a. Copeland Creek (March 2007), channel bed is elevated and uniform with deposited sediment, emerging cattail growth is clogging channel, causing low flows to spread shallow and diffusely across stream bed. Cattails would grow 5 ft high within one year of this photo.

Photo b. Copeland Creek at Snyder Lane immediately following storm flows of early January 2008, 1-2 ft of sediment deposition occurs at the Snyder Lane crossing.

Photo c. Copeland Creek at Snyder Lane crossing, September 2008, following vegetation removal activities and prior to sediment removal activities.

Photo d. Copeland Creek at Snyder Lane crossing, October 2008, following sediment removal activities and construction of low-flow channel.

Figure 5-1

Maintenance Activities at Copeland Creek

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Photo a. Looking upstream at Bloomfield Channel (Zone 8A) filled with sediment.

Photo b. Using a front loader to clear sediment in box culvert.

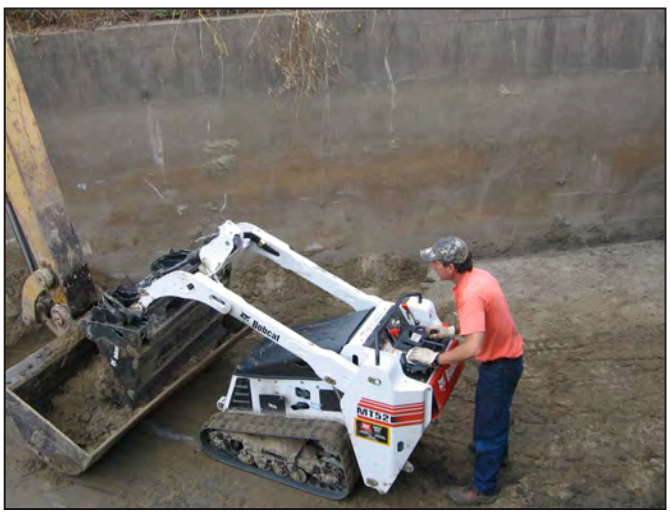

Photo c. Loading sediment onto an excavator.

Photo d. Excavator staged on road above culvert.

Horizon WATER and ENVIRONMENT

Figure 5-2

Sediment Removal Equipment Used in Concrete Lined Channels and Culverts

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Photo a. Wilfred Creek at Snyder Lane crossing (March 2019) culvert severely blocked by chronic deposition, good site for targeted sediment removal.

Photo b. Copeland Creek looking downstream from Snyder Lane crossing (April 2017) – similar to Photo (a), a chronic depositional area.

Photo c. Adobe Creek looking upstream from weir (February 2018) – chronic depositional area requiring targeted sediment removal.

Photo d. Adobe Creek looking upstream from weir (February 2018) – chronic depositional area requiring targeted sediment removal.

Horizon WATER and ENVIRONMENT

Figure 5-3

Targeted Sediment Removal Areas

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Photo a. Bloomfield Channel (Zone 8A).

Photo b. Cotati Creek (Zone 1A).

Photo c. Colgan Creek (Zone 1A).

Photo d. Lorna Dell Creek (Zone 1A).

Photo e. Spring Lake Diversion (Zone 1A).

Photo f. Santa Rosa Creek Diversion Structure.

Horizon WATER and ENVIRONMENT

Figure 5-4

In-Channel Structures

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Photo a. Brush Creek Reservoir dam inlet structure with ponded water and some surrounding vegetation along creek above structure (Zone 1A).

Photo b. Piner Creek Reservoir dam inlet structure surrounded by water (Zone 1A).

Figure 5-5

Example of Reservoir Dam Inlet Conditions

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Photo a. Cook Creek Sediment Basin (Zone 1A) before being cleared of sediment.

Photo b. Cook Creek Sediment Basin after being cleared of sediment.

Figure 5-6
Cook Creek Sediment Basin

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Photo a. East Washington Creek, looking downstream from Garfield Drive, before sediment removal project (Zone 2A).


Photo b. Maintenance crew clearing vegetation by hand.


Photo c. Excavator positioned on access road on the top of the stream bank. Long-arm reaching into channel.


Photo d. Removed sediment placed into dump truck by excavator.


Photo e. Box culvert sediment removal staged from road crossing above.


Photo f. East Washington Creek, looking upstream at Garfield Drive, after sediment removal project.

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Figure 5-7

Equipment, Access, and Staging for Sediment Removal at East Washington Creek

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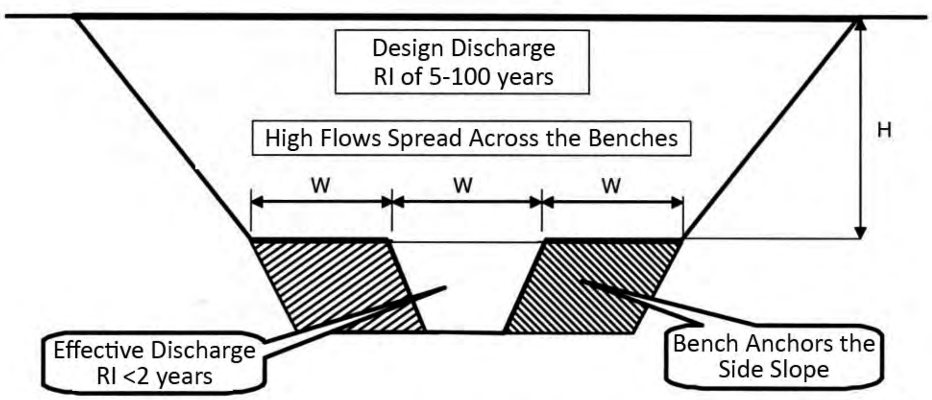
Meandering small main channel that has developed within the confines of an agricultural ditch in Ohio.



A two-stage ditch with a small main channel and recommended minimum width low grassed benches.

Source: Ward, A.D., and Trimble, A.S., 2004. Environmental Hydrology. Lewis Publishers, New York, pp. 475.

Figure 5-8

Two-Stage Low Flow Channel Conceptual Schematic

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Photo a. Copeland Creek (Reach 3) from Seed Farm (before sediment removal activities in March 2018)

Photo b. Copeland Creek (Reach 3) from Seed Farm (after sediment removal activities in November 2018)

Photo c. Laguna Creek (Reach 3) looking downstream from Redwood Drive before sediment removal activities (March 2019).

Photo d. Laguna Creek (Reach 3) looking downstream from Redwood Drive after sediment removal activities (July 2019)

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Figure 5-9

Examples of Low-Flow Channels That Require Sediment Removal

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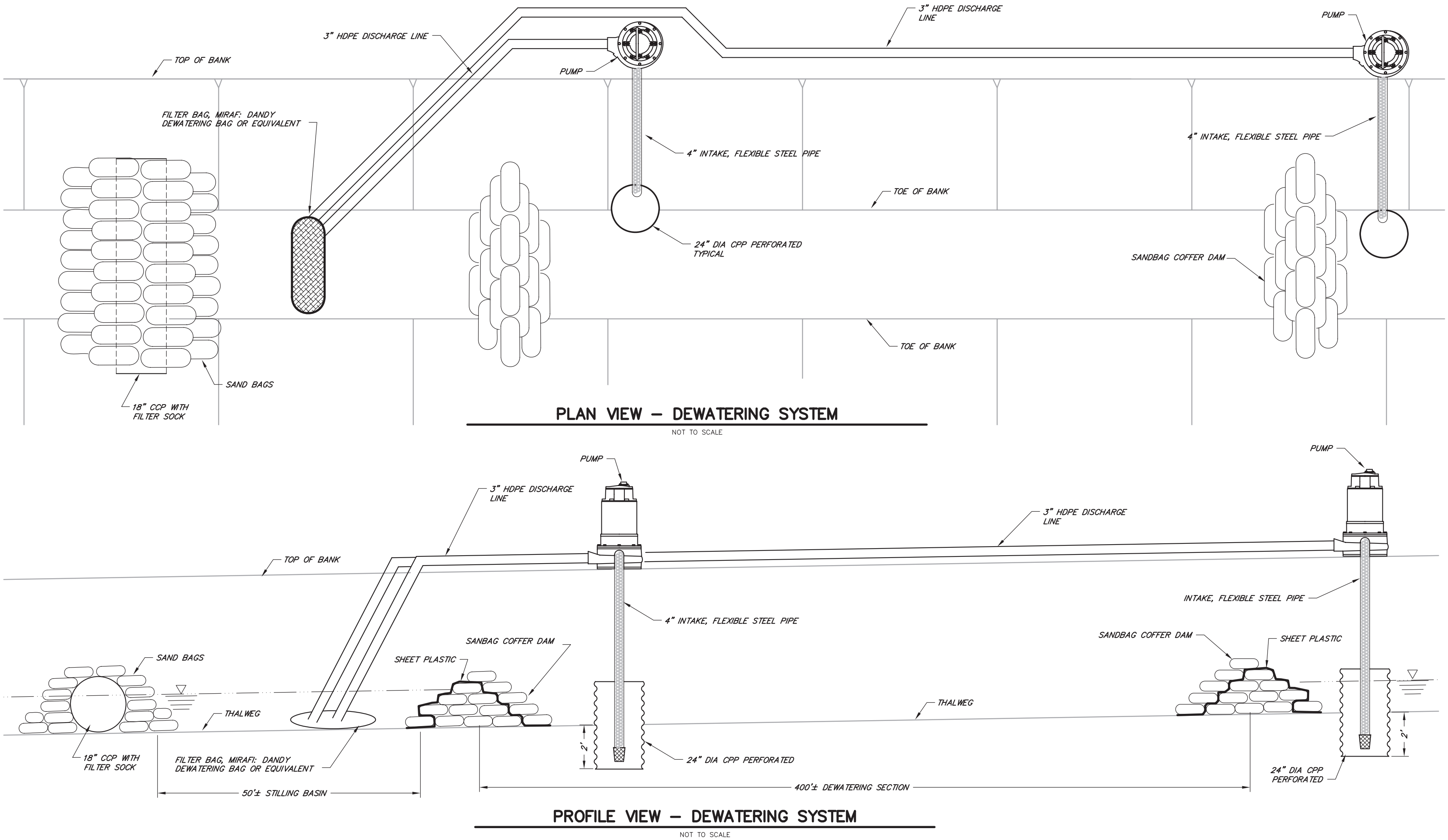

Source: Sonoma County Water Agency, 2007.

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Figure 5-10
Dewatering Plan Using Coffer Dams and Pumping

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Photo a. Dewatering at Hinebaugh Creek sediment removal project (August 2008), intake screen and bypass hose seen in near ground, earthen berm damming flow seen just downstream of bypass hose, long-reach excavator shown in distance conducting sediment removal work from top-of-bank.

Photo b. Dewatering at Hinebaugh Creek sediment removal project (August 2008), upstream of dewatering reach shown in photo (a), intake screen, pump, and bypass hose shown in foreground.

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Chapter 6
BANK STABILIZATION

6.1 Bank Stabilization Approach & Goals

6.1.1 Framing Considerations

The following considerations frame the context and need for bank stabilization activities.

- **Streambank failure is a natural occurrence**. Stream channels are dynamic environments whereby existing stream banks fail and collapse and new banks are formed through erosional and depositional processes. However, while bank failure happens quickly, stream bank formation takes a long time.
- **Engineered channels limit a stream's ability to migrate.** Under natural conditions, a stream's active channel or channels migrate laterally across the floodplain through a process of erosion and bank failure, through erosional avulsion and overtopping, or some combination of the two. Human intervention has historically attempted to control and constrain the sometimes erratic and unpredictable nature of streams. These attempts have been largely effective, but streams will attempt to continue to change their form, trying to overtop their banks and move across the floodplain. As described in Chapter 3, the engineered channels of the program area generally represent constrained systems that have replaced natural streams that would have meandered and migrated across their floodplains.
- **Urban environment places further constraints on engineered stream system.** Urban flood control channels are also constrained by surrounding factors including their narrow alignments, inability to deposit overbank sediment on to a floodplain, altered hydrology including flashy runoff responses to moderate rainfall events due to urban impervious land cover, dry season flows from irrigation and other sources which often support marsh vegetation which historically would have been absent, use of urban channels as recreational corridors, and the need to address fire and other public safety concerns. Where these factors are present, they further constrain the ability to establish natural type streambanks.
- **Destabilized banks may restabilize naturally over time, but this is generally not feasible in urbanized areas.** The natural geomorphic recovery of eroded banks to reconstituted banks can occur through natural processes of vegetation recruitment and in-filling of sediment, but this can take several decades to occur (Wolman and Gerson 1978). The flood protection, land use, infrastructure, and water quality concerns in the program area require more immediate corrective actions on failing streambanks. If bank failures occur in areas with homes, roads, or other infrastructure adjacent to the channel, this presents a risk. In addition, eroding sediment from failing banks leads to increased sediment loading downstream. For natural resources like the Laguna de Santa Rosa, upstream bank stabilization actions help reduce sediment loading in the Laguna.

- **Equilibrium can be restored or adjusted through intervention.** Under natural conditions, a stream's invert elevation (thalweg), gradient, and shape self-adjust in balance with discharge and sediment loading. This balance is dynamic, and to the extent that it is altered by human activities (including land uses in upper watershed and floodplain areas), intervention may be needed to restore balance or guide a stream's response to disturbance to preserve infrastructure.
- **Sonoma County channel streambanks are mostly earthen.** Most of the streambanks in the program area are earthen and not hardened. This is a different condition than more urban regions where flood control channels are typically made of hardened materials such as concrete or rock rip-rap. While several locations in the program area do have rip-rap banks or concrete, these typically occur at crossings or other structures. The presence of mostly earthen banks provides the Stream Maintenance Program (SMP) with greater management and resource enhancement flexibility; though it does also increase the potential for bank instability, slumping, or erosion.

6.1.2 Bank Stabilization Goals

Consistent with the management approach described in the maintenance principles of Chapter 4 above, the first step in bank stabilization projects is to identify the cause or causes of instability in the affected reach, and implement a solution that addresses the underlying cause of instability. In general, bank protection is conducted to achieve one or more of the following goals.

- Increase channel and/or bank stability.
- Decrease need for repeated maintenance.
- Reduce loading of eroded sediment into the channel and to downstream reaches; reduce the need for sediment management.
- Improve streambank area for vegetation development, facilitating increased habitat value.

Note that because improved bank stability reduces sediment input into the channel and supports development of mature riparian vegetation, bank stabilization can be used as a coordinated treatment with sediment and vegetation activities. In this way, bank stabilization activities can provide several benefits to the overall health and function of the channel.

6.2 Bank Stabilization at Engineered Channels

Bank stabilization involves the repair and stabilization of eroded or eroding stream or reservoir banks. Bank stabilization activities occur in engineered channels and other facilities, including culvert outlets in streams and the banks around reservoirs. Bank stabilization activities are generally conducted from June 15th to October 31st when streams are at their driest. In years that are dry, work may begin earlier than June 15th and extend past October 31st (usually not longer than an extra two weeks on either end), provided that Sonoma County Water Agency (Sonoma Water) has received permission from the appropriate regulating agencies. Based on past activities, bank stabilization projects in the SMP program area typically require two to four days to complete. The following sections include a description of bank stabilization activities in engineered channels and bank stabilization at other facilities.

Similar to the sediment removal activities described in Chapter 5, the number of new bank stabilization projects undertaken in a given year depends on weather and hydrologic conditions during recent years. A higher number of bank stabilization projects are likely to occur in wet years when banks shear or slump due to bank soil saturation, high soil pore water pressure, and high stream velocities. Another key factor influencing bank stability is rodent activity and the presence of burrows within the bank that can reduce bank integrity. Following wet years such as 2005-2006, as many as 30 bank stabilization projects were conducted. Following the drier winters of 2007 and 2008 only three bank stabilization projects were conducted per year. In an average year approximately 1-2 bank stabilization projects may be identified and implemented.

The bank stabilization designs and implementation activities described below draw upon a palette of bioengineering techniques addressing slope stability. These approaches include using engineered back filled soils, erosion control fabric, and planting of native riparian trees at the top-of-bank and the toe-of-slope to provide additional bank stability and increased canopy in the channel. As available, sediment used in bank stabilization projects are taken from stockpiled sediment collected during sediment removal projects (see Chapter 9, *Sediment Disposal and Reuse,* for additional details). Where soil compaction, erosion control fabrics, and revegetation are not adequate in providing a stable slope on their own, other bioengineered solutions would be prioritized over the use of hardscape installations.

Use of hardscape is discouraged in the SMP. Hardscape is only be used in cases where other alternatives would not result in a sufficiently stabilized slope. A typical condition where a hardscape solution may be expected to be used is to stabilize an emerging culvert outlet to prevent reoccurring erosion. In such cases, rock is used only beneath and below the culvert outfall, as well as on the sides to ensure stability of the culvert. Rock sizes are typically 1 foot in diameter or less (sized accordingly for culvert size). If riprap must be used for other bank slope stabilization purposes, it consists of rock typically between 1-2 feet in diameter. During recent years, use of rock or other hardscape bank stabilization materials has been significantly reduced at Sonoma Water in favor of more integrated bioengineering approaches.

The specific design of a bank stabilization project depends on site-specific conditions such as: (1) the type of bank failure (sheered slope, undercut bank, rotational slump, culvert failure, etc.); (2) hydraulic conditions (bank height, angle, shear stress, etc.); (3) geomorphic setting (such as the inside or outside of a stream bend); and (4) the characteristics of the channel adjacent to the site. These site-specific conditions are considered when selecting treatments.

Chapter 12 provides more detailed information on program implementation including the site reconnaissance, evaluation, prioritization, and design steps that would be considered in developing a suitable bank stabilization design.

Where replanting vegetation is possible, bank stabilization sites are revegetated per the vegetation management templates (Figures 7-6 and 7-7). Where possible native riparian trees are included in the revegetation plan, spaced appropriately based on the tree species and the desired canopy extent. Trees are selected from the plant palettes provided in Table 11-1 and Figures 11-2 and 11-3, and follow planting standards indicated in the vegetation management templates. Tree selection considers site location, how appropriate the site is for the tree type, and the potential for the tree to destabilize the bank slope in the future. Arroyo willow (*Salix lasiolepis*), which is common to these systems, is not planted due to its wide shrub-like form and the increases in channel roughness this species causes. Native grasses are seeded or planted in areas disturbed by bank stabilization activities, including between existing or newly-planted trees.

When repairs are made, banks are recontoured to match the adjacent bank slope (i.e., returned to pre-failure condition). Most Program engineered channels have bank slopes of 2:1 or steeper. If site conditions allow, the bank slope may be stabilized at a less steep slope (to reduce the likelihood of renewed failure), but only if there is available space to grade the banks back and the work is conducted within the original channel design. Stabilized banks are flush with the existing bank slope, and only limited new material may protrude from the bank.

Individual bank stabilization projects shall be confined to an area not to exceed 20 feet beyond the failed or failing bank or structure. If a riparian zone is present adjacent to the bank failure site, care is taken to disturb the least amount of vegetation, including mature trees, as necessary. Bank failure sites may contain exposed soils or, by the time of bank repair, be covered by vegetation such as grasses or blackberries. Overgrown vegetation is only removed to the extent necessary to repair the bank.

Most often for the reaches in the program area, biotechnical stabilization is preferable to hardscape engineering approaches because it offers substantial environmental advantages in terms of improved habitat value for fish and wildlife, as well as improved aesthetics. With this in mind, bank stabilization designs, including those that include hardscape, include a revegetation component. Use of rock in specific capacities, such as at the toe of slope, in combination with other biotechnical measures and plantings on the higher bank can be a very effective approach for stabilizing a bank. The selection of bank stabilization method also considers the stability thresholds for bank stabilization materials, per waste discharge requirements (WDR) and Water Quality Certification Provision 24 (Order No. R2-2016-0020).

Figure 6-1 through Figure 6-4 illustrate standard bank stabilization treatment designs that have been developed for SMP channels. These designs use bioengineering techniques including engineered back-filled soils, elevated soil lifts, and erosion control fabric. These approaches also emphasize the planting of native riparian trees at the top-of-bank and the toe-of-slope and understory shrubs in the mid slope to provide additional bank stability and increase the riparian canopy of the channel. Where soil compaction, erosion control fabrics, and revegetation are not adequate in providing a stable slope on their own, other bioengineered solutions would be prioritized over the use of hardscape installations.

Note that in some cases, bank stabilization may not offer the most effective (or the most cost-effective) solution over the long term. Where there is extensive bank and channel failure or where reliable bank protection cannot be provided, or where heavily engineered solutions would be the only option for reliable armoring, it may be preferable to remove or re-contour the channel bed or to realign a short segment of the channel. Such channel reshaping or grading approaches may provide a more effective, longer-term solution that supports overall stream health and function compared to more traditional bank stabilization approaches. Activities requiring a broad redesign or reshaping of the channel would not be considered routine maintenance and are beyond the scope of the SMP.

Equipment used for bank stabilization activities may include excavators, bulldozers, front-end loaders, and 10- and 20-cubic-yard dump trucks. Staging occurs on adjacent access roads. Soil and rip-rap is staged in areas that have been previously disturbed (i.e., service road, turn-outs, etc).

BMPs and avoidance and minimization measures are applied based on the equipment used, site conditions, and access to the site. If repair activities affect the active channel, the work area is isolated from flowing stream segments using silt fences, wattles, and/or cofferdams. Additional BMPs are identified in Table 10-1 and applied, as appropriate, to all bank stabilization projects.

6.3 Bank Stabilization at Other Facilities

Most in-channel structures are constructed of concrete and typically do not require bank stabilization, unless the structure were to fail. If such concrete structures fail or collapse, they would be replaced in-kind. Due to the nature of sediment basins, any bank failures that occur would eventually be covered up by sediment trapped in the basin. When the basin is cleared of sediment, the banks would be recontoured to their original as-built design. Bank stabilization in reservoirs may be required infrequently. The design, construction, and maintenance of dam and levee features associated with the reservoirs involves dam safety engineering protocols and is beyond the scope of this SMP. However, any bank stabilization activities required on the banks around the reservoir would utilize the same techniques and requirements as described in Section 6.2 above.

6.4 Bank Stabilization Triggers

As described above, channel and bank erosion are natural processes, and SMP activities focus on sites where the erosion directly threatens property or infrastructure, or can lead to larger bank failures that further reduce conveyance capacity or flood protection for adjacent properties.

Bank stabilization is designed and implemented in consideration of the overall function of the reach and subwatershed context. The use of hardscape is restricted as much as possible, and the use of extensive hardscape is only considered as a last resort. If biotechnical engineering can effectively stabilize a bank, this is the preferred approach. Hardscape is only used where no effective alternative is feasible due to the magnitude of the hydraulic forces involved, the need to protect infrastructure, or an adjacent land use constraint.

In general, bank stabilization is likely to be needed in reaches where one or more of the following conditions apply:

- BS-1 Bank failure has occurred, and the bank must be repaired to preserve riparian vegetation, prevent additional sediment inputs and/or to protect channel capacity and freeboard requirements.
- BS-2 Chronic bank erosion is occurring, leading to excess sediment loading and/or damage to riparian vegetation.
- BS-3 Bank erosion or failure poses a threat to existing infrastructure or adjacent land uses.

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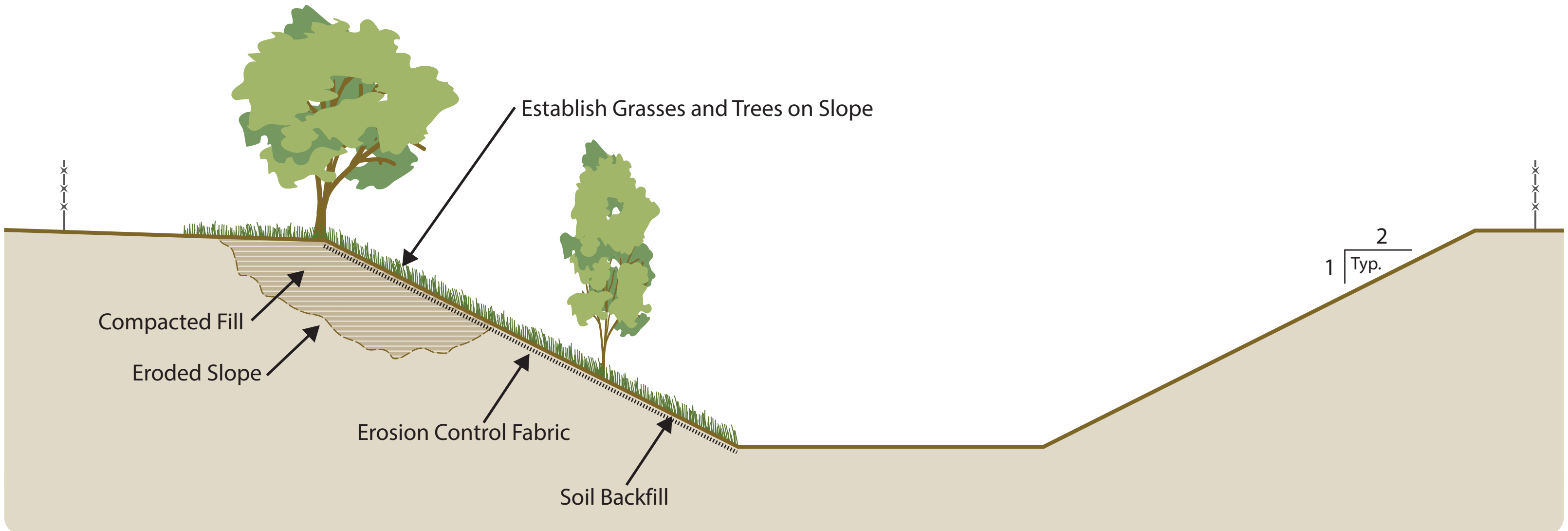

Photo a. Bank failure on Peterson Creek (Zone 1A).

Photo b. Same site as Photos (a) after bank repair using no rock-rip rap.

Bank Stabilization sites will be replanted per appropriate vegetation target conditions (see Figures 7-5 and 7-6) and based on site conditions.

Figure 6-1

Bank Stabilization Treatment Design — Compacted Soil

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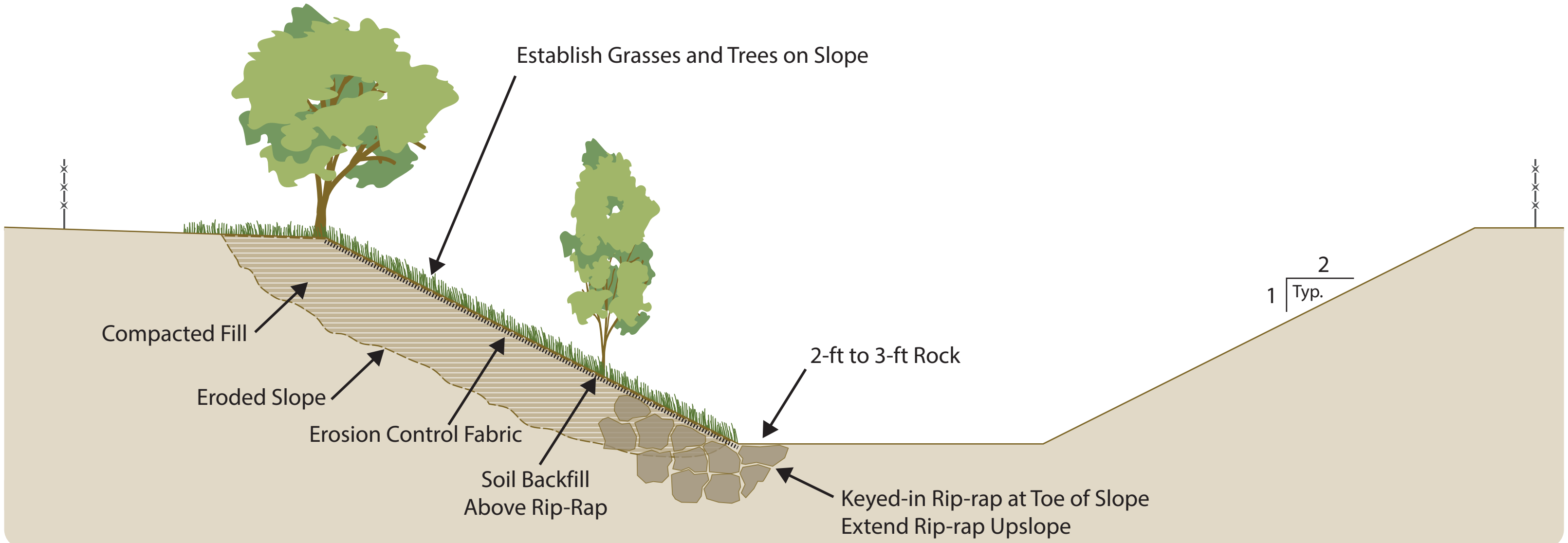

Photo a. Bank failure on Gossage Creek (Zone 1A).

Photo b. Same site as Photo (a) after bank repair, prior to revegetation.

Bank Stabilization sites will be replanted per appropriate vegetation target conditions (see Figures 7-5 and 7-6) and based on site conditions.

Figure 6-2
Bank Stabilization Treatment Design — Rip-rap at Toe of Slope

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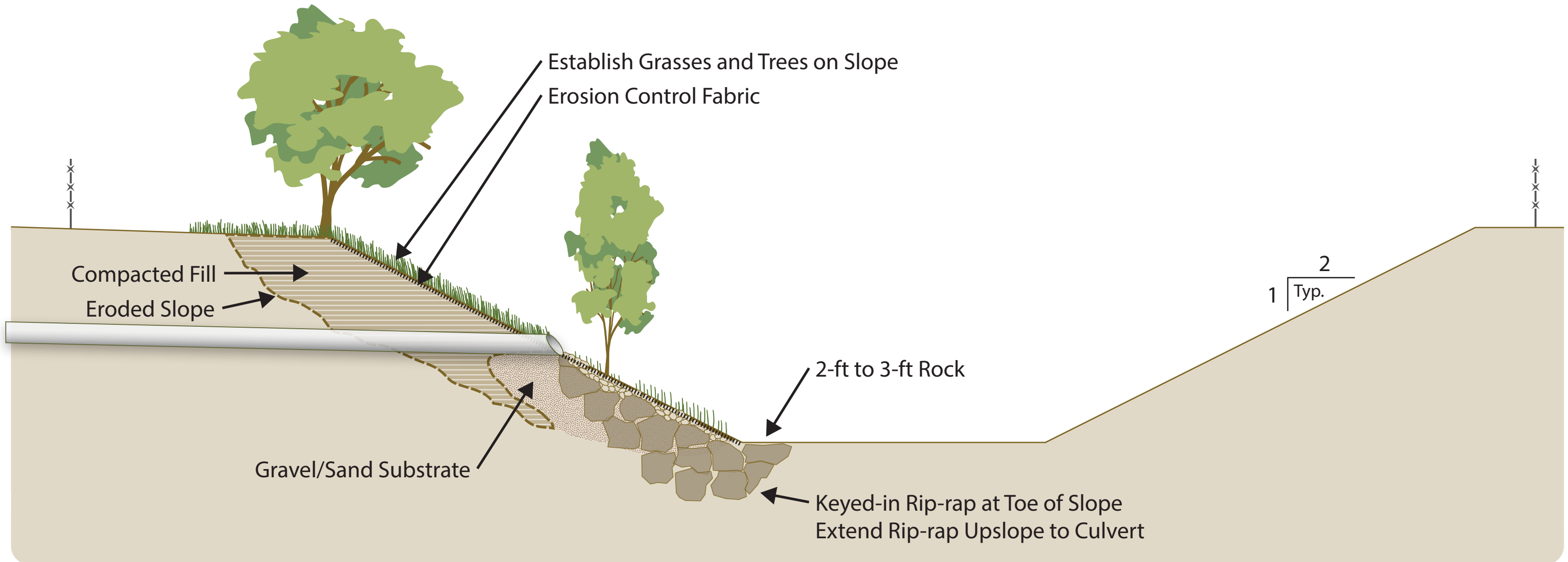

Photo a. Culvert failure on Piner Creek (Zone 1A).

Photo b. Same site as Photos (a) after bank repair using minimum necessary rock rip-rap.

Bank Stabilization sites will be replanted per appropriate vegetation target conditions (see Figures 7-5 and 7-6) and based on site conditions.

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Figure 6-3

Bank Stabilization Treatment Design — Culvert Repair

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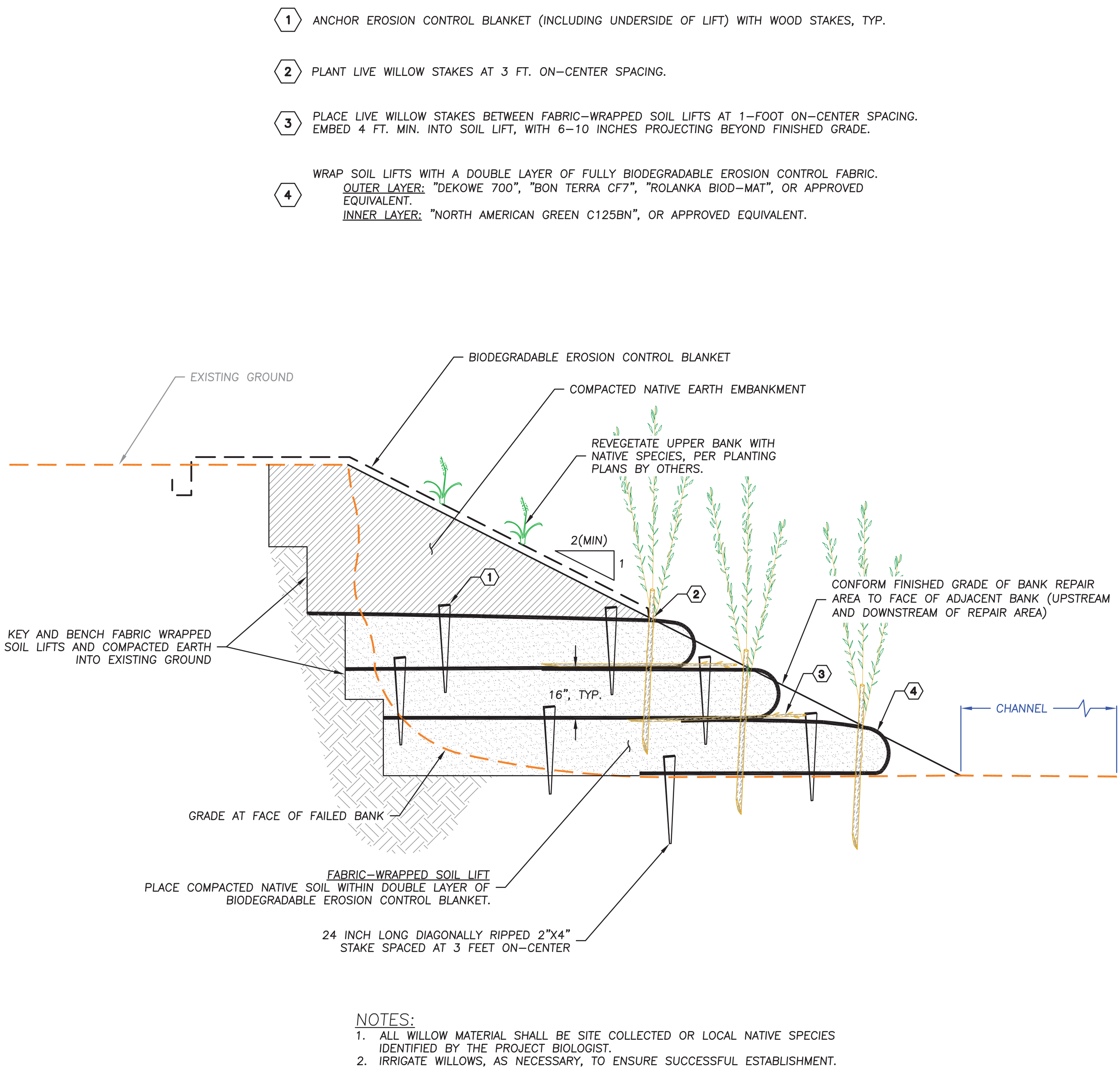

Bank Stabilization sites will be replanted per appropriate vegetation target conditions (see Figures 7-5 and 7-6) and based on site conditions.

Source: Waterways Consulting Inc. 2019

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Figure 6-4
Biotechnical Bank Stabilization Treatment Design – Elevated Soil Lift

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Chapter 7
VEGETATION MANAGEMENT

"Vegetation Management in Upper Bank Zone" of Chapter 8, *Other Maintenance Activities*, describes maintenance activities in the upper bank zone, defined as the area from the access road down to the mid-point of the channel side bank. Upper bank trees are generally upland species, are adapted to more xeric conditions than in-stream species, and are generally not in contact with flood flows.

7.1 Vegetation Management Approach & Goals

This section summarizes the planning steps taken prior to conducting vegetation management work to ensure that the work is effective and also avoids and minimizes potential environmental impacts to the extent possible. In this way, minimization and avoidance measures are built into the overall approach.

7.1.1 Framing Principles for Vegetation Management

Eight principles frame the context and approach for vegetation management activities.

(1) Riparian vegetation provides physical stabilization for streambank and terrace surfaces through the growth of root structure. In addition to the structural benefits provided by roots, vegetation also contributes to streambank stability by helping remove excess soil moisture, which can contribute to slumping and other types of bank failure.

(2) Vegetation along flood control channels is managed to accommodate natural recruitment. Lower bank and mid/upper bank vegetation zones require different but complementary management approaches. Vegetation in the lower bank zone establishes and matures more rapidly than the slower growing species that establish, or are planted, along the higher mid- and upper bank zones. Lower bank species can also typically be shorter lived, more exposed to stream changing flood events, and more likely to vary in overall cover and density than upper bank species. Along many of Sonoma Water's engineered channels, active stream processes as well as on-going vegetation management keep the lower zone in an early to middle seral stage (less than 10-20 years old). Woody species growing higher on the bank represent the longer term, more permanent makeup of the riparian corridor and have less change in terms of cover, density and species makeup.

(3) Riparian vegetation benefits instream habitat by shading the channel, drawing subsurface water up, lowering water temperatures, limiting in-channel emergent vegetation, and providing large woody debris (LWD). Cooler water temperatures are preferable for cold water species, such as salmonids. Shading of the channel can also hinder the growth of instream emergent vegetation, in turn reducing the need for future instream vegetation management. Riparian vegetation pulls subsurface moisture up via the stream, in some cases, keeping water in the channel. It also provides cover, forage, and breeding habitat for a variety of birds and other wildlife that use the streambank area.

(4) **Invasive species may limit the success of native, slower-growing vegetation and can degrade habitat quality over time.** Because many invasive species (both native and non-native) grow quickly, they often out-compete non-invasive native species. This may occur to the point that entire channels are filled with fast-growing, invasive vegetation further degrading habitat quality.

(5) **Excessive vegetation growth can decrease a channel's flood conveyance capacity.** This occurs in three ways. First, excess growth of instream and bank vegetation can obstruct the channel by reducing its cross section and conveyance capacity of the floodway as a whole. Second, vegetation increases bed and bank friction or hydraulic roughness, resulting in energy losses, turbulence, decreased capacity, and leads to an increased threat of flooding. Third, increases in hydraulic roughness can encourage further sediment deposition as flow velocities slow down. This effect is illustrated in photos in **Figure 7-1** through **Figure 7-4**.

(6) **Establishing adequate flood protection may require aggressive vegetation management.** In areas where creeks are closely bordered by developed land uses or agriculture, the increased risk of flooding created by excess vegetation growth may be unacceptable, and it is important to identify the threshold at which vegetation must be managed in each reach to provide adequate flood protection and ensure the safety of the community.

(7) **Vegetation management is necessary for other public safety concerns.** Vegetation management is necessary along channels to reduce the fire risk, improve visibility, reduce encampments, and improve overall public safety and awareness.

(8) **Vegetation management is conducted consistent with Sonoma Water's Integrated Pest Management (IPM) Plan**. Sonoma Water uses a variety of control methods including pruning, mowing, grazing and herbicide application, to manage problematic vegetation. Consistent with the IPM Plan, herbicides are only applied when necessary and at targeted locations.

7.1.2 Vegetation Management Goals

Consistent with the framing principles above, the primary goals of vegetation management are to:

- ensure that adequate flood conveyance capacity is maintained;
- develop a mature and complex riparian canopy and corridor that offers habitat, shading of the creek, and aesthetic value while minimizing future understory maintenance requirements;

- maintain channel for public safety purposes including reducing fire fuel, keeping sightlines open, removing hazardous trees, and clearing dense vegetation in the upper bank to improve visibility and discourage areas prone to homelessness and trash;
- encourage native vegetation and discourage nonnative vegetation, particularly invasive species;
- control emergent vegetation in the channel;
- minimize flow obstructions; and
- improve bank stability.

In most channels, meeting these goals requires a balance between habitat and flood protection needs. **Figure 4-2** illustrates targets for incremental vegetation and habitat improvement. Although it is possible to identify an ideal vegetation configuration, it may not be possible to achieve this condition in all Sonoma Water maintained channel reaches. The vegetation maintenance target for each reach is informed by an understanding of what potential conditions can be achieved. Vegetation should be managed to bring the reach as close as possible to its target condition. Over the longer term, management approaches will actively explore ways of improving the target condition of each reach, and to keep improving along the vegetation and habitat spectrum.

Table 7-1 presents summary information for riparian canopy cover conditions for the engineered flood control channels in the program area. Since implementing the SMP, the degree of canopy cover over the engineered flood control channels has increased significantly under the vegetation planting program and selective pruning techniques. At the onset of the SMP, most of the engineered channels supported less than 25% canopy cover. As of 2013, a majority of engineered channels supported 51-75% canopy cover. As an example, refer to **Figure 7-5** for images of Forestview Creek in 2008 and 2019. As shown in this figure, canopy conditions have substantially increased throughout this particular reach. Canopy cover is expected to continue increasing under SMP operations and as newly planted trees mature.

Table 7-1. 2013 SMP Canopy Cover Conditions: Engineered Channels in Zones 1A, 2A, and 3A

% Canopy Cover	Number of Reaches	Length (mi)
up to 25%	38	33.20
26-50%	68	48.03
51-75%	78	59.19
>75%	38	16.44
Totals	***222***	***156.86***

Vegetation is managed in tandem with sediment. The two primary goals of the SMP are to provide sufficient hydraulic capacity to reduce flood risk through urban areas and to improve riparian and instream habitat for fish, wildlife, and plant life. Developing a riparian canopy supports these goals by improving water quality and reducing dense vegetation such as cattails *(Typha* spp.), Himalayan blackberry *(Rubus discolor),* and arroyo willow *(Salix lasiolepis)* that tend to trap more sediment in the channel.

Once the appropriate tree alignment and orientation has been accomplished, the majority of the vegetation management work is removing new sprouting "suckers," removing hydraulic blockages (downed trees or debris accumulations in the middle of the channel), and thinning and limbing existing trees, not the removal of entire trees on the lower toe and banks.

To inform the vegetation management approach, Sonoma Water evaluated and classified the different kinds of vegetation commonly managed along engineered channels into native and non-native functional groups or “classes”. These classes of vegetation and how they are managed under the SMP are described below in Section 7.2, “Prioritization and Timing of Vegetation Management Actions.”

7.1.3 Vegetation Management Target Conditions

Figure 7-6 and **Figure 7-7** illustrate vegetation target conditions at lower bank and toe-of-bank locations. These figures serve as templates to help guide vegetation management crews for both vegetation clearing and planting work. Figure 8-1 in Chapter 8 presents a similar template for vegetation target conditions at upper bank locations.

In Figure 7-6 and Figure 7-7 green indicates vegetation to be maintained for the longer term, while orange indicates vegetation to be thinned or removed. Upper and side banks are intended to be largely bare (besides template trees) and grass lined. Below each scenario is a cross section that illustrates target conditions. These figures represent the long-term goals for mature riparian canopy at the toe; upland trees along the upper bank; and understory species below top-of-bank, according to channel size and allowable roughness.

7.1.4 Managing Vegetation Through Successional Stages

The illustrated planting standards of Figure 7-6 and Figure 7-7 identify initial planting levels but also takes succession into account by building in appropriate target densities.

For the instream channel area, target densities are developed and maintained based on the channel roughness created by the different tree arrangements and channel forms. The arrangement of the trees is dictated by channel size and capacity. In general, woody species create the greatest roughness in the channel, so instream trees are the primary species targeted to be managed at sustainable densities. The SMP approach focuses on moving the successional stage of riparian vegetation from an early seral stage (Figure 7-6) to a climax stage (Figure 7-7). These stages vary between reaches and different creeks but can be differentiated by age and size of the vegetation.

Vegetation management following sediment removal may return a channel back into an early successional stage. Early seral vegetation is generally composed of numerous young willows, at a relatively high density. In the early stages, general habitat function (wildlife habitat, geomorphic interactions, leaf input, shading, etc.) is provided by numerous small saplings. As these saplings grow, they naturally thin to a lesser, more sustainable, number (based on available resources). Basically, early on, many small plants are providing similar habitat value to fewer large plants. But as vegetation grows, gets thinned, and appropriate locations for retention are established, not all the initially installed plants can be retained because of "roughness" considerations. During vegetation management, the central tendency is to move vegetation along the flood channels from an early stage to a later stage with a denser canopy cover over the channel. This means that some plants that were initially installed will require removal to provide areas for early seral habitat in many cases re-sprouting and closely over-hanging the water through the fall.

Sonoma Water manages restoration planting and vegetation management as a successional process for overall long-term ecologic improvement. In channels without mature vegetation, planting and natural recruitment initially favor more vegetation than is ultimately needed in the channel. Over time, vegetation is thinned toward target densities while increasing overall leaf area canopy cover. The long-term goal is to achieve the target climax conditions for vegetation as shown in Figure 7-7.

Recommended plant species to be used according to channel geomorphic form are shown in Table 11-1. All listed plants are native riparian species found in Sonoma County waterways. Not all species are equally appropriate for all sites; the planting list for any given site should be developed in consideration of the current and known historic native flora of the site and the local subwatershed area.

The overall vegetation management approach is built on a successional process, recognizing that there is a higher number of initial trees than what can be accommodated by the channel when the vegetation matures. In general, climax spacing for trees varies from 30- to 50-feet on-center depending on the channel, its capacity, morphology, needed access points, utilities and infrastructure. For restoration, initial spacing varies between 15 and 25 feet. These target densities for permanent trees can be used to measure success for planting projects over time.

Channels in Zone 2A (Petaluma River Watershed) are being evaluated for roughness under a range of flow conditions as part of the *Channel Objectives Work Plan* required under Waste Discharge Requirement (WDR) Order No. R2-2016-0020. The goal of the workplan study is to evaluate roughness values for the standard vegetation arrangements as shown in the vegetation management targets (Figure 7-6 and Figure 7-7) at a range of successional stages, and a range of clearance approaches. Sonoma Water is undertaking hydraulic analysis of the roughness conditions created by the standard tree arrangements. This on-going study relating vegetation conditions and hydraulic roughness are used by Sonoma Water to guide vegetation management approaches in the future, with the goal of maintaining instream vegetation, while not increasing the flood risk.

7.2 Prioritization and Timing of Vegetation Management Actions

7.2.1 Vegetation Classes to Guide Management Actions

Three primary vegetation classes are identified in the SMP to help attain program goals, guide management activities, and provide appropriate mitigation. These three vegetation classes include:

- **Class 1:** *Native Riparian Vegetation:* Class 1 native vegetation (except for those species listed under Class 2, below) shall be retained wherever possible, and pruned or thinned where necessary so as to foster the development of a riparian canopy. Examples of native riparian vegetation include: white alder (*Alnus rhombifolia*), box elder (*Acer negundo*), big leaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), red willow (*Salix laevigata*), Pacific willow (*Salix lucida lasiandra*), Fremont's poplar (*Populus fremontii*), and oaks (*Quercus* spp.) as appropriate. Additionally, there are a number of native understory riparian shrubs suitable for larger flood control channels (depending on location) including: American dogwood (*Cornus sericea*), western spicebush (*Calycanthus occidentalis*), elderberry (*Sambucus* spp.), snowberry (*Symphoricarpos* spp.), hazelnut (*Corylus cornuta californica*), and a number of others. The removal of such native vegetation is avoided to the greatest extent possible.
- **Class 2:** *Problematic In-Channel Vegetation:* Class 2 vegetation is identified as particularly problematic for flood management purposes. As indicated in Table 10-1, these species inhibit and prevent the establishment of a native riparian canopy and limit the beneficial uses that can be achieved in the riparian zone. Table 11-5 lists the mechanism by which invasive species displace native species and their growth tolerances. This class of vegetation includes the following species:

    1. Cattails (*Typha* sp.)
    2. Himalaya blackberry (*Rubus discolor*)
    3. Arroyo willow (*Salix lasiolepis*)
    4. Weeping willow (Salix babylonica)
    5. Sandbar willow (*Salix exigua*)
    6. Holly oak (*Quercus ilex*)
    7. European olive (*Olea europaea*)
    8. Giant reed (*Arundo donax*)
    9. Pampas grass (Cotaderia selloana, and C. jubata)
    10. Indian bean (Catalpa bignoniodes)
    11. Privet (*Ligustrum* sp.)
    12. English and Algerian ivy (*Hedera helix*, *H. canariensis*)
    13. Periwinkle (*Vinca major*.)
    14. Red clusterberry (*Contoneaster* sp.)
    15. Brooms (*Spartium* and *Genista* spp.)
    16. Sweet fennel (Foeniculum vulgare)
    17. Harding grass (Phalaris aquatica)
    18. Water primrose (Ludwigia peploides montevidensis)
    19. Eucalyptus (*Eucalyptus* ssp.)

20. Tree of heaven (Ailanthus altissima)
21. Acacia (*Acacia* ssp.)
22. White poplar (*Populus alba*)
23. Lombardy poplar (Populous nigra 'Italicia')
24. Tamarisk (*Tamarix* spp.)
25. Rattlebox (Sesbania punicea)

- **Class 3:** *Other Non-Native Vegetation:* Class 3 vegetation consists of non-native species that are not listed under Class 2, above. Examples of Class 3 vegetation include various landscaping species that are establishing in the flood control channels but are recognized as providing beneficial uses similar to their native counterparts. These species include: a variety of ash species (Modesto ash [*Fraxinus velutina*], green ash [*F. pennsylvanica*], raywood ash [*F. oxycarpa*], and evergreen ash [*F. uhdei*]), London plane tree (*Platanus acerifolia*), and Carolina poplar (*Populus canadensis*).

7.2.2 Vegetation Assessment and Work Prioritization Process

Understanding existing vegetation conditions in the flood control channels for which Sonoma Water has maintenance responsibilities provides the basis for maintenance prioritization and decision making. Sonoma Water assesses vegetation conditions in the program flood control channels annually in the spring season to evaluate vegetation management needs across the Program Area. The following questions guide the assessment process. This information is recorded in the data forms for the annual vegetation assessment.

A. Understand channel hydrologic and geomorphic context and setting:

(1) What geomorphic processes are dominant in the channel? Is the channel generally erosional or depositional? In general, more roughness (vegetation) is allowed in erosional reaches than depositional reaches.

(2) What is the available conveyance capacity? Consider field evidence as well as hydraulic/modeling studies (if available). Evaluate elevation of debris drift lines, deposited sediment, and consider elevation and risk of bankfull flows.

(3) Visually estimate existing channel roughness, vegetation growth conditions, and how much instream vegetation has grown since the previous year based on annual inspection records.

B. Assess specific in-channel vegetation conditions:

(1) Identify the in-channel and bank vegetation types.

(2) Evaluate the relative composition and how much of the channel vegetation is native (and riparian suitable) versus non-native and problematic invasive species.

(3) Assess channel reach for evidence of vegetation obstructing flows, accumulating other debris, deflecting flows and causing bank scouring, or directing flows toward other infrastructure, toward banks, or causing other flow related issues such as ponding or

bed scour. Excessive bank scour is considered when more than 1 ft. of bank is actively eroded in the lateral dimension. Consider the ecology and functions of the existing channel vegetation. Is the existing vegetation providing nesting, cover, or other supportive functions for specific species or their habitats? Is the existing vegetation providing root wads/mass for overhanging banks? Is the existing vegetation providing significant shading? Is the existing vegetation weedy and capable of suppressing native species establishment?

i. Significant shading is considered when a tree provides important shade functions (e.g., shading over pools and is likely the only tree in the area providing shade).

ii. Consider the overall shade provided by existing vegetation – and if that shade is provided by the vegetation along the entire bank slope, just the upper bank, or just the lower bank.

iii. Consider what would be the anticipated cover and growth habitat when the existing vegetation continues to mature. How would this trajectory affect the overall riparian ecology (beneficial or detrimental)?

(4) Compare high water mark to summer water level. Generally, instream vegetation raises water surface elevations in flood control channels more significantly at lower and median flows than high flows. Evaluate tree spacing along the channel toe. Evaluate side bank and top of bank tree spacing. Compare existing tree arrangement with target vegetation conditions (Figure 7-6 and Figure 7-7). Evaluate if existing vegetation is triggering a need for removals or thinning. Preferentially retain streamside vegetation (toe trees) when a similar capacity gain is available by removing or thinning a tree on the side bank.

7.2.3 Work Timing

Routine vegetation pruning and removal on the lower bank and in the channel bed generally occurs from June 15 to October 31. If the channel is dry, and with notification and approval by the overseeing regulatory agencies, non-ground-disturbing vegetation thinning/pruning work may be conducted in the channel zone beyond the primary maintenance work window of June 15 to October 31. Non-ground disturbing vegetation work on the upper banks of stream channels may be conducted year-round. The general timing of vegetation management is summarized below:

- Routine in-stream vegetation thinning and removal in the lower bank zone (June 15 – October 15) with the possibility of extension per notification requirements described above;
- Tree planting, relocating, and/or transplanting (all year);
- Upper bank planting, pruning, and removal, access road and v-ditch clearing (all year);
- Nursery stock tree planting (October 15 to May 31)

- Mowing at access roads and dam faces (March 1 to August 31);
- Access road herbicide spraying (February 1 to April 30).

7.3 Vegetation Management Activities in Engineered Channels for the Lower Bank and Channel Bed Zone

7.3.1 General Approach

This section describes the techniques and procedures for conducting vegetation management, with a focus on the lower bank and channel bed zones. Section 8.1.2, "Upper Bank and Urban Forestry Vegetation Activities" describes activities in the upper bank zone. Vegetation management does not include any ground-disturbing activities except as described in specific cases below. Vegetation management actions (including on-site mitigation planting) are implemented to improve current site conditions towards the appropriate target. Vegetation removal or thinning necessary to achieve target conditions are phased over time. Mitigation for vegetation management activities is described in Chapter 11, *Program Mitigation.*

Vegetation management and removal activities are relatively consistent from year to year, though locations change. Years that experience flooding or strong winds may require additional work to clear downed trees or vegetation debris. Conversely, vegetation management needs following dry or drought years are generally reduced except where vegetation is largely supported by urban runoff. Some channels may require annual vegetation management while others do not. This largely depends on the type of vegetation in the channel, sun exposure, and amount of urban runoff. For example, channels characterized by cattails or willows may need annual pruning while channels with a mature riparian canopy generally require less maintenance to maintain flow capacity.

Vegetation management techniques include hand removal using small tools and hand-held equipment, mechanical removal using heavy equipment, and spot chemical control. Heavy equipment used for vegetation removal may include a flail mower attachment on an excavator or Bobcat® that is used to cut cattails or blackberries, or a backhoe or rubber-tracked excavator that is used for removing material from the channel.

Vegetation management activities vary depending on the type of facility involved. While the methods described here are the common practices of Sonoma Water, maintenance techniques may shift over time and by location depending on site constraints and new technologies.

The degree of vegetation management performed depends on local reach conditions, neighboring land uses, and existing channel conveyance capacity. Most vegetation management activities utilize a 3- to 12-person crew and 2 to 3 crews can be deployed on the same day.

Figure 7-8 presents a comparison of Santa Rosa Creek in 1997 and 2019 highlighting some of the dramatic improvements in channel vegetation through the SMP approach. **Figure 7-9** provides more details on the willow removal and alder pruning approach in Santa Rosa Creek. Figure 7-9 illustrates some general outcomes of vegetation management activities and is a useful example prior to discussing the more specific topics below.

The subsections below (7-10 through 7-14) describe specific vegetation management activities in engineered flood control channels. These subsections focus on vegetation management in the lower bank and channel zone.

7.3.2 Willow Thinning and Removal

Willows are perhaps the most common channel vegetation type throughout the Program Area. Willows generally grow from the lower bank slope (near or at the toe-of-slope) and can grow into and across the channel bed quickly, often within a single season. Sonoma Water generally conducts willow removal from June 15 to October 31.

Pruning and removal of arroyo willows is the major vegetation management activity conducted by Sonoma Water. Arroyo willows are an issue for Sonoma Water's flood control channels due to their rapid growth (over 1.5 inches in diameter per year and vertical growth up to 15 feet per year) and the bushy structure of the plant which is effective at slowing flows and trapping debris. White alder, big leaf maple, Fremont poplar, box elder, Oregon ash, red and Pacific willow species are better suited to flood control channels because they generally form a single main trunk that can be limbed up and pruned so as not to extensively block the channel cross section. The rapid growth, multi-stemmed base, and bushy nature of arroyo willow generally prevent this type of management approach, though in some cases (especially where arroyo willow is the dominant tree along a stretch of channel), these trees are being managed toward a more upright stature. In general, for arroyo willow pruning, forming an upright tree requires considerably more management effort since the form of the tree is not naturally upright and the attempt to make it upright is counter to arroyo willow's natural tendency. Species like red, yellow, and Pacific willow do not have the same growth forms as arroyo willows and are retained where they do not present issues for flows or roughness, or where possible, are transplanted when feasible.

Arroyo willows are removed where they are significantly impeding flows and reducing the channel conveyance capacity. If arroyo willows are not removed (in cases where the canopy is needed and channel capacity is not at risk), they are pruned to minimize their ability to catch debris and impede the flows. Red and yellow willows are generally retained, but are pruned to reduce the number of branches and trunks below the top of the channel banks. Again, the goal is to nurture growth of healthy native trees, so young red and Pacific willows are not pruned in a manner that would affect their health (i.e., young willows within the channel are not pruned down to one stalk).

Willow removal generally requires hand clearing using chainsaws, pole saws, pruners, and loppers (see **Figure 7-10**). Willow stumps may be hand treated with an herbicide such as Aqua Master® (formerly known as Rodeo®) to prevent future growth (see Section 7.7 for additional detail on herbicide application). Cut vegetation must then be removed from the channel. This is achieved using a variety of methods including hand removal (passing branches up the slope), attaching a line to the cut limbs and pulling them up the slope with the aid of an excavator arm, using an excavator reaching into the channel from top-of-bank, using a skid-steer with a grapple bucket, by angled pulls using a line and two vehicles, or using a winch on a truck or tractor.

In cases where arroyo willow root wads protrude from the channel bottom after limbs have been pruned, these are generally left in place but depending on the channel size and geometry, the root wad may require removal to reduce roughness on the channel bed. Removal of a root wad generally requires the use of heavy equipment such as an excavator. Arroyo willow removal may also be combined with sediment removal. In such cases, the channel is cleared of both sediment and arroyo willow roots using methods described in Section 5.2, "Sediment Management Activities," in order to increase channel capacity and to decrease the rate of return of arroyo willows. Any use of heavy equipment in the channel for vegetation management purposes follows and utilizes the avoidance measures and best management practices (BMPs) identified for sediment removal projects in Table 10-1.

7.3.3 Removal of Exotic Bushes

Non-native, invasive bushes (e.g., Class 2 species such as Himalayan blackberry, privet, brooms, red clusterberry, and ivy, Section 7.2.1 above), can be problematic in flood control channels and streams.

Blackberry and other non-native invasive bushes are commonly found in reaches with little to no riparian canopy. Blackberry is the most problematic of this class of species. This species generally grows from the bank slope, particularly near (or at) the toe-of-slope and can grow into and across the channel bed quickly, often within a single season (see Figure 7-2). Sonoma Water generally conducts in-channel blackberry removal from July 15 to October 31 (or later during dry years and under review and approval from the appropriate agencies as described above).

The preferred long-term control method is to establish a riparian canopy over the channel to increase shade and reduce proliferation. Problematic infestations are addressed by mechanical removal. The preferred method for mechanically removing exotic bushes is to cut and mulch in-place with a flail mower attachment operated by heavy equipment such as a skid-steer, tractor, Bobcat® or excavator. At blackberry bush removal sites, stalks are then raked together, picked up, and removed from the site using a dump truck. If a technique is used such as a flail mower or other chopping machine, efforts to remove all slash, sawdust, cuttings,–and other debris-are taken to leave the site relatively free of vegetative debris. In areas lacking access for heavy equipment, hand-removal of blackberry may be necessary. This requires a large crew to cut blackberry using power tools such as hedge trimmers and haul and dispose of the cut material. There is a high cost and level of effort associated with cutting and hauling blackberry.

Following mechanical removal, the plants are allowed to resprout. In the late fall (October-November) the resprouted leaves are spray treated with herbicide (Aquamaster or similar glyphosate product) to control regrowth. Herbicide application is very focused to the targeted plant and is directed by personnel licensed with the State of California to train and supervise in the application of herbicides. The development of a canopy encouraged by tree planting (discussed below) helps to reduce the longer-term regrowth of blackberry.

7.3.4 Cattail Removal

Cattails are commonly (but not necessarily) found in reaches with little to no riparian canopy. Cattails generally establish in low-gradient channels that support flows throughout much of the year (see Figure 7-3). This often means cattails are found within the active channel in areas of slow-moving flow. Finer sediments naturally settle out in these locations, but further sedimentation is encouraged by cattails that slow flows and trap sediments. Cattails are also the climax community (the final stage in ecological succession) that is favored in channels in need of sediment removal. Sonoma Water generally conducts cattail removal from August 1 to October 31 (or later in dry years pending approval). Maintenance generally occurs later in the summer so that cattails do not have time to reestablish and grow before winter.

Cattails are generally removed using bladed weed-eaters. In areas where mature trees do not prohibit access, heavy equipment, such as an excavator with a flail mower extension positioned at top-of-bank, may be used. This approach to cattail management is a shorter-term solution as cattails readily grow back.

Cattail removal may also be combined with sediment removal. In such cases, the channel is cleared of both sediment and cattails using methods described in Section 5.2.1, “Reach Scale Sediment Removal,” in order to increase channel capacity. This approach includes removal of cattail roots along with the sediment and has proven successful in reducing in-channel cattail re-growth for several years. Over the long-term, cattail growth is further discouraged by the development of a canopy over the channel, strategic planting of cattail competitors, and the establishment of a low-flow channel.

Sonoma Water has observed that cattail growth thins out in areas of high canopy cover, but in the absence of stream gradient and flow processes to move sediment downstream, cattails can become a sediment catching problem in well shaded areas too. Sonoma Water’s replanting program following sediment removal includes plant species that help further reduce cattail growth. Cattail management requires a multi-pronged approach that considers vegetation interactions (canopy shading, competition, and seral stage) as well as geomorphic processes (sediment accumulation and flow frequency. Early seral vegetation can provide light shading and has a higher stem density then an established riparian corridor and can be an initial and effective retardant to cattail development. Climax riparian vegetation such as large oaks, bays, alders, box elders and maples over hanging the channel provide more complete shading and exclude cattails.

7.3.5 Ludwigia Removal

Water primrose is an invasive, exotic, aquatic weed found increasingly on the west coast as well as nationally. The species occurs in the Russian River as well as in the Laguna de Santa Rosa (Laguna) and in tributaries to the Laguna system. This plant can completely fill channels and trap sediment (Figure 7-4). Similar to cattail management, Sonoma Water’s long-term, preferred management approach for *Ludwigia* is to incrementally transition the geomorphic processes and habitat attributes in channels to minimize conditions that support *Ludwigia*. This includes a shaded low-flow, bankfull channel as opposed to a wide shallow channel that encourages *Ludwigia* growth.

To help address *Ludwigia* management issues, Sonoma Water has been a member of the Ludwigia Task Force headed by the Laguna Foundation since 2002. Since 2002, Sonoma Water has also coordinated on the issue with UC Davis weed researchers to accurately identify the species, define and document shade, nutrient, and inundation tolerances (Foster pers. comm. 2008). In certain situations, *Ludwigia* has been observed to be a flood management concern when large patches of the plant are up rooted and collect against bridgeheads during high flows. Additionally, if existing patches of the plant are not scoured out by winter high flows, the plant has a tendency to sprout new shoots from the previous year's stems. The build-up of biomass in the channel can cause problems similar to cattails by reducing channel capacity.

Ludwigia growth and channel blockages have been observed in low-lying flood control channels of the program area draining to the Laguna de Santa Rosa west of Highway 101. Generally, in most Sonoma Water flood control channels, streamflow rises above the *Ludwigia* patches and is not necessarily problematic in conveying flows.

Mechanical removal is the primary method of control for this species and is generally conducted using a long-reach excavator from maintenance roads adjacent to the project site channel. Where the channel is too wide, the excavator may occasionally travel partially down the bank in areas that do not impact existing native and riparian vegetation. The excavator works from the mid-bank position, thus reducing the need for multiple trips along the bank slope by smaller equipment. Aquatic harvesters may be used to remove vegetation from the main Laguna channel.

7.3.6 Tree Pruning and Exotic Tree Removal

Maintenance activities related to tree pruning and exotic tree removal focus on selectively thinning brush and multi-trunked trees. Multi-stemmed trees are pruned down to a single trunk and lower limbs are removed up to the top of the channel banks, if possible. The goal of this maintenance approach is to develop a native canopy over the channel but not to significantly increase channel roughness such that the flood hazard is increased. See **Figure 7-11** for examples of tree pruning techniques.

Non-native, invasive Class 2 and 3 trees (e.g., tree of heaven, acacia, white poplar Lombardy poplar, eucalyptus, Indian bean and London plane tree) may be cleared from the top-of-bank area or within the channel. Non-native, mature trees that provide canopy or may provide habitat to nesting birds or raptors, such as eucalyptus, may be selectively removed if other native mature trees are present nearby and the loss in canopy and/or habitat is not considerable. If these trees are the only mature trees along the channel and provide the only canopy and habitat in the area, they are left in place until such a time as a native canopy is developed.

The tree pruning approach considers the extent of local riparian canopy and other vegetation at the site. For example, if the active channel is fully shaded by early seral arroyo willow, the complete removal of which would expose the channel to direct sunlight, then pruning and thinning techniques, that allow a narrow strip of vegetation to persist on the sides of the banks to shade the channel are used. Consideration is also be given to the bank's orientation to sun exposure and how that may affect potential growth and shading conditions. This process is repeated for each tree assessed for removal. For example, if a privet is providing the only shade and vertical element along the channel it is retained until such time as a replacement tree has developed to provide a similar ecologic function. In other words, vegetation removal may be phased to reduce potential impacts of reducing channel shade. The reach is also identified for planting of more desirable trees the following planting season. Pruning on the bank side slopes usually requires careful hand clearing using chainsaws, pole saws, pruners, and loppers.

In some cases, some trees are intentionally re-purposed to provide a different kind of habitat than the plant would provide at maturity. When new willows establish in between trees selected for long-term residence, these are usually pruned at the ground level and allowed them to resprout. The resprouts provide sub-canopy functionality similar to new young trees colonizing the stream bank, or what native riparian shrubs would provide. Since native shrubs are not part of the in-channel planting scheme in flood control channels, repurposing existing plants rather than removing them has been found to provide good habitat value and be a sustainable practice. Oaks along the top and side banks can be targeted for this approach as well, and this process has been effective in providing additional complexity in canopy layers which is beneficial by providing cover for wildlife.

7.3.7 Tree Removal and Reuse

Mature, healthy, native trees are generally only removed if channel capacity is significantly limited or if the tree is creating unacceptably high hydraulic roughness in the channel and the situation cannot be rectified by pruning.

Sick, dying, or dead mature trees may be removed if they are determined to be reducing channel capacity, increasing roughness, have the likely potential of falling into the channel and increasing the flood hazard, or presenting a potential safety hazard to recreational users (in areas where the access road is accessible to the public) or adjacent properties. The assessment of a tree hazard situation or the reduction of channel capacity is made on site by appropriate maintenance, environmental staff, or an arborist. Snags are left in place to provide habitat for birds and small mammals if it is determined by staff that they do not otherwise pose a flood or safety hazard. Sick, dying, or dead trees/snags may also be pruned to reduce the flood and/or safety hazard and to ensure that at least a portion of the tree provides habitat.

As described above in the Framing Principles for Vegetation Management of Section 7.1.1, the presence of LWD is evaluated for the opportunity to leave such material in place. Key determinants include whether the LWD is deflecting flow toward banks and the proximity to a channel crossing or other facility. While the habitat benefits of LWD are sought in the program area, these benefits are evaluated in balance of the potential flooding or erosion effects due to the presence of LWD.

Materials can be harvested from desirable tree species and utilized at different work sites. Often roots can be retained and can be managed and positioned as resprouts to aid a bank stabilization project. Large red or Pacific willows that require removal may also be cut into large sprigs and used on other restoration sites. See **Figure 7-11** for examples of tree removal activities. Removal of trees from the channel bed may require heavy equipment in the channel depending on the size of the tree and the site conditions. This may require a backhoe, excavator, or Bobcat® with a tree-spade attachment.

7.4 Vegetation Management Activities in Modified and Natural Channels for the Lower Bank and Channel Bed Zone

In addition to managing vegetation in engineered channels, Sonoma Water conducts vegetation management activities in modified and natural channels as well. Sonoma Water holds hydraulic easements over approximately 49 miles of modified channels and 80 miles of natural channels. Work in natural and modified channels is infrequent and typically occurs at the request of an adjacent landowner after a storm event.

Note that through the development of the SMP, the following natural channels were identified as hosting particularly sensitive aquatic habitats and were therefore removed from SMP coverage: Blutcher Creek (Zone 1A), Willow Creek (Zone 5A), Sheephouse Creek (Zone 5A), Dutch Bill Creek (Zone 5A), Green Valley Creek (Zone 5A), Jonive Creek (Zone 5A), Hudspeth Creek (5A), Atascadero Creek (5A), Forestville Creek (5A), Barlow Creek (5A), Salmon Creek (Zone 8A), Fay Creek (8A), Coleman Valley Creek (8A), and Finley Creek (8A). This means that vegetation clearing shall not occur in these creeks under the SMP and any planned maintenance work in these creeks would require a separate evaluation and permitting process.

Generally, vegetation management in modified and natural channels includes clearing vegetation to remove significant flow obstructions. This work is routine and involves minor blockage removals and tree limbing. Vegetation management in modified and natural channels is covered under existing SMP permits. Any planned maintenance work in natural channels will not result in the reduction or removal of instream woody vegetation or LWD that is providing functioning habitat with the exception of culvert crossings and areas 75 feet upstream or downstream of culvert crossings or facilities where the clearing of woody vegetation may be necessary to clear or prevent a flow blockage.

For modified channels, LWD preservation or removal is evaluated based on site-specific conditions and whether the LWD is deflecting flow toward the streambanks or if the site is near a crossing or facility whereby the LWD could trap additional debris and/or create blockages at the crossing. If such threats do not exist, and the LWD is providing valuable habitat, the LWD will be preserved on site.

The most common work conducted in modified and natural channels is the removal of blackberry thickets or fallen trees that significantly increase the potential for flood damage to structures. Vegetation management in these channel types occurs only on an as-needed basis, usually at the request of an adjacent landowner during or following a large storm event.

The equipment used to removal vegetation in these channels varies from site to site but may include either hand-held tools or larger mechanized tools. Access to sites and staging will occur via adjacent access roads if one is present. If no access road is present, access and staging occur in the least damaging way to surrounding vegetation and habitat. Preference is given to already disturbed areas, private yards, or grassy areas.

7.5 Tree Planting

Planting of nursery stock can occur anytime of the year but typically occurs October 15 to May 31. Sonoma Water plants from nursery stock, cuttings, and also direct seeding. Planting is timed for the typically wetter months of the year so that newly planted trees have the opportunity to establish before the hotter and drier summer months. Planted nursery stock trees are generally planted as 1- to 15-gallon container trees. Once planted, trees are monitored and watered by hand during the dry season as necessary for approximately 2 to 3 years or until established. Trees planted on the upper bank require irrigation longer than those located closer to the toe-of-slope. Some trees planted near the toe-of-slope may not require irrigation (although all planted trees are monitored for watering needs).

Trees are planted just up from the toe-of-slope and along the top of the bank slope. Trees planted along the top-of-bank may include maples (*Acer* ssp.), oaks (*Quercus* ssp.), box elder, and Fremont poplar. Trees planted at the ordinary high water mark, slightly above the toe-of-slope may include alders, ash, maples, and red or Pacific willows. Trees are spaced appropriately to allow room for a mature tree canopy to develop and thinned later as necessary to maximize canopy yet retain channel capacity. See the SMP plant palettes shown in Table 11-1 and Figures 11-5 and 11-6 for additional tree species that may be planted. Chapter 11, *Program Mitigation*, includes more detail on the SMP planting template and plant palette.

7.6 Vegetation Management at Engineered Structures, Reservoirs and Sediment Basins

Other SMP program area facilities include in-channel structures, reservoirs, and sediment basins. Vegetation management at these other facilities only includes vegetation removal as described below.

7.6.1 In-Channel Engineered Structures

Vegetation management at in-channel engineered structures is focused on maintaining a clear access to the structure and ensuring that the structure can operate as designed. Access roads may be mowed using a flail mower or treated with herbicide (see Section 8.2 for more detail on road maintenance and Section 7.7 for more details on herbicide use). Pruning of branches overhanging the road is conducted using hand-held tools such as pruners, pole saws, and chainsaws. In-channel concrete structures are generally maintained free of vegetation.

7.6.2 Reservoirs

The majority of vegetation management conducted in reservoirs is focused on the mowing of the dam levee, both inside the reservoir and on the outer dam face, and clearing of vegetation from around dam structures including the spillway and inlet structure.

Mowing is conducted using a flail mower and access to the dam is provided via the access road along the top of the dam. See **Figure 7-12** for photos of example mowing activities. The California Division of Safety of Dams (DSOD) requires that all earthen dams be maintained free of shrubs and woody debris to maintain structural integrity of the dam and to enable visual inspection of dams for leaks. Because the program area dams are maintained free of any vegetation except grass, it is very unlikely that any shrubs and/or trees will require removal from the dam.

Vegetation clearing around the spillway also follow DSOD requirements that the spillway be maintained free of vegetation except grass. If vegetation maintenance is necessary at spillways, it is conducted using hand-held tools such as weed-whackers, pruners, and chainsaws (for any overhanging branches). Reservoir spillways are generally maintained free of vegetation.

7.6.3 Sediment Basins

Vegetation management in sediment basins is focused on maintaining a clear access road. The road may be mowed using a flail mower or treated with herbicide (see Section 8.2 for more detail on road maintenance and Section 7.7 for more details on herbicide use). Clearing of branches overhanging the road is conducted using hand-held tools such as pruners, pole saws, and chainsaws.

Vegetation in the sediment basin is removed when sediment management activities occur. See Chapter 5, *Sediment Management and Removal*, for more detail on sediment removal activities.

7.7 Herbicide Use

Herbicide use in Sonoma Water-maintained channels is conducted consistent with Sonoma Water's IPM Plan (Blankinship & Associates, Inc. 2019), which focuses on long-term prevention of pests through a combination of techniques including biological control habitat manipulation, modification of cultural practices, and use of resistant varieties. Mechanical removal and mowing are the primary methods for managing problematic vegetation. Herbicides are used only after monitoring indicates that they are needed and minimized to the smallest amount necessary to be effective. In addition, as described in Section 7.8, "Grazing," Sonoma Water seeks other vegetation control methods such as goat grazing to reduce reliance on herbicides. Sonoma Water prioritizes herbicide use in some sites and identifies other sites where herbicide use can be reduced or eliminated. Example sites where herbicide use is prioritized (highest to lowest) include: (1) weeds occurring in dams and facilities regulated by DSOD, (2) woody invasive plants in flood control facilities, (3) woody invasive plants at critical infrastructures, (4) cut stump treatment in flood control channels, (5) access road spraying, and (6) non-woody weeds and grasses in grounds and landscape.

Herbicide used in proximity to channels and water bodies are labelled for aquatic use but not applied directly to surface water. In-channel use of herbicides are selectively applied to specific problem pests and used in conjunction with other non-chemical control methods (e.g., physical removal and grazing). Arroyo willows and blackberries are the primary targets of in-channel herbicide application due to their fast-growing, persistent nature and potential to significantly impede channel flows. After mechanical methods have been applied, herbicide use is limited to direct application on stumps of willow trees and spot spraying for blackberry. See **Figure 7-13** for examples of herbicide application activities. Sonoma Water staff use only the minimum amount of herbicide needed to adequately control vegetation and are trained not to apply herbicides to upland areas within 72 hours of predicted rainfall.

Outside of the active channel, herbicides may be broadcast sprayed via truck-mounted rig to access roads to protect roadway integrity and for public safety purposes. The area sprayed is limited to as a narrow a width as practicable (Figure 7-13). To reduce the potential for public exposure, top-of-bank access road spraying typically occurs very early in the morning and concludes around nine o'clock AM.

Sonoma Water generally uses Aqua Master® (formerly known as Rodeo®), an aquatic contact herbicide that consists of glyphosate isopropylamine salt and water, for treatment of stumps and access roads, but other herbicides may be used depending on the target plant species. Approximately 5-10 gallons of Aqua Master® is used per month during the 5-month summer field season (25 to 50 gallons per season) for treatment of willow stumps. A drift-reduction agent called Stay-Put® is mixed with the herbicide. Drift-reduction agents such as Stay-Put® commonly consist of poly-acrylamide or polyvinyl polymers.

All herbicide application activities are conducted in accordance with all applicable federal, state, and local regulations (under regulatory authority of the United States Environmental Protection Agency [USEPA], the California Department of Pesticide Regulation [DPR], and the Sonoma County Agricultural Commissioner, respectively) and Sonoma Water utilizes BMPs as identified in Table 10-1 when applying herbicides. See Section 2.2.3 for a more complete description of relevant regulations pertaining to herbicide use and the SMP compliance approach.

7.8 Grazing

Sonoma Water recently implemented a goat grazing program that covers a number of Sonoma Water-owned facilities including flood control reservoirs, water supply tank sites, and flood control channels. The primary goals for conducting grazing include fire fuel reduction, increasing biodiversity and supporting native plant species, and reducing the annual amount of mowing and weed eating conducted along trails by Sonoma Water's maintenance crews. For the purposes of fire fuel reduction, grazing is targeted in areas where Sonoma Water's property is adjacent to residential areas to create a fire break. Vegetation that is typically targeted by goat grazing includes blackberry, grasslands, poison oak, and areas where there is dense understory. **Figure 7-14** shows a photo of goat grazing activity at Sonoma Water's facilities.

7.9 Access and Staging

Access to maintenance sites occurs via the adjacent access roads where present. At project sites with no access road, access is provided via the least environmentally damaging, yet feasible route (typically along the top-of-bank area). Access to vegetation maintenance sites occurs via the adjacent access road to the general location, and by foot into the channel. Removal of mature trees for access to the channel bed by foot is generally not necessary.

Selective clearing of shrubs or trees may be necessary on the banks to provide access to the channel bed. If clearing is required, invasive species such as blackberry or fast-growing species such as arroyo willow are targeted.

Staging for vegetation maintenance activities occurs to the extent possible on the adjacent access road. Cut vegetation is transported from the channel bed up the bank slope to the access road by hand or by mechanical equipment such as an excavator or back hoe. Vegetation is chipped on site and/or hauled away in dump trucks.

7.10 Vegetation Management Triggers

During the vegetation assessment process, the maintenance manager evaluates channel conditions according to the triggering criteria described in **Table 7-2**. The trigger identification codes in **Table 7-2** include VM for vegetation management and PS for public safety triggers. Public safety triggers are also shown in **Table 8-1** in Chapter 8, *Other Maintenance Activities*. If triggering criteria are met or exceeded than vegetation management may be necessary. The trigger evaluation process may determine that no management action is necessary.

Table 7-2. Vegetation Management Triggers and Potential Management Actions

Management Triggers		Potential Management Actions	
Trigger I.D.	**Trigger Description**	**For 10/25/50-yr Channel**	**For 75/100-yr Channel**
VM-1 (PS-1)	Vegetation is presenting considerable fall hazard	Remove, reorient, or reduce hazard height below 3'	
VM-2 (PS-2)	Dead or dying trees- public hazard		
VM-3	Trees growing within 15’ of any channel hardscaping, culverts or bridgeheads	Remove or thin vegetation	
VM-4	Vegetation growth is significantly decreasing flood conveyance capacity and/or compromising freeboard requirements, particularly where infrastructure or adjacent properties are at risk	If recruits <6’: no action unless other triggers observed If recruits ≥6’: thin 1/3 to 1/2 of vegetation, or coppice to meet Channel Form	If recruits <10’: no action unless other triggers observed If recruits ≥10’: thin 1/3 to 1/2 of vegetation, or coppice to meet Channel Form
VM-5	Overall toe tree density is greater than vegetation allowance (trees recruiting between established trees)		
VM-6	Overall upper bank tree density is greater than vegetation allowance (trees recruiting between established trees)		
VM-7	Overall shrub (woody understory) density is greater than vegetation allowance		

Management Triggers		Potential Management Actions	
Trigger I.D.	**Trigger Description**	**For 10/25/50-yr Channel**	**For 75/100-yr Channel**
VM-8	Willows have sprouts ("suckers") at base	If sprouts <6': no action unless other triggers observed If sprouts ≥6': remove	If sprouts <10': no action, unless other triggers observed If sprouts >10': remove
VM-9	Instream debris blocking the bankfull channel geometry such that channel capacity and/or freeboard requirements are compromised	Remove debris	If providing aquatic habitat feature and no other triggers observed: no action or partially dismantle; If other triggers observed: partially dismantle or remove debris
VM-10	Downed trees and/or woody debris present on side/upper banks such that channel capacity and/or freeboard requirements are compromised	Remove debris	
VM-11	Localized vegetation is deflecting flow, causing channel bank erosion or scour and vegetation management may alleviate issue with lower overall impact than sediment management actions	Remove, prune or thin vegetation causing flow deflection, erosion, or scour	
VM-12	Nomograph or hydraulic conditions assessment shows loss of freeboard ≥50%	Thin to regain required freeboard/thin to meet target or design channel form	
VM-12	Vegetation obstructing vehicle access road(s)	Prune or remove obstructing vegetation	
VM-12	Vegetation obstructing fence line		
VM-13	Vegetation and/or debris obstructing v-ditch		
VM-14	Invasive species (Class 2) > 10% cover	Remove invasive species and treat with herbicide as appropriate	

Management Triggers		Potential Management Actions	
Trigger I.D.	Trigger Description	For 10/25/50-yr Channel	For 75/100-yr Channel
PS-3	Urban channel sight lines are obscured and clear visibility through the channel zone is impaired	As feasible, coordinate with local law enforcement to determine how vegetation management could support public safety codes. As determined necessary, vegetation management activities would be based on coordination efforts with local law enforcement and/or the trigger evaluation process. Management actions would include: thinning woody understory to regain sightlines (in accordance with channel form vegetation allowance) and lifting established trees and shrubs at least 6'.	
PS-4	Signs of delinquent activity (e.g. graffiti, trash) and/or illegal encampments present		
PS-5	Reach presents a fire risk, subject to California Fire Code Section 304.1.2, which states: "Weeds, grass, vines, or other growth that is capable of being ignited and endangering property shall be cut down and removed by the owner or occupant of the premises" and/or weed abatement notice has been received to remove hazardous vegetation	Mow dry grasses and herbaceous (i.e. non-woody) vegetation above the ordinary high water mark to height ≤4”. Manage vegetation to ensure that the potential for grass-to-brush and brush-to-tree type ladder ignitions are reduced to a safe level. Manage vegetation in fire lanes to ensure that tall grass is not creating a fire risk into neighborhoods.	
PS-6	Reach presents a fire risk, subject to California Fire Code Section Chapter 49, (Requirements for Wildland-Urban Interface Fire Areas), Section 4906: Hazardous Vegetation and Fuel Management, and/or fire abatement notice has been received to remove hazardous vegetation	Lift (remove lower limbs) at least 8-15’ for mature trees and 3-6’ feet for large shrubs/young trees Clear zone adjacent to combustible structure (wood fence, etc.) and also clear zone for outfalls and other infrastructure, 10-30’ Maintain sight lines between thalweg and access road (involves thinning recruits to target vegetation template goal) Removing dead branches, dried and downed trees and other flammable woody material	

In addition to the vegetation triggers identified in Table 7-2, the following conditions are additionally considered to help inform the need for potential maintenance activities:

1. What other maintenance work may be required at the reach through other trigger categories?

2. Are the approaches identified for the reach consistent with the overall approach and methods as described in this SMP Manual?

3. What is the channel form and type, and what is the channel's designed capacity (10-100 year channel)? Can the individual tree be pruned or thinned rather than removed entirely) to provide the necessary conveyance capacity?

4. What are current channel cross-section, vegetation, and habitat conditions? Do conditions provide shade or other habitat benefits?

5. What are the adjacent land uses and flooding history?

6. What is the potential for special status species or habitat, and do conditions provide longer-term canopy development or riparian corridor benefits?

7. Are there other significant public safety concerns or exceptional circumstances?

The rationale to remove, thin, or preserve individual trees is made in the field by SMP field staff familiar with regional and wetland ecology and the oversight and guidance of a biologist or arborist that is familiar with the program area's vegetation and knowledgeable of channel botanical conditions. Design guidance for the SMP's vegetation planting program is provided in Chapter 11, *Program Mitigation*, as it is related to the program's mitigation and restoration approach.

Photo a. Corona Creek before willow removal (Zone 2A).

Photo b. Corona Creek after willow removal (Zone 2A).

Photo c. Starr Creek willows in channel before maintenance (Zone 1A).

Photo d. Starr Creek after maintenance (Zone 1A).

Photo e. Willows blocking culvert outlet on Windsor Creek before maintenance (Zone 1A).

Photo f. Willows cleared from culvert outlet on Windsor Creek after maintenance (Zone 1A).

Figure 7-1

Examples of Willow Removal

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Photo a. Blackberry removal on Lawndale Creek (modified channel in Zone 3A).

Photo b. Blackberry removal on Ducker Creek (Zone 1A).

Photo c. After blackberry removal on Roseland Creek (Zone 1A).

Figure 7-2
Examples of Blackberry Removal

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Photo a. Coleman Creek, looking downstream from Snyder Lane, before cattail removal (Zone 1A).


Photo b. Coleman Creek, looking downstream from Snyder Lane, after cattail removal (compare to Photo a) (Zone 1A).


Photo c. East Washington Creek, looking downstream from Maria Drive, before cattail removal (Zone 2A).


Photo d. East Washington Creek, looking downstream from Maria Drive, after cattail removal (compare to Photo c) (Zone 2A).

Figure 7-3
Examples of Cattail Removal

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Photo a. Ludwigia filling the channel. Hinebaugh Creek, looking upstream from Rohnert Park Expressway (Zone 1A).

Photo b. Ludwigia reestablishing along edge of channel after recent removal project. Laguna de Santa Rosa, looking downstream, immediately downstream of confluence with Hinebaugh Creek and approximately 200 feet downstream of Photo (a) (Zone 1A).

Figure 7-4

Examples of Ludwigia Removal

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Photo a. Forestview Creek, 2008, looking downstream from the upper reach.

Photo b. Forestview Creek, 2019, looking downstream from the upper reach.

Figure 7-5
Forestview Creek in 2008 and 2019

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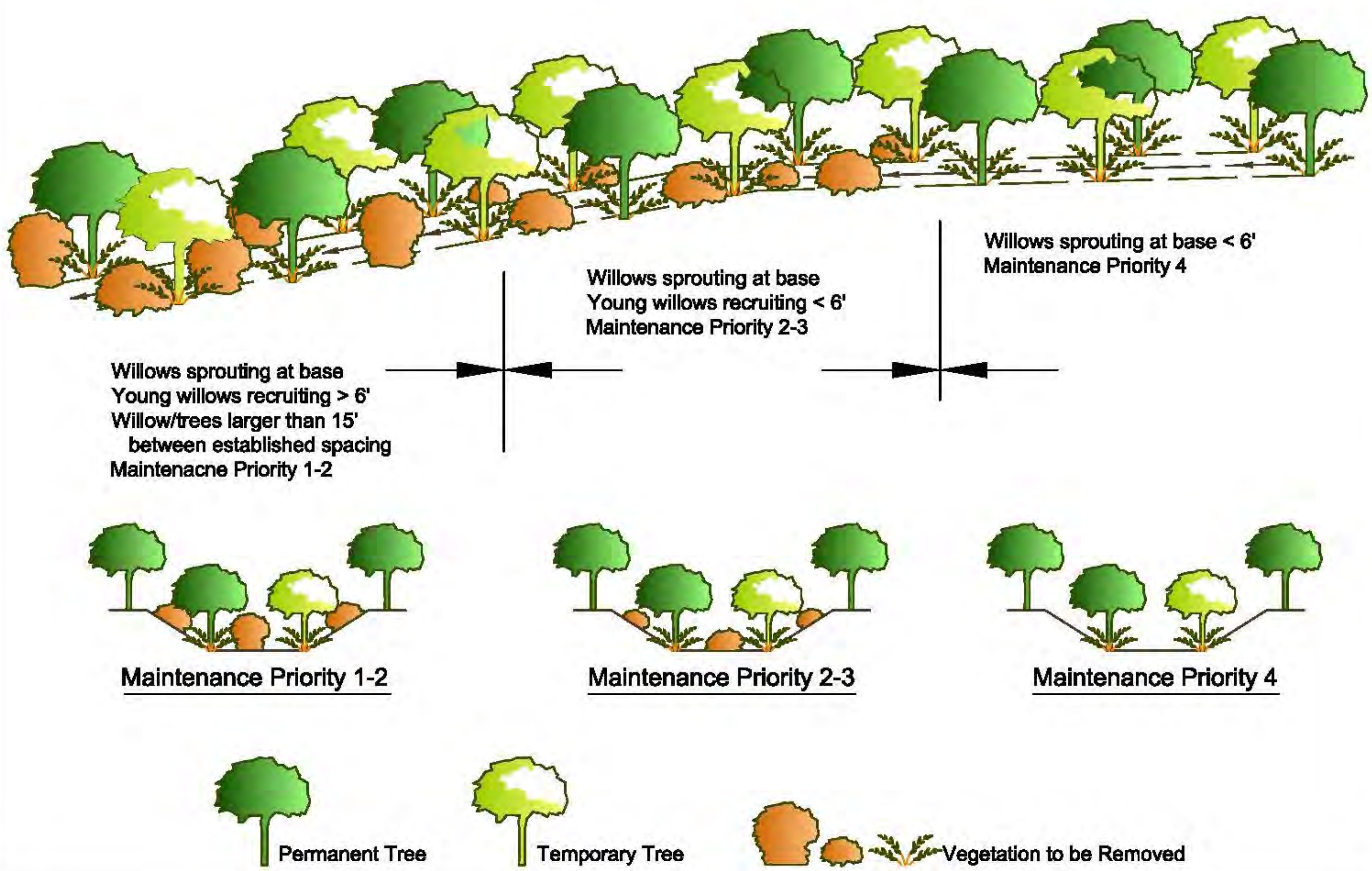

This figure focuses on thinning that would be performed at the toe of Sonoma Water's flood channels in a seral state of vegetation colonization and establishment. The green is intended to indicate vegetation that can be expected to stay, the orange indicates categories of vegetation assessed for thinning or removal

Horizon WATER and ENVIRONMENT

Figure 7-6

Vegetation Management Target at Channel Toe at a Seral Stage

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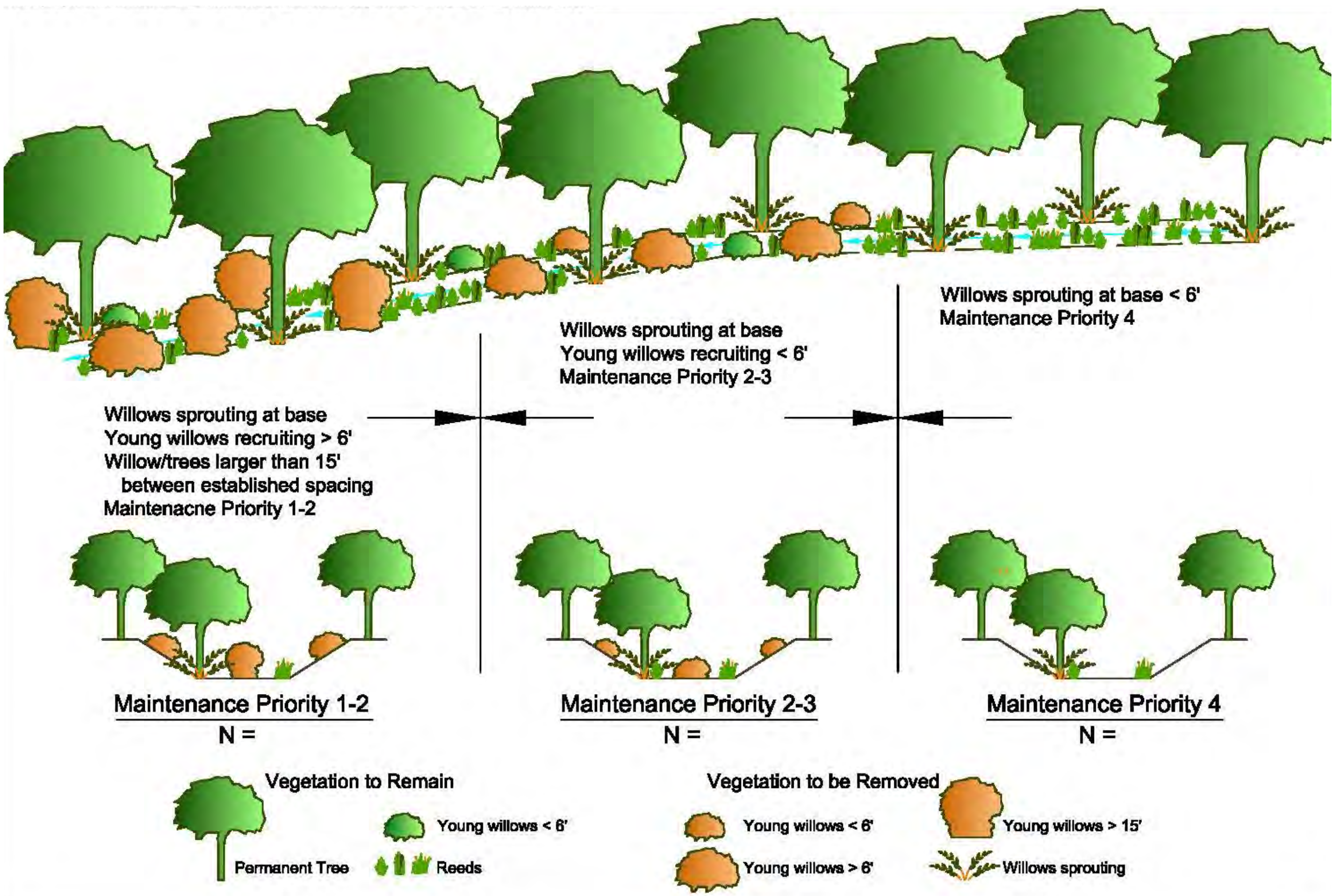

This figure focuses on thinning that would be performed at the toe of Sonoma Water's flood channels in a climax stage of vegetation colonization and establishment.

Horizon WATER and ENVIRONMENT

Figure 7-7
Vegetation Management Target at Channel Toe at a Climax Stage

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Photo a. Santa Rosa Creek, 1997, looking downstream near Pierson Street Crossing.

Photo b. Santa Rosa Creek, 2019, looking downstream near Pierson Street crossing.

Figure 7-8
Santa Rosa Creek in 1997 and 2019

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Photo a. Santa Rosa Creek (Zone 1A), looking downstream. On the left side of the creek, arroyo willows were removed from between the alders, and the alders were pruned. No work has been conducted on the right side of the creek in this photo.

Photo b. Santa Rosa Creek (Zone 1A), looking downstream. Arroyo willows were removed along the right bank and the alders were pruned. No work has been conducted on the left side of the creek in this photo.

Photo c. Santa Rosa Creek (Zone 1A), looking upstream. Same reach as Photo (b), two weeks after Photo (b) was taken. Arroyo willows have been cleared from both banks and alders have been pruned.

Horizon WATER and ENVIRONMENT

Figure 7-9

Examples of Willow Removal and Alder Pruning on Santa Rosa Creek

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Photo a. Cutting willows with assistance from a maintenance team member.

Photo b. Cutting trees using a chainsaw.

Photo c. Pruning using a pole saw.

Photo d. Passing cut branches up the bank.

Photo e. Passing cut brush up the bank.

Horizon WATER and ENVIRONMENT

Figure 7-10

Examples of Willow Pruning

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Photo a. Clearing cut brush with an excavator. Excavator is staged on adjacent access road.

Photo b. Clearing cut brush with a sling and excavator.

Photo c. Removing brush from creek with a sling and small tractor. Tractor remains outside of active channel.

Photo d. Chipping cut branches on adjacent paved road.

Figure 7-11
Examples of Tree Pruning and Exotics Removal

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Photo a. Flail mower.

Photo b. Upper Laguna, looking downstream. Note wood stakes at top-of-bank and just up from toe-of-slope where recent planting was completed.

Figure 7-12
Examples of Mowing

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Photo a. Applying herbicide to gravel access road in early morning using a truck.

Photo b. Applying herbicide to gravel access road in early morning using a truck

Photo c. Hand-painting arroyo willow stumps with herbicide to discourage regrowth.

Figure 7-13

Examples of Herbicide Application

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Goat grazing on a hill slope on Sonoma Water’s property.

Figure 7-14
Examples of Goat Grazing

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Chapter 8
OTHER MAINTENANCE ACTIVITIES

8.1 Introduction

Chapters 5, 6, and 7 described maintenance activities for the core program activities of sediment management, bank stabilization, and vegetation management in the lower bank zone. This chapter describes maintenance activities for other facilities and issues covered by the program including:

- Vegetation management in upper bank zone
- Access road and upper bank maintenance
- V-ditch maintenance
- Culvert maintenance, repair, and installation
- Debris removal
- Fence maintenance
- Graffiti removal
- Trash clean-up
- Public safety
- Vegetation Management in Upper Bank Zone

Upper bank vegetation along channels requires an integrated management approach with slightly different goals and objectives than what is described in Chapter 7, *Vegetation Management.* Whereas Chapter 7 focuses on the vegetative conditions for stream bottoms and the lower banks, the following subsections pertain to the upper bank zone, which is defined as the area from the access road down to the mid-point of the channel side bank. Upper bank trees are generally upland species, are adapted to more xeric conditions than in-stream species, and are generally not in contact with flood flows. Upper bank canopy, in conjunction with toe trees lining the stream channel, provides the majority of existing riparian canopy managed under the Stream Maintenance Program (SMP).

8.1.1 Urban Forest Management Approach & Objectives

Vegetation management in the upper bank zone in urban areas uses an urban forestry management (UFM) approach. UFM seeks to develop a healthy urban forest through managing natural recruitment and planted trees by thinning, pruning, and reducing fuel loads such as ladder fuels. Overall outcome conditions mimic a shaded fuel break,[9] as defined by California Department of Forestry and Fire Protection (CAL FIRE). In general, this approach seeks to establish and maintain a foundation of upper bank trees that can be managed into a mature corridor of trees along the upper bank while reducing the understory vegetation.

As a responsible public agency and property owner, Sonoma Water Agency (Sonoma Water) has an obligation to maintain its properties for multi-purpose objectives, including: protecting water quality; reducing hazardous waste; ensuring general public safety and fire safety; maintaining functioning infrastructure; and maintaining access for maintenance and emergency vehicles.

Objectives for UFM were established for the SMP to address a variety of public safety concerns, including homeless encampments and fire safety. Since UFM activities are property management driven, UFM is implemented on a subset of SMP channels. These channels include the engineered channels under Sonoma Water ownership, as shown in Figures 1-2 through 1-9. UFM concerns and in-stream management needs are integrated to maximize habitat opportunities for native wildlife and recreational activities for people while reducing the fire and safety hazards along public use trails. For the purposes of the SMP, UFM approach includes the following objectives:

1. Establish long-term sustainable tree spacing and tree structure to develop a mature corridor of trees along the upper bank that maintain 50-75 percent overall canopy.

2. Establish shaded canopy to temper subcanopy density and reduce growth of invasive plant species in the channel (e.g., cattails) and along the upper bank (e.g., Himalayan blackberry) to reduce maintenance and minimize the need for herbicide use.

3. Ensure access for maintenance and emergency vehicles.

4. Prune or remove hazardous trees.

5. Manage and reduce fire fuel.

6. Encourage a safe public environment through clear site lines.

Upper bank trees are generally upland species and are adapted to more xeric conditions than instream species. Upland bank trees are generally not in contact with flood flows. Upper bank canopy, in conjunction with toe trees lining the stream channel provides the majority of existing riparian canopy managed under the SMP.

Figure 8-1 illustrates the maintenance target for upper bank locations that have an in-channel low flow access road, which is relatively common in urban areas. Figure 8-1 is similar to Figures 7-5 and 7-6 which provide vegetation targets for the lower bank area. Figure 8-1 also provides

[9] The tree canopy is thinned to reduce the potential for a crown fire to move through the canopy. The woody understory vegetation is likewise thinned out. The shade of the retained canopy helps reduce the potential for rapid re-growth of shrubs and sprouting hardwoods and can reduce erosion.

targets for vegetative height in regard to fire abatement and thinning and pruning for urban safety.

8.1.2 Upper Bank and Urban Forestry Vegetation Activities

Tree Management and Planting

In the top-of-bank area outside the stream channel (including the access road and adjacent above channel area), healthy mature native trees are only trimmed if a limb is blocking the access road, appears unbalanced or broken, or to maintain appropriate spacing for access (targeted ideal spacing). Hand clearing may also be used at the top-of-bank to remove hazard trees (e.g., snags, dying or dead trees, broken branches) from areas with high public use or that are adjacent to residences or other structures.

General objectives for urban forestry are to maintain clear understory sites lines, reduce ladder fuels, and develop and maintain 50-75 percent overall canopy as possible. The spacing varies based on the composition of the tree species on site.

Similar to native plant restoration activities described elsewhere in this manual, the UFM approach seeks to achieve similar canopy goals by managing natural woody vegetation recruitment. The UFM approach involves identifying trees that will develop into mature trees. Achieving a riparian corridor with shaded tree canopy is a program objective along channels where conditions are appropriate to develop such a canopy corridor. Target tree spacing conditions are shown in Figure 8-1. Trees targeted for planting in the upper bank zone grow more slowly than trees in the wetter lower channel zone.

Over time, as the upper bank tree vegetation matures and enlarges, the overall approach is to increase tree spacing. For instance, for initial planting in the top-of-bank zone, 10-foot spacing may be the target for planting from seed or acorn. As the trees grow, become more established, and the canopy begins to connect, the trees would be thinned and the spacing increased to approximately 20 feet, and then up to 40 feet upon maturity. However, tree management is directly dependent on tree location, species, size, and structure. Ultimate decisions regarding tree spacing is made based on the field conditions. The tree spacing conditions shown in Figure 8-1 provide general guidance as a basis to then verify and confirm against field conditions.

UFM is a long-term management approach which includes encouraging a diversity of tree ages and species. Saplings and natural recruitment are an integral component to this long-term approach. Potential replacement saplings include those that are growing during the periods between understory management activities. If the upper bank is not pruned for 3-5 years, this would allow a period for natural recruitment and resprouts to reestablish. If one of the “anchor” trees fail, the “replacement tree” would be selected from the natural recruitment of saplings that has recently established or was retained from earlier efforts. Through this process, saplings and natural recruitment are selectively retained in order to encourage a diversity of age and species composition. Saplings are retained based on tree species, age, location and how they fit in with meeting the overall objectives of UFM.

Mowing

To reduce fire hazards, grasses in the top-of-bank area are mowed up to three times annually using a flail mower where space allows or with hand-held tools (e.g. weed-whacker) where a flail mower is not practical. If a flail mower or other chopping machine is used, then all slash, sawdust, cuttings, are left in place as mulch (except in the active channel). Both actively and passively planted vegetation needs to be protected from mowing to obtain incremental ecological lift. Nesting bird surveys are required to be performed and monitored during work activities.

Work Timing to Reduce and Avoid Impacts

UFM activities are typically conducted between November and early March, largely outside of passerine nesting season. This period is the optimal time of year for performing UFM activities because it minimizes nesting bird impacts, allows for pruning trees while they are dormant, is generally better working conditions for staff and crew, and better suits staff and crew labor constraints because it distributes the workload more evenly throughout the year.

Conducting UFM activities in upper bank areas in November through early March reduces the intensity of the disturbance to riparian areas in the summer, and allows for greater flexibility in accomplishing vegetation maintenance activities. Limiting the vegetation maintenance activities to the June through October timeframe makes it difficult to accomplish the entire scope of vegetation maintenance and property management objectives. It also forces work into a period of heavy bird nesting activity and tree pruning outside of their dormancy period.

Maintenance Levels

Channels included in UFM are categorized into three levels of maintenance. These categories are established based on the following considerations: public access usage, general historic public safety concerns, proximity to homes and buildings, and proximity to sensitive receptors (e.g., schools). For example, channels that are located in urban areas, with high public usage, prone to public safety issues, and in close proximity to residences or sensitive receptors, receive a more frequent level of maintenance than areas that are located in a rural area without these issues.

- **Category 1**: These channels have high public usage, may have a history of public safety concerns, and are located adjacent to residences, business, or sensitive receptors. These channels would be pruned and thinned for UFM objectives on an approximate 3- to 4-year interval. Examples of creeks under this category would include reaches of Piner Creek, Santa Rosa Creek, Paulin Creek, and Todd Creek.
- **Category 2**: These channels receive less frequent UFM maintenance because they may be channels that do not have regular public access, have not experienced regular public safety issues, may be in a more rural environment, and are not directly adjacent to residence, business, or sensitive receptors. These channels would be pruned and thinned approximately every 4-6 years. Examples of this type include Abramson Creek, Washington Creek, and Moorland Creek.
- **Category 3**: These are channels that are located in more rural outlying areas. These channels do not have regular public safety issues and are not located directly adjacent to residence or business. Work in these reaches would be more localized and responsive. For instance, if there

was a specific problem area with fire fuels or public safety that needed to be addressed, that specific location would be addressed for that issue. Examples of this type include lower Santa Rosa Creek, lower Laguna de Santa Rosa, and lower Colgan Creek.

Upper Bank and UFM Workload and Rotation of Work Sites

Categories 1 and 2 combined includes 125 reaches and approximately 49.9 miles. Given these factors, the average annual workload for UFM would total approximately 25 creek reaches and approximately 10 linear miles per year. UFM implements work site rotation on an annual basis for several purposes:

1. Incrementally manage all engineered channels owned by Sonoma Water over time;

2. Rotate work on a specific channel annually by reach so that work on a given channel is distributed over time (for example if a creek has 5 reaches, work on one reach per year for 5 years); and

3. Rotational management inherently accommodates multi-successional phases of vegetation and allows for natural recruitment of tree species.

8.2 Access Road Maintenance

Access road maintenance may include grading and/or resurfacing road repairs and vegetation removal. Access road maintenance work may involve hand tools, mechanized equipment, or chemical application (for vegetation treatments). The potential timing for road maintenance activities is:

- Road repairs, grading, and/or resurfacing – All year.
- Access road pruning – All year.
- Spray dirt/gravel access roads – March 1st to April 30th.
- Mow low-flow access roads – March 1st to August 30th.

Road repairs generally require grading to restore the original contours of the road. Road repairs may also include replacement of culverts, pipes, valves, drop-inlets or other similar structures that help to drain the road. Equipment used may include a motor grader, roller, and trucks. All repairs are conducted in compliance with Sonoma Water's Flood Management Design Manual (FMDM).

Vegetation removal for road repair and maintenance is accomplished by pruning of limbs and branches that overhang the road, mowing, and/or application of contact herbicides approved for use in aquatic environments. The access road and the area between the access road and the fence lines enclosing Sonoma Water's right-of-way or easement is mowed using a flail mower or hand tools to reduce fire hazards and protect the integrity of the roadway and fence. Hand tools such as pole saws, loppers, and chainsaws are used to remove tree limbs that overhang the road or otherwise block access.

During the spring, AquaMaster® herbicide or a similar product is applied on the surfaces of gravel access roads to discourage weeds from establishing in the roadway and protect the integrity of the road. Spraying is limited to as a narrow a corridor as possible, and only gravel road surfaces are treated.

As described in Section 7.7 all herbicide application activities are conducted in accordance with all applicable federal, state, and local regulations as referenced in Chapter 2, Section 2.2.3 and Sonoma Water utilizes best management practices (BMPs) as identified in Table 10-1 when applying herbicides.

Some of the SMP maintained channels, particularly channels with larger cross sections such as Santa Rosa Creek, were designed with a low-flow access road midway down the channel bank on the inside of the channel. These access roads may be mowed and maintained free of woody vegetation to facilitate channel access and maintenance.

8.3 V-Ditch Maintenance

V-ditches are typically located above and beyond the top-of-bank zone, on the outer edge of the access road. These facilities were designed to collect runoff from the access roads and adjacent slopes. Flow from V-ditches is conveyed beneath the access roads and discharged into the adjacent channel via culverted outlets. V-ditches require maintenance that may include clearing of leaves and overgrown grasses, and re-grading if the ditch banks fail or sediment accumulates. Maintenance work may also require repositioning culverts that drain the ditch under the road. Due to excessive rodent activity along many Program service roads, V-ditches, and banks water is sometimes captured by rodent burrows instead of entering the V-ditch culverts. This process can cause piping and instability along banks and beneath the V-ditch culverts. Repairs and maintenance to V-ditches typically entail:

- repositioning the culvert or installing a new culvert to replace a damaged culvert within the existing culvert footprint;
- strengthening culvert outlets where they join channels with rip-rap to reduce the erosion culvert destabilization potential; and
- installing flow dissipation devices below the outfall of culverts to further reduce the potential for future bank erosion and scour.

8.4 Culvert Maintenance, Repair and Installation

Culverts in the program area occasionally require repair or replacement. The installation and repair of drop-inlet culverts and the clearing, repair, or replacement of road crossing culverts are the most common routine culvert maintenance activities.

8.4.1 Drop-Inlet Culverts

Drop-inlet culverts are typically used to route drainage from V-ditches on the outside edge of the channel access roads (or other upland areas) to the stream channel below. These culverts cross beneath the access road and generally exit into the channel bank a few feet above the toe-of-bank.

Installation of a new drop-inlet culvert may be appropriate where existing V-ditch drainage and routing are not adequate. Pooled water in the V-ditch that is not adequately drained can overtop the bank and then directly flow down the bank face causing surface erosion or rotational failures due to saturated soils. Additionally, flows entering the upper bank area increase the opportunity for bank failure. New drop-inlet culverts would be installed to drain areas within the channel right-of-way to reduce bank failure issues related to pooling water.

Beside installation of new drop-inlet culverts to aid drainage, the repair of existing drop-inlet culverts is also a routine maintenance activity. **Figure 6-3** shows an example design detail of how drop-inlet culverts may be repaired at sites where bank failure has occurred around the culvert.

The following design guidance is provided to ensure proper drop-inlet culvert functioning while avoiding and reducing impacts:

- Repair or replacement of an existing culvert occurs within the same footprint as the original culvert.
- The culvert outfall path, from the culvert edge down to toe-of-slope should be protected with erosion control material as needed to dissipate energy and reduce the erosion potential.
- The culvert placement and slope are installed to minimize outfall velocity and reduce the potential for future bank erosion and scour from outfall. Energy dissipation approaches are used as needed.

8.4.2 Road-Crossing Culverts

Sonoma Water owns and maintains culverted road crossings. These crossings are on non-public access roads within Sonoma Water's maintenance right-of-way. These culverts may require repair or replacement due to structural failures of the culvert or supporting footings or headwalls, or the partial or complete internal failure of the culvert itself. Causes of failures may include improper sizing, misalignment, the road design and its loadings, and the age of materials. Culvert failure typically reduces hydraulic capacity due to flow obstruction by the culvert, sediment, or debris that collects as a result of the failure. Failure may also lead to increased erosion downstream of the culvert where concentrated flows may become more erosive.

Repair or replacement of an existing culvert typically occurs within the same footprint as the original culvert. Culvert replacement includes replacing the culvert (generally corrugated metal pipe (CMP) or reinforced concrete pipe) and anchoring it in place with steel reinforced concrete or grouted rip-rap depending upon the road crossing situation. Culverts are generally installed using an excavator working above the channel from top-of-bank. Culverts are placed at grade and anchored to subgrade. The excavation is then backfilled and the bull walls poured. When forms are removed the remaining fill material is added and protective rip-rap is installed at the outfall. Road material is laid, graded, and compacted.

Like with other maintenance projects, staging occurs to the extent possible on the access road adjacent to the channel. Rip-rap for the replacement is also stockpiled on the access road, or other disturbed areas.

This SMP intends to cover repair activities for existing culverts of all sizes. However, the installation of new or replacement culverts is limited up to a 48-inch diameter for purposes of the program. Required culvert installation larger than 48 inches in diameter would occur outside of the SMP.

8.5 Debris Removal

Debris consists of all non-sedimentary materials deposited in channels as a result of floodwaters or through human activity, including such materials as downed trees and/or tree limbs, tires, shopping carts, trash, furniture, homeless encampments, and other substances. Debris removal is performed regularly in engineered channels and far more infrequently in modified and natural channels (as described above). Debris removal may also be required to provide access for minor maintenance activities at stream gages, outfalls, culverts, flap gates, and grade control structures. See **Figure 8-2** for examples of debris removal activities.

The SMP approach to the removal of woody debris is described in Section 7.3, "Vegetation Management Activities in Engineered Channels for the Lower Bank and Channel Bed Zone," and Section 7.6, "Vegetation Management at Engineered Structures, Reservoirs and Sediment Basins."

Sonoma Water routinely patrols its flood control channels to remove debris that could significantly increase the potential for flooding. Debris removal activities are generally conducted by work crews using hand tools and occasionally a winch. Heavy equipment is typically not used for debris removal. Vegetative debris may be chipped on site or simply removed via dump truck. Non-vegetative debris is removed from the site via dump truck for disposal at a solid waste landfill. However, containers of hazardous waste, such as paint and oil, are sealed in protective containers and disposed at an appropriate hazardous waste facility. BMPs identified in Table 10-1 are applied, as appropriate.

Related to debris removal, Sonoma Water also coordinates with local law enforcement to control the establishment of homeless encampments on the flood control channels that Sonoma Water owns. Such encampments can be major sources for debris, garbage, and water pollution. Signs are posted 48 hours in advance of homeless encampment removal. The issue of homeless and creeks is also discussed below in Section 8.8, "Trash Clean-up," and Section 8.9, "Urban Creek Issues".

8.6 Fence Maintenance

Sonoma Water maintains the fencing that lines its channel parcels and easements as well as the gates to the access roads. Maintenance activities generally include repair of broken fences. Fence repair and maintenance activities include the complete removal of any old or damaged fencing material that is subsequently replaced. Fence maintenance activities apply all appropriate BMPs as identified Table 10-1. See Figure 8-2 for examples of fence maintenance activities.

8.7 Graffiti Removal

Concrete facilities, gates, and trees are sometimes subject to spray paint graffiti. SMP work crews survey for graffiti and then remove or cover graffiti as necessary. Graffiti removal activities apply all appropriate BMPs as identified Table 10-1. See Figure 8-2 for examples of graffiti removal maintenance activities.

8.8 Trash Clean-up

There are many sources of trash that enter the flood control system. Often urban debris is dumped into creeks intentionally to avoid dump fees. The public utilizes the linear park system along flood control channels and litters water bottles, food wrappers, plastic bags, etc., that are then carried downstream. As described below in Section 8.9, "Urban Creek Issues", homeless encampments are common on program flood channels. Piles of garbage inside the flood plain waiting to be captured by rising flows are commonly associated with homeless encampments. Often before vegetation management or sediment removal can occur, debris and garbage must be removed. This kind of clean-up is needed year-round. Trash clean-ups apply all applicable BMPs as identified Table 10-1.

8.9 Urban Creek Issues

While Sonoma Water's selection and prioritization of maintenance activities for individual reaches focuses on maintaining flood capacity while protecting and enhancing natural resources, they are also obligated to take public safety issues into account. In urbanized areas, Sonoma Water considers past flooding history and other non-hydraulic information in prioritizing maintenance activities, including issues related to adjacent land use, public safety, pedestrian visibility, emergency access, fire management, and pest and animal management.

8.9.1 Urban Surface Flooding

For channels under Sonoma Water's authority, Sonoma Water is responsible for providing adequate flood protection and channel conveyance. Flow conveyance targets, or the Level-of-Service (LOS), for each maintenance reach are determined by as-built plans and specifications for engineered modified channels and/or the historic flow conveyance or a Federal Emergency Management Agency (FEMA) designated flow rate for non-engineered modified channels. To decrease flooding risks and uncertainties, Sonoma Water also includes a safety factor of one to several feet above the LOS or projected flood elevation, referred to as freeboard.

8.9.2 Homelessness

Riparian corridors, channel right-of-way's, and bridge underpasses are increasingly exploited as locations for homeless encampments. Encampments can cause damage to structures and flood control facilities, cause significant ecological degradation, lower water quality, and create a serious public health hazard and public safety concern. Unwanted trash and debris become harborages and food sources for vectors and related pathogens, sources of odors, fuel for fires, and a nuisance to the public. Homelessness also generates enormous quantities of trash and hazardous materials (e.g., human waste, hyper-dermic needles, paints and solvents, batteries, and aerosols) that require specialized hazardous materials training, appropriate Personal Protective Equipment (PPE), personnel vaccinations, and proper disposal methods.

As a steward of the environment, Sonoma Water works with local partners, including non-governmental organizations (NGOs), schools, businesses, and residents, in assessing existing obstructions and abandoned structures. Local partners are encouraged to contact the Sonoma Water to report illegal dumping or spills. Sonoma Water also works with local law enforcement to control the establishment of homeless encampments on the flood control channels under Sonoma Water authority. Under these partnerships, Sonoma Water may provide guidance, support, or funding for trash removal efforts.

8.9.3 Urban Fire Risks and Safety Concerns

Maintenance channels in the program area are generally located in developed areas and act as an interface between natural and urban areas. Overgrown vegetation within riparian corridors and flood control channels provides a potential fuel source for wildfires. However, vegetation can be managed to minimize the potential for ignition, facilitate suppression activities, and reduce the likelihood of extreme fire behavior. Sonoma Water considers potential risks of wildfire when determining the timing and extent of vegetation management within urbanized areas.

In addition to wildfire risks, dense vegetation may present other safety concerns. Many channels are publicly accessible via walkways or at road crossings and overgrown vegetation may conceal potential threats to pedestrians. Also, dense understory can screen bank or bed conditions, obstructing the view of Sonoma Water personnel and their ability to identify and assess channel instabilities.

8.10 Management Triggers for Public Safety Objectives

Table 8-1 below provides a list of potential management actions and triggers to initiate each action for the objective of protecting public safety including reducing the fire risk, maintaining visibility, and reducing other signs of delinquent activity. Where noted, some of the public safety (PS) triggers are shared with vegetation management (VM) triggers. Table 8-1 defines each potential management option and conditions that trigger implementation of each action, allowing SMP staff to more consistently select appropriate management actions when necessary.

Table 8-1. Public Safety Potential Management Actions and Triggers

Trigger I.D.	Management Triggers	Potential Management Actions
VM-1/PS-1	Vegetation is presenting a considerable fall hazard	Remove, reorient, or reduce hazard height below 3'
VM-1/PS-2	Dead or dying trees present a public hazard	

<table>
<tr><th>Trigger I.D.</th><th>Management Triggers</th><th>Potential Management Actions</th></tr>
<tr><td>PS-3</td><td>Urban channel sight lines are obscured and clear visibility through the channel zone is impaired</td><td rowspan="2">As feasible, coordinate with local law enforcement to determine how vegetation management could support public safety codes. As determined necessary, vegetation management activities would be based on coordination efforts with local law enforcement and/or the trigger evaluation process. Management actions would include: thinning woody understory to regain sightlines (in accordance with channel form vegetation allowance) and lifting established trees and shrubs at least 6'.</td></tr>
<tr><td>PS-4</td><td>Signs of delinquent activity (e.g. graffiti, trash) and/or illegal encampments present</td></tr>
<tr><td>PS-5</td><td>Reach presents a fire risk, subject to California Fire Code Section 304.1.2, which states: "Weeds, grass, vines, or other growth that is capable of being ignited and endangering property shall be cut down and removed by the owner or occupant of the premises" and/or weed abatement notice has been received to remove hazardous vegetation</td><td>Mow dry grasses and herbaceous (i.e. non-woody) vegetation above the ordinary high water mark to height ≤4”.
Manage vegetation to ensure that the potential for grass-to-brush and brush-to-tree type ladder ignitions are reduced to a safe level.
Manage vegetation in fire lanes to ensure that tall grass is not creating a fire risk into neighborhoods.</td></tr>
<tr><td>PS-6</td><td>Reach presents a fire risk, subject to California Fire Code Section Chapter 49, (Requirements for Wildland-Urban Interface Fire Areas), Section 4906: Hazardous Vegetation and Fuel Management, and/or fire abatement notice has been received to remove hazardous vegetation</td><td>Lift (remove lower limbs) at least 8-15’ for mature trees and 3-6’ feet for large shrubs/young trees
Clear zone adjacent to combustible structure (wood fence, etc.) and also clear zone for outfalls and other infrastructure, 10-30’
Maintain sight lines between thalweg and access road (involves thinning recruits to target vegetation template goal)
Removing dead branches, dried and downed trees and other flammable woody material</td></tr>
</table>

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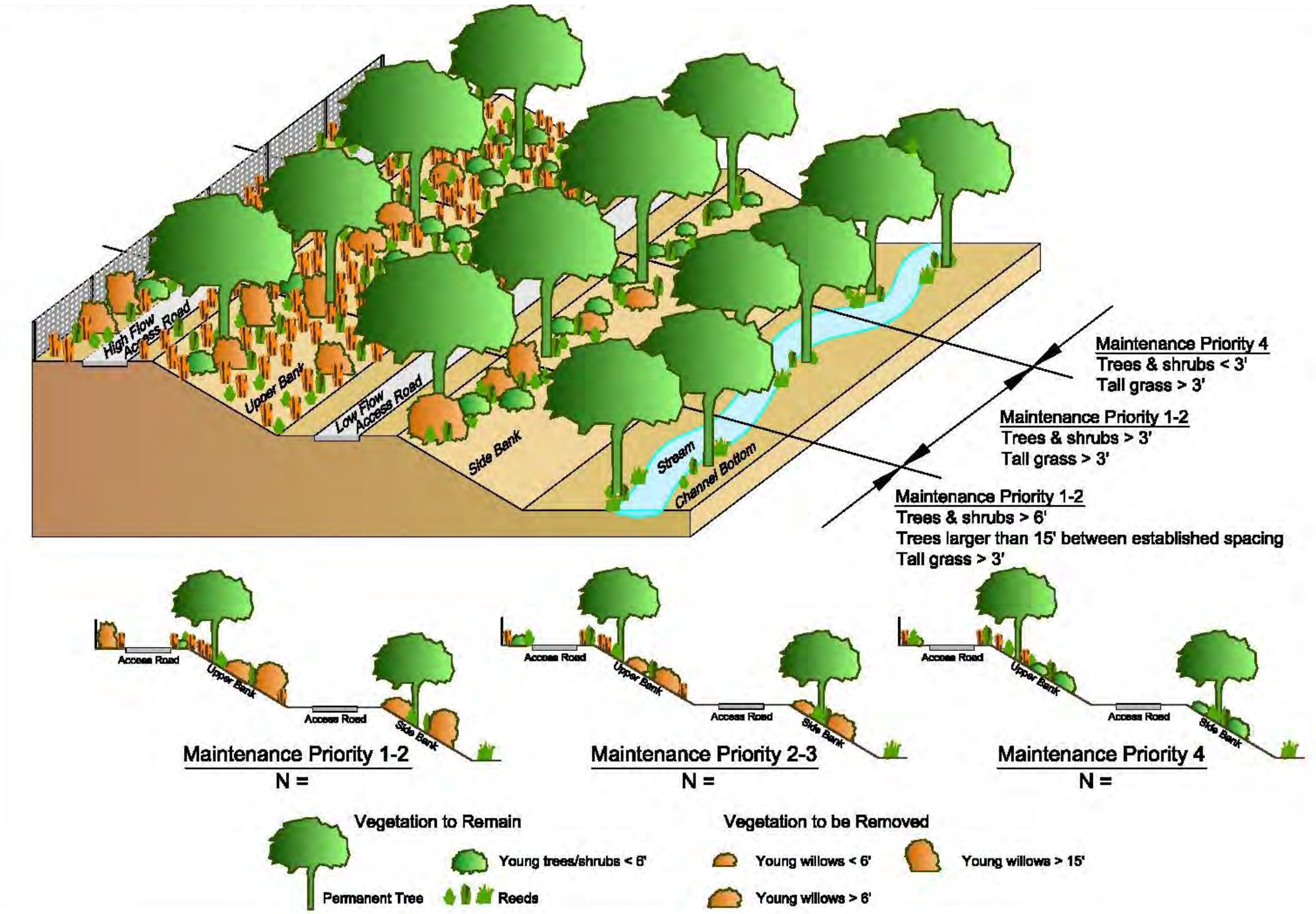

This figure illustrates upper bank vegetation management approaches incorporating public safety considerations such as: keeping site lines open, keeping fence-line lifted, pruning urban high, and reducing hiding places.

Figure 8-1

Vegetation Management Target for Upper Banks in Urban Area

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Photo a. Debris blockage in Laguna de Santa Rosa (Zone 1A).

Photo b. Removing debris from Laguna de Santa Rosa (Zone 1A).

Photo c. Graffiti on bulkhead on Copeland Creek (Zone 1A).

Photo d. Graffiti on bridge piling on Santa Rosa Creek at Willowside (Zone 1A).

Figure 8-2

Examples of In-channel Debris and Graffiti Removal

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Chapter 9
SEDIMENT DISPOSAL AND REUSE

9.1 Sediment Disposal and Reuse Planning Approach

Sediment disposal and reuse is an integral component of the Stream Maintenance Program (Program or SMP). Sediment removal activities described in Chapter 5 typically generate approximately 20,000 to 25,000 cubic yards of sediment per year. The majority of this material is sediment but plant debris may be included. A small portion of the sediment can be reused onsite to support restoration activities or may be used for other Sonoma County Water Agency (Sonoma Water) activities, but the majority requires offsite disposal. Going forward, and as described further below, Sonoma Water continues to look for opportunities to form partnerships with other local agencies and landowners to reuse sediment in a regionally coordinated manner. Collected sediment may be a valuable resource in the future to help support climate change adaptation activities. This section describes the planning approach for sediment disposal activities that occur annually together with the other program activities.

9.1.1 Sediment Disposal and Reuse Goals

Federal and state regulations govern the disposal of sediment and debris. Sonoma Water complies with these regulations to ensure disposal activities do not harm people or aquatic habitats. The SMP has the following sediment disposal and reuse goals:

- Protect the safety of workers, the public, and the environment from potentially harmful debris;
- Beneficially reuse as much sediment as possible from maintenance activities;
- Utilize the nearest off-site disposal location as feasible to reduce potential impacts resulting from the hauling of sediment;
- Do not use sediment to fill creeks, lakes, or wetland habitat, except as part of previously permitted projects that are seeking good quality fill material;
- Contain disposal sites to prevent sediment from entering nearby waterbodies;
- Comply with human health and environmental protection standards, as established by federal and state agencies, for all sediment disposal activities; and
- Protect and ensure that fragments of non-native propagules cannot re-enter local channels. This is of particular importance for water primrose (*Ludwigia peploides montevidensis*) removal in Zone 1A where *Ludwigia* is a major invasive species management issue.

9.1.2 Annual Sediment Disposal and Reuse Planning

Sediment disposal planning is coordinated and integrated with the annual SMP work cycle (as described in Chapter 12, *Program Management*). The primary sites for sediment disposal include: local gravel reuse companies who are interested in material that can be used as aggregate for concrete mixes and construction material; landscaping-related businesses; local dairies in the Stony Point road vicinity; local general contractors seeking fill material for construction projects; the Sonoma County Central Landfill in Petaluma; and onsite backfill material (construction fill) at the Sonoma Water Mirabel Facility exclusively. As part of the SMP Manual update, Sonoma Water will look for opportunities to partner with other local agencies (e.g., Sonoma County's Roads Department and Public Works Department) to utilize sediment in a regionally coordinated manner. For example, Sonoma Water is currently is considering using Riverfront Regional Park as a temporary sediment disposal area as the County may implement future restoration projects at this park where sediment could be reused.

The annual sediment disposal planning process includes the following steps:

Step 1: Identify the need, location, and volume of sediment removal

During the annual maintenance inspection and prioritization process, sediment removal locations and estimated sediment quantities are identified. Sediment removal designs assist in calculating locations and quantities of sediment to be removed. Once the locations and volumes of the sediment to be removed are known, reuse or disposal options are evaluated. Following the disposal goals presented above, all efforts are made to reuse sediment on-site or for a local Sonoma County use.

Step 2: Sediment sampling and testing

Sediment disposal and reuse sites must be approved by the Regional Water Quality Control Board (RWQCB) Executive Officer on an annual basis, prior to initiation of sediment removal activities. The conditions for site approval are based on analytical results from sediment sampling at the proposed maintenance locations and at the proposed disposal or reuse sites.

SMP requirements for sediment sampling and testing are described in the Monitoring and Reporting Programs (MRP) attached to the authorizations issued by the San Francisco Bay RWQCB (WDR Order No. R2-2016-0020) and the North Coast RWQCB (WDR No. R1-2009-0049 and Section 401 Water Quality Certification WDID No. 1B09026WNSO, ECM PIN CW-735104).

Per the requirements of the MRPs, Sonoma Water samples, tests, and evaluates sediment targeted for removal for its grain size, total organic carbon, metals, polycyclic aromatic hydrocarbons (PAH), and other organochlorine pesticides chemical concentrations. Sediment testing results, including maps of sampling locations, are submitted annually to the RWQCBs for their review prior to initiation of sediment management activities. The RWQCB Executive Officer reviews the testing results from the maintenance sites and the proposed disposal sites and, upon receipt of satisfactory results, issues an approval letter for placement of sediment at the proposed disposal sites.

The SMP Database includes the annual summary reports submitted to the RWQCBs, as well as, the data and results of the sediment testing. Tables A-4 and A-5 in Appendix A identify the SMP creeks and reaches where sediment testing has occurred under the Program between 2010 and 2019. The sampling parameters/analytes required by the RWQCB have been modified since Program inception based on the on-going collection of sediment samples and results.

For all projects, any observed contamination as evidenced by chemical-like odors, oily sheens, or irregularly colored sediment would be immediately reported to the local fire department's hazardous materials team and the appropriate RWQCB staff person in the Cleanup and Investigations Unit. These agencies would then direct Sonoma Water on how to handle and remove potentially hazardous sediment.

If testing results are found to exceed selected water quality criteria, Sonoma Water coordinates with the appropriate RWQCB to develop a contingency sampling plan. In this event, additional samples are taken to determine the extent of contamination and pinpoint potential contamination sources. Under the guidance of the RWQCB, selection of the number and location of additional samples is determined based on potential contamination sources such as parking lots, automotive service centers, and dry cleaners. All excavated materials are stockpiled separately on heavy plastic, covered, and stored until an appropriate disposal location is determined. Additional sampling results are then compared to the Total Threshold Limit Concentrations (TTLCs) and Soluble Threshold Limit Concentrations (STLCs) specified in California Code of Regulations (CCR) Title 22 Chapter 11 for hazardous waste identification. Sediments not meeting the TTLC and/or STLC criteria are disposed of at an appropriate treatment, storage, and/or disposal, facility.

Step 3: Identify sediment disposal options

Based on the results of the sediment testing, sediment disposal options are identified. There are seven general categories of potential reuse or disposal options. These disposal options are listed below and are considered according to how well the options support Program objectives for sustainability and avoidance of environmental impacts.

- **On-site reuse.** This includes reusing the sediment on-site (i.e., at the maintenance project site or reach) within the channel or easement area for various fill or restoration purposes. For example, sediment excavated from the channel bottom could be placed adjacent to the active channel (remaining within the easement area), to enhance soil, vegetation, and riparian habitat conditions. Sediment could also be used on-site for bank stabilization purposes. On-site sediment reuse is often limited or not available due to various physical constraints at the channel site, including limited conveyance capacity, no available bench or terrace for sediment placement, or a very narrow channel easement.
- **Other Sonoma Water site reuse.** Similar to on-site reuse, this includes reusing the sediment at other Sonoma Water owned or managed sites, such as channel or easement areas, for fill or restoration purposes. The key difference is that this option would occur at a different channel or easement area within the program area, but in a similar setting to where the sediment was originally removed.
- **Wetland or floodplain restoration or enhancement.** This consists of beneficial reuse of the sediment outside or off-site of Sonoma Water channel or easement areas, but in a wetland or floodplain setting to support ecologic functioning and habitat. As examples,

gravel removed from one creek that does not support steelhead or salmonids could be placed in another creek to enhance salmonid habitat.

- **Upland agricultural or commercial reuse (dry).** Sediment is reused for upland agricultural or commercial reuses that are dry, whereby the sediment would not be secondarily eroded to stream channels or water bodies. Demand for dry sediment is high, particularly for use as soil amendment for agricultural crops or used as construction base rock for building pads, foundations, other structures, or roads.
- **Upland agricultural or commercial reuse (wet).** Under this option, sediment would be used as fill in an already approved and permitted wetland project. This is a specific case where an approved and permitted project requires the use of sediment to fill a wetland. It is important to note that this sediment disposal plan in no way encourages or sanctions the filling of existing wetlands. However, for projects that are already approved and permitted, it may be preferable to use sediment materials that share similar wetland properties. In this way, using good quality excavated channel sediment for reuse in a wetland setting may be preferable or advantageous to using other fill material or soils.
- **Landfill disposal.** Sediment would be disposed at an approved and operating landfill for use as daily cover material for landfill operations. Currently, waste generated in the program area is taken to the Redwood Landfill in Novato, California through an agreement with the Sonoma County Waste Management Agency. Sediment would be taken to the nearest landfill in need of cover material.
- **Hazardous waste disposal.** This option involves the disposal of sediments containing hazardous levels of contaminants. Hazardous waste is disposed at appropriate hazardous waste facilities. The nearest hazardous waste landfill is located in Kettleman City, California.

Multiple options can be used in a given maintenance season for sediment disposal. Off-site disposal (third, fourth, fifth, sixth, and seventh options) is required for the majority of maintenance activities. Hazardous waste disposal would only be used if the sediment is deemed hazardous.

A resource assessment is necessary for most potential disposal sites, though not necessary for the landfill and hazardous waste options. A resource assessment and screening process includes delineating wetlands at the disposal site, evaluating site habitats for suitability and presence of sensitive species, and reviewing the site’s cultural and historic resources. Other natural resources that may influence the site’s suitability to receive sediment are also evaluated. Assessing disposal or reuse site resources guide and screen the selection of the most suitable disposal methods. The following criteria were developed specifically for the SMP to guide sediment disposal activities:

- Disposal of sediment cannot conflict with previously planned land uses, as identified in city/county general plans or more site-specific plans.
- Permits and approvals if required are obtained prior to the onset of disposal activities.

- Sediment disposal does not result in fill of wetlands or waters of the U.S. or state (unless previously permitted).
- Based on compliance with CCR Title 22 criteria, sediment identified as hazardous or designated waste are placed at an appropriate hazardous waste facility.

Potential disposal sites are identified in the annual SMP notification and reporting process described in Chapter 12.

Step 4: Identify the appropriate best management practices (BMPs) to avoid or reduce impacts generated by sediment loading, transport, and disposal activities

All BMPs implemented for the maintenance activities, as described in Chapter 10, Table 10-1, are applied to activities associated with loading, transport, and disposal of sediment. Based on the amount of sediment requiring off-site disposal, the number of trucks required for transport to the disposal location is estimated, as well as the hauling routes identified.

Step 5: Notification

Consistent with the annual notification process for the SMP (Chapter 12) Sonoma Water notifies the appropriate regulatory agencies permitting the SMP on the status of annual sediment disposal needs (following the planning process outlined above) and the identified disposal sites. Sediment testing results from the creek and disposal sites are provided to the agencies along with the notification package. Approval for use of the disposal sites is obtained from the RWQCB prior to initiation of maintenance activities.

Step 6: Post Maintenance Reporting

Consistent with the annual reporting requirements of the SMP described in Chapter 12, a description of the conducted sediment disposal activities is included in the annual SMP summary report.

9.2 Sediment Disposal Activities

Sediment disposal activities are essential to the completion of the sediment removal, bank stabilization, and vegetation removal core maintenance activities of the Program. Through pre-planning efforts, disposal sites are identified and permitted for use in accordance with federal, state, and local regulations, and appropriate landowner permits or agreements. Sediment disposal activities are described in a sediment disposal plan included in the annual notification report, developed along with the workplan for annual maintenance activities. The sediment disposal plan identifies disposal sites; loading, transportation, and placement BMPs; transportation routes; and other procedures to avoid or minimize potential impacts on people and the environment. Once the sediment from the creek and disposal sites have been tested and disposal locations have been approved by the RWQCB, implementation of the annual sediment disposal plan proceeds.

Sediment disposal activities involve loading, transport, and placement of sediment at the selected disposal locations. Sediment loading takes place at or near the channel maintenance site and involve use of front-end loaders and other heavy equipment to collect and place sediment into hauling trucks (see **Figure 5-7**, Photo d). Multiple hauling trucks may be filled depending on the quantity of sediment to be disposed. The trucks are covered to prevent sediment spill during transport, and applicable BMPs described in Table 10-1 are implemented to prevent impacts during handling and transport of the sediment.

Placement of the sediment at the offsite locations may involve use of equipment, such as bulldozers. The same BMPs applied during loading of the sediment, including those relating to equipment staging and maintenance, are applied while activities are conducted at the disposal site. The disposal site is managed in the same manner as the maintenance sites. If sediment is transported to a landfill for disposal, the trucks unload the sediment at the landfill. The landfill operators would then handle the sediment. Extra handling and transport precautions may be required if the sediment is classified as a hazardous material.

Chapter 10
IMPACT REDUCTION, MINIMIZATION MEASURES, AND BEST MANAGEMENT PRACTICES (BMPS)

10.1 Introduction

This chapter presents the program's impact reduction and minimization measures and best management practices (BMPs). These measures were identified and developed to protect the natural resources of the program area and the Beneficial Uses of the program's flood control channels. This chapter is best viewed in sequence, after Chapters 4 through 9, which precede it. Chapter 4, *Maintenance Principles,* guides the maintenance prioritization process and the maintenance work. Chapters 5 through 9 describe the approach, maintenance goals, and maintenance activities focusing on sediment removal, bank stabilization, and vegetation management, and other maintenance actions. The measures identified and described in this chapter are applied to the Program maintenance activities of Chapters 5 through 9. Taken together, the maintenance principles described in Chapter 4 and the maintenance activity-based measures described in this chapter provide a comprehensive approach to avoiding and minimizing program impacts. Chapter 11, *Program Mitigation* addresses the mitigation of residual impacts that are not adequately avoided or minimized through the approaches described in Chapters 5-9.

This chapter is organized around three essential tables: **Table 10-1**, **Table 10-2**, and **Table 10-3**, located at the end of the chapter. Table 10-1 presents program-wide BMPs according to the following topics:

- Timing of Work
- General impact avoidance and minimization
- Air quality
- Biological resources (including species-specific measures)
- Cultural resources
- Construction and seismicity
- Hazardous materials safety
- Vegetation management
- Water quality and channel protection
- Good neighbor policies

Table 10-2 indicates which BMPs from Table 10-1 are applicable to the program activities described in Chapters 5-9. For example, BMPs for channel dewatering (measure BR-4 in Table

10-1) apply to sediment removal and bank stabilization activities, but not to blackberry removal or mowing activities.

Many of the BMPs in Table 10-1 aim to avoid or reduce impacts to sensitive wildlife and plant species and their supporting habitats. Table 10-3 lists all of the engineered channel reaches in the program area and, as of July 2019, indicates any observed federal or state listed species (or the presence of suitable habitat for the listed species). Note that Table 10-3 is a snapshot in time and the Stream Maintenance Program (SMP) Database is updated more frequently and includes the latest information regarding applicable species occurrences.

In sum, these three tables describe what the avoidance and minimization practices are (Table 10-1), which BMP measures apply to which program activities (Table 10-2), and what is the status of federally or state listed species in the program reaches (Table 10-3). SMP Manager uses these three tables iteratively, along with the SMP Database which gets updated periodically, throughout program operations to identify the appropriate protective measures based on the nature of the planned maintenance activity, and the resources found in the reach where the activity occurs.

The reach maps provided in Appendix C illustrate vegetation conditions at the Program stream reaches.

10.2 Program-wide Best Management Practices

The following sections summarize the avoidance and minimization measures and BMPs for the resource topics listed above and shown in Table 10-1. For each resource topic, the key environmental concerns and objectives of the protective measures are described. If relevant, additional information on the regulatory context or specific regulatory requirements for the measures is provided. Table 10-1 should be referenced for specific details.

10.2.1 Timing of Work

The core SMP maintenance activities of sediment management, vegetation management, and bank stabilization can be classified as either causing or not causing ground disturbance. In Table 10-1, BMP GEN-1 Work Window describes the annual timing of maintenance work according to the status of the maintenance project as either causing or not causing ground disturbance. All ground-disturbing maintenance activities occurring in the channel (including sediment removal and bank stabilization) take place during the low-flow period, between June 15 and October 31. Exceptions may be made for emergencies or on a project-by-project basis with advance approval of Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), National Marine Fisheries Service (NMFS), and/or U.S. Fish and Wildlife Service (USFWS) as appropriate. During heavy storms in engineered channels through the urban zones, occasional removal of blown down trees and culvert blockages is needed in real-time to maintain flows and prevent flooding. This work is generally not ground disturbing but can be ground disturbing when a tree falls and roots and soil become exposed to high flows. This work is extremely time sensitive and must be accomplished immediately during high flow events (or immediately after water level recedes). In many cases during heavy winter storms, large downed trees that become entrained in high flows against culverts, sills, bridges and other trees are too hazardous to address in high flows. In these cases, the water level must recede before the work can take place.

In particularly dry years when channels remain dry earlier than June 15 or later than October 31, Sonoma County Water Agency (Sonoma Water) may request approval to conduct ground-disturbing type maintenance work prior to June 15 or later than October 31. Ground-disturbing activities are intended to be conducted during periods of dry weather. In the fall season, once the first significant rainfall occurs, all in-channel equipment and/or diversion structures shall be removed. Exposed soils in upland channel areas are stabilized via hydroseeding, hand seeding and straw, and/or with erosion control fabric/blankets. Significant rainfall is defined as 0.5 inch of rain in a 24-hour period.

Non ground-disturbing work (Urban Forestry Management) on the upper banks of stream channels (e.g., vegetation management, road, and V-ditch maintenance) may be conducted year-round. Non ground-disturbing work (vegetation thinning/pruning) may be conducted in the channel zone beyond the primary maintenance work window of June 15 to October 31, if the channel is dry and/or disturbance to the thalweg can be avoided (and with notification and approval by the relevant agencies).

10.2.2 General Avoidance and Minimization Measures

Channel maintenance activities occurring during the rainy season can result in potential environmental impacts, particularly to aquatic habitats. Potential impacts could include erosion from stockpiled sediments or pollutants from work equipment entering the creek. To prevent wet season impacts, instream SMP maintenance activities occur during the dry season when rain and flows are minimized. BMP measure GEN-1 *Work Window* defines the period of instream work activity for the SMP from June 15th to October 31st, although this work period could be extended in consultation with regulatory agencies. The staging and stockpiling of maintenance equipment and materials is restricted, monitored, and maintained to prevent transport of wash water containing sediment or hazardous chemicals to storm drains, creeks, or surrounding properties.

In accordance with the Maintenance Principles presented in Chapter 4, BMPs were also developed to ensure that maintenance activities would be conducted to protect and enhance existing habitat-supporting characteristics of the stream system. When heavy equipment must access sensitive creek areas, such as the creek bed and banks, measures are taken to avoid harm to trees and compaction of soil and the area is stabilized and restored after maintenance is complete. Details of these measures are provided in Table 10-1.

The impact avoidance and minimization measures provided in Table 10-1 are based on conditions required in a typical storm water pollution prevention plan (SWPPP). These conditions are required for construction activities conducted under the National Pollution Discharge Elimination System (NPDES) Construction General Permit. Storm Water Management Plans (SWMPs) are required by current municipal NPDES permits in the County. SMP maintenance activities are not directly required to comply with conditions of NPDES stormwater permits; however, implementation of SMP maintenance activities would be consistent with requirements of the permits and management plans.

10.2.3 Air Quality Protection

All activities conducted under this SMP comply with pertinent requirements of federal, state, and local environmental laws and regulations for air quality, including, but not limited to, the federal Clean Air Act and state and local air pollution ordinances.

Any activity that entails earthwork and/or construction must implement dust control measures, as required by the Bay Area Air Quality Management District (BAAQMD). The BAAQMD's *Basic Construction Mitigation Measures* (Bay Area Air Quality Management District [BAAQMD] 2011) are implemented for all stream maintenance activities (BMP measure AQ-1).

10.2.4 Biological Resources Protection

A large number of maintenance activities are conducted in areas which are natural or semi-natural, where activities could disturb biological resources. The primary maintenance activities of the SMP are sediment and vegetation removal from creek channels that provide habitat for a variety of species, including special-status species which are protected under federal and state regulations. Implementation of ground-disturbing maintenance during the dry season, as prescribed by BMP measure GEN-1 *Work Window*, assists in minimizing impacts to aquatic biological resources. As shown in Table 10-1, additional measures were developed to minimize disturbance to biological resources including the training of maintenance personnel to identify and protect special-status species and proper implementation of dewatering activities. Activities conducted under this SMP comply with applicable federal, state, and local laws and policies that protect biological resources, including but not limited to the federal Endangered Species Act, federal Migratory Bird Treaty Act, the California Endangered Species Act, the California Environmental Quality Act, and the California Fish and Game Code. Compliance with these regulations are met through the programmatic permitting for the SMP and the SMP Environmental Impact Report. This includes compliance with terms and conditions of biological opinions issued for federally protected species, such as salmonids.

This Program Manual was developed to include a fundamental understanding of biological resources within the flood control channel system. The SMP maintenance approach considers the ecological health of the channels and the link between maintenance and the opportunities to improve or enhance habitats. Programmatic and activity-specific BMPs are used to support this connection. Table 10-3 identifies which federally or state listed fish, wildlife, and plant species may potentially occur in the Program's maintenance reaches. Based on possible occurrence of species as shown in Table 10-3, the species-specific BMPs identified in Table 10-1 are applied when conducting maintenance activities in those reaches.

When the Program was initiated in 2008 much of the work focus was on conducting maintenance at engineered reaches where routine maintenance had been deferred or ceased since the time of the salmonid listings in the late 1990s. As described in Chapter 7, *Vegetation Management,* a small portion of Sonoma Water's efforts in modified and natural channels involves removing minor vegetation blockages and tree limbing to remove significant flow obstructions. Modified and natural channels typically have higher resource values and require careful implementation of potential impact avoidance and minimization measures and BMPs. Table 10-3 is reviewed and adaptively updated (if needed) during the Program's annual workplan development process. Sonoma Water develops project specific notifications for work in modified or natural channel easements. Project-specific notifications include a wetland delineation (if needed), the results of site surveys for special-status plant and animal species, and identification of significant habitat features, and identification of appropriate avoidance and reduction measures. All these measures are taken to reduce the environmental effects associated with the maintenance work.

10.2.5 Cultural Resources Protection

Because most flood control channels Sonoma Water maintains have been engineered and/or significantly modified from their natural condition, most activities identified in this SMP Manual have little or no potential to affect cultural resources. However, bank stabilization or other activities that require disturbance or compaction of native soils could disturb or damage buried resources, if they are present. Ground-disturbing activities conducted under this SMP must comply with federal, state, and local laws and policies protecting cultural resources and human remains, including but not limited to the National Historic Preservation Act, Native American Graves Protection and Repatriation Act, and the California Public Resources Code (PRC). Sonoma Water also ensures compliance with laws regarding the treatment of Native American remains. Pursuant to Section 5097 of the PRC, Native American burials are under the jurisdiction of the Native American Heritage Commission and the treatment of any native remains are coordinated with this agency and the appropriate affiliated Native American Tribe(s).

Compliance with these regulations is met through the Program’s permitting and authorizations. A cultural resources inventory and report identify known cultural resources in the program area. This report provides guidance to Sonoma Water when conducting ground-disturbing activities. The status of sensitive cultural resources for the planned project sites or reaches are confirmed by the program manager prior to any work occurring.

Although the cultural resources inventory provides Sonoma Water with information on known cultural resources, it is possible that undiscovered cultural or paleontological resource may be present in the program area. Therefore, Table 10-1 and Table 10-2 identify programmatic BMPs that are applied to ground-disturbing maintenance activities to identify potential resources that are currently unknown. Additionally, because some of the maintenance sites may not have been surveyed or disturbed for over five years, and new discoveries may have surfaced during that time, a BMP measure is included to conduct a cultural resources assessment of those sites. In general, cultural resources assessments are conducted at maintenance sites that are anticipated to result disturbance of native soils. The assessment includes a records search, Native American Tribe consultation, a pedestrian survey, and preparation of a report to document the results.

10.2.6 Hazardous Materials Safety

Certain maintenance activities require mechanical equipment that uses fuel and lubricants, or the application of herbicides that are hazardous to people and the environment if misused. If such fuels, lubricants, herbicides, or other chemicals were accidently spilled, potential contamination of the program area’s water and soil could result.

BMPs in Table 10-1 include detailed procedures to ensure all equipment is properly maintained and handled to minimize the risk of environmental contamination. Procedures to respond to accidental spills or discovery of previously unknown contamination are implemented as part of a

Spill Prevention and Response Plan. This plan is also a requirement of the NPDES Construction General Permit mentioned previously.

Historic and current soil and groundwater contamination from industrial and commercial activities (gas stations and dry cleaners) in close proximity to maintenance sites may be contributing pollutants to the sediments or water in the channels. Disturbance of existing known contamination, including groundwater plumes, during maintenance could disrupt cleanup efforts or exacerbate pollution issues. As such, a database search for existing contamination within 1,500 feet of the work site is conducted during the project design phase. Sonoma Water works with staff from the Regional Water Quality Control Board’s Cleanup and Investigations unit to determine if and how maintenance activities can proceed.

Program creeks can be common locations for illegal dumping of trash containing hazardous waste, such as tires, oil filters, paint cans, and electronic devices, project activities could encounter hazardous waste. Creek channels also receive runoff from streets and urbanized areas which carry non-point source contaminants like oil and paint that are poured down storm drains. Indirect contamination of creeks occurs when contaminants are transported through the storm drain network and deposited directly to streams. Presence of these contaminants can sometimes be observed as an oily sheen, a discoloration of the soil, or an unnatural chemical odor. If presence of potential contaminants is observed at the site, the area is treated as if a hazardous spill occurred.

Soil testing is conducted in all sediment removal and bank stabilization projects in accordance with the MRP attached to the authorizations issued by the San Francisco Bay RWQCB (WDR Order No. R2-2016-0020) and the North Coast RWQCB (WDR No. R1-2009-0049 and Section 401 Water Quality Certification WDID No. 1B09026WNSO, ECM PIN CW-735104). Appendix A includes a summary of sediment testing results to date under the Program. If soils are encountered that contain concentrations of listed substances that exceed hazardous waste levels, the contaminated area is treated as if a hazardous spill occurred (i.e., the Spill Prevention and Response Plan is implemented) and all measures to ensure compliance with federal, state, and local regulations are taken. Any observed contamination as evidenced by chemical-like odors, oily sheens, or irregularly colored sediment is immediately reported to the local fire department’s hazardous materials team and the appropriate Regional Water Quality Control Board staff person in the Cleanups and Investigations Unit.

Maintenance activities are conducted during the dry season, a period when the threat of wildland fire is the highest. Equipment used for maintenance activities use flammable fuels and lubricants. Table 10-1 includes a BMP to reduce the risk of fire ignition during maintenance activities.

10.2.7 Vegetation Management

Vegetation management activities involve removal, thinning and pruning of trees and shrubs by hand or with the use of machinery. Herbicides are used to control invasive plant species. Maintenance activities also include planting and revegetation of the work site.

Table 10-1 includes specific BMPs to avoid or minimize potential impacts from vegetation management activities. Vegetation management BMPs support preservation of as much existing vegetation as is possible, particularly for native species, and fostering a balance between habitat and flood conveyance. BMP measure VEG-2 *Use of Herbicides* ensures the use and handling of herbicides for maintenance activities is consistent with federal, state, and local regulations. BMP measure VEG-3 ensures that work sites are properly replanted and monitored for successful revegetation.

10.2.8 Water Quality and Channel Protection

The combination of the General Impact Avoidance Measures and the Biological Resource Protection, Hazardous Materials Safety, Sediment Management, and Vegetation Management BMPs discussed above and in Table 10-1 also protect against water quality degradation during and after maintenance activities. An additional BMP measure is included in Table 10-1 that prescribes proper use of erosion controls for exposed soils after maintenance work is complete (BMP WQ-1 *Apply Erosion Control Fabric to or Hydroseeding of Exposed Soils*).

Implementation of the BMPs in Table 10-1 comply with federal, state, and local regulations to protect water quality, including the requirements of NPDES stormwater discharge and aquatic pesticide application permits and management plans.

Table 10-1 also includes a BMP to guide in-channel grading activities such that post sediment removal channel grades are geomorphically appropriate, that in-channel bed forms such as meanders, bars, and benches are preserved, and that sudden or sharp transitions in bed elevations do not occur.

10.2.9 Good Neighbor Policies

In general, the work duration at a project site or reach varies from less than a day to a week. Many work sites are located in residential areas or near to businesses, schools, and libraries. Good Neighbor BMPs were developed to keep work sites clean, reduce loud noises, ensure vehicle and pedestrian access, and reduce unpleasant odors.

To avoid adverse effects on creekside views from neighboring homes and businesses, SMP activities implement work site “housekeeping” measures to keep sites neat, clean, and orderly during and after maintenance.

To minimize the effects of noise on neighboring homes and businesses, work is limited to normal business hours (8:00 a.m.–5:00 p.m.). Routine activities in residential areas do not occur on Saturdays, Sundays, or Sonoma Water observed holidays. Sound control devices are actively used on all power equipment.

Most maintenance activities occur on access roads adjacent to stream channels that are not open to public vehicular use. Therefore, SMP maintenance activities have very little potential to disrupt traffic circulation except in situations when necessary to close travel lanes temporarily (e.g., to remove debris from a bridge or culvert), or where maintenance vehicles are traveling to and from the maintenance sites (e.g., fill hauling).

Depending on the channel location and reach conditions, sediment removed as part of maintenance activities may be rich in decaying organic matter which generates gases such as reduced sulfur compounds that are unpleasant. Where feasible, to prevent impacts of nuisance odors on nearby residences, stockpiled sediment removed from channels is promptly removed or placed as far away as possible from residential areas and odor sensitive land uses.

To keep the public informed about stream maintenance work (why it is necessary, when it occurs, and what a neighborhood can expect when crews arrive to conduct maintenance work) Sonoma Water posts and updates information about planned maintenance activities on their website, as stated in BMP measure GN-2 *Public Outreach*. Each spring, once maintenance sites have been selected for the annual work season, a newspaper notice is published with information on the planned maintenance sites, approximate work dates, and contact information.

Signs are posted in the neighborhood to notify the public two weeks in advance of maintenance schedules, trail closures, and road/land closures as necessary. As discussed under BMP measure GN-2 *Public Outreach*, signage used at work sites provide contact information for lodging comments and/or complaints regarding the activities.

10.3 Updating Table 10-3 Species Rankings

It is anticipated that as SMP restoration activities are implemented and established, stream reaches that currently do not provide suitable habitat for special-status species may improve. To provide feedback and current assessments of habitat, annual field visits are conducted by Sonoma Water staff at that year's proposed maintenance sites to assess current habitat conditions and determine if management actions are needed per species-specific BMP measures BR-8 through BR-19. Results of these habitat assessments and corresponding updates to Table 10-3 species rankings are included in the Annual Notification and/or Report (depending on assessment timing) for final approval by resource agencies. In addition,

Table 10-3 is updated with the results of focused species surveys/monitoring, species encountered during maintenance activities, and species captured and relocated during channel dewatering (BMP measure BR-5).

10.3.1 California Tiger Salamander Distance Rankings

Table 10-3 provides the distance of SMP reaches from known California tiger salamander (*Ambystoma californiense*) (CTS) occurrences. Program CTS distance rankings are categorized as follows:

1. Less than 500 feet from a known CTS occurrence.

2. Greater than 500 feet and less than 2,200 feet from a known CTS occurrence.

3. Greater than 2,200 feet and less than 1.3 miles from a known CTS occurrence.

4. Greater than 1.3 miles from a known CTS occurrence.

In order to determine CTS distance rankings, Sonoma Water performs a digital spatial analysis to measure the distance of SMP stream reaches to known (extant, presumed extant) CTS occurrences. The spatial analysis is performed annually each spring, and based on the latest available California Natural Diversity Database (CNDDB) inventory at that time. In instances where a stream reach includes more than one CTS distance ranking, the distance in feet of each rank is provided in Table 10-3. CTS distance ranking spatial analysis maps are provided each year for anticipated ground disturbing projects in the Annual Notification for approval by resource agencies. A discussion of CTS mitigation requirements for ground-disturbing activities is provided in Chapter 11.

Table 10-1. Stream Maintenance Program Best Management Practices

BMP ID	Name	BMP
General Impact Avoidance and Minimization		
GEN-1	Work Window	1. All ground-disturbing maintenance activities occurring in the channel (i.e., from top-of-bank to top-of-bank) will take place during the low-flow period, between June 15 and October 31. Exceptions may be made for emergencies or on a project-by-project basis with advance approval from RWQCB, CDFW, NMFS, and/or USFWS as appropriate. 2. Once the first significant rainfall occurs, all in-channel equipment and/or diversion structures shall be removed. Exposed soils in upland areas will be stabilized via hydroseeding or with erosion control fabric/blankets. Significant rainfall is defined as 0.5 inch of rain in a 24-hour period. 3. Work on the upper banks of stream channels (e.g., vegetation, road, and v-ditch maintenance) may be conducted year-round. Ground disturbing activities will only be conducted during periods of dry weather.
GEN-2	Staging and Stockpiling of Materials	1. Staging will occur on access roads, surface streets, or other disturbed areas that are already compacted and only support ruderal vegetation to the extent feasible. Similarly, to the extent practical, all maintenance equipment and materials (e.g., road rock and project spoil) will be contained within the existing service roads, paved roads, or other pre-determined staging areas. Staging areas for equipment, personnel, vehicle parking, and material storage shall be sited as far as possible from major roadways. 2. All maintenance-related items including equipment, stockpiled material, temporary erosion control treatments, and trash, will be removed within 72 hours of project completion. All residual soils and/or materials will be cleared from the project site. 3. As necessary, to prevent sediment-laden water from being released back into waters of the State during transport of spoils to disposal locations, truck beds will be lined with an impervious material (e.g., plastic), or the tailgate blocked with wattles, hay bales, or other appropriate filtration material. If appropriate, and only within the active project area where the sediment is being loaded into the trucks, trucks may drain excess water by slightly tilting the loads and allowing the water to drain out through the applied filter.

BMP ID	Name	BMP
		4. Building materials and other maintenance-related materials, including chemicals and sediment, will not be stockpiled or stored where they could spill into water bodies or storm drains or where they will cover aquatic or riparian vegetation. 5. No runoff from the staging areas may be allowed to enter waters of the State, including the creek channel or storm drains, without being subjected to adequate filtration (e.g., vegetated buffer, hay wattles or bales, silt screens). The discharge of decant water from any on-site temporary sediment stockpile or storage areas, to waters of the State, including surface waters or surface water drainage courses, outside of the active project site, is prohibited. 6. During dry season, no stockpiled soils shall remain exposed and unworked for more than 30 days. During wet season, no stockpiled soils shall remain exposed, unless surrounded by properly installed and maintained silt fencing or other means of erosion control. 7. All spoils will be disposed of in an approved location. Sediments that are found to contain contaminants in excess of hazardous materials disposal criteria will be stockpiled separately on heavy plastic pending disposal at an appropriate hazardous materials disposal location.
GEN-3	Channel Access	1. Access points to the channel for the purposes of stream maintenance will be minimized according to need. Access points should avoid large mature trees, native vegetation, or other significant habitat features as possible. Temporary access points shall be sited and constructed to minimize tree removal. 2. In considering channel access routes, slopes of greater than 20 percent shall be avoided if possible. Any sloped access points will be examined for evidence of instability and either revegetated or filled with compacted soil, seeded, and stabilized with erosion control fabric as necessary to prevent future erosion. 3. Personnel will use the appropriate equipment for the job that minimizes disturbance to and compaction of the stream bottom. Appropriately-tired vehicles, either tracked or wheeled, will be used depending on the site and maintenance activity.
Air Quality Protection		
AQ-1	Dust Management Controls (based on Bay Area Air Quality Management District's basic dust control measures for all sites)	Sonoma Water will implement the BAAQMD's Basic Dust Control Measures (www.baaqmd.gov) at maintenance sites less than 4 acres in size. Current measures stipulated by the BAAQMD guidelines include the following: 1. Water all active maintenance areas (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) at least two times per day to reduce dust emissions.

BMP ID	Name	BMP
		2. Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain freeboard as necessary to prevent transported material from blowing from the trucks. 3. Remove all visible mud or dirt track-out onto adjacent public roads using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited. 4. Limit all vehicle speeds on unpaved roads to 15 miles per hour. 5. Complete any paving of roadways, driveways and sidewalks as soon as possible. 6. Minimize idling times either by shutting equipment off when not in use or by reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure (Title 13, Section 2485 of the California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points. Provide clear signage for construction workers at all access points. 7. Maintain and properly tune all construction equipment in accordance with manufacturer's specifications. All equipment will be checked by a certified visible emissions evaluator. 8. Post a publicly visible sign with the telephone number and name of the person to contact at Sonoma Water regarding dust complaints. Following the review of any dust complaints, Sonoma Water's maintenance manager will respond and take corrective action within 48 hours.
Biological Resources Protection		
General Measures		
BR-1	Area of Disturbance	1. Activities will avoid damage to or loss of native vegetation to the maximum extent feasible. 2. Soil disturbance shall not exceed the minimum area necessary to complete the operations as described.
BR-2	Pre-Maintenance Educational Training	1. At the beginning of each maintenance season and before conducting stream maintenance activities, all personnel will participate in an educational training session conducted by a qualified biologist. This training will include instruction on how to identify bird nests, recognize special-status species that may occur in the work areas, and the appropriate protocol if any nests or listed species are found during project implementation. 2. Personnel who miss the first training session or are hired later in the season must participate in a make-up session before conducting maintenance activities.
BR-3	Biotechnical Bank Stabilization	If hydraulic conditions allow, the natural bank will be retained or a biotechnical repair technique will be used rather than, or along with, a hardscape repair.

BMP ID	Name	BMP
BR-4	Impact Avoidance and Minimization During Dewatering	1. All dewatering activities conducted in streams bearing state- or federally-listed salmonids shall comply with the terms and conditions of the Russian River Biological Opinion (summarized in BMP measure BR-18) for salmonids in Zone 1A, Programmatic Biological Opinion for salmonids in Zones 2A/3A, and any other Biological Opinions and associated Consistency Determinations issued by NMFS or CDFW for the SMP. 2. Prior to dewatering, the best means to bypass flow through the work area will be determined to minimize disturbance to the channel and avoid direct mortality of fish and other aquatic vertebrates. The area to be dewatered will encompass the minimum area necessary to perform the maintenance activity. The period of dewatering will extend for the minimum amount of time needed to perform the maintenance activity. Where feasible and appropriate, dewatering will occur via gravity driven systems. Where feasible and appropriate, diversion structures shall be installed on concrete sections of the channels, such as concrete box culverts often used at road crossings. 3. A species relocation plan (BMP measure BR-5) shall be implemented as a reasonable best effort to ensure that native fish and other native aquatic vertebrates and macroinvertebrates are not stranded. 4. Instream cofferdams shall only be built from materials such as sandbags, clean gravel, or rubber bladders which will cause little or no siltation or turbidity. Visqueen shall be placed over sandbags to minimize water seepage into the maintenance areas. The visqueen shall be firmly anchored to the streambed to minimize water seepage. If necessary, the footing of the dam shall be keyed into the channel bed at an appropriate depth to capture the majority of subsurface flow needed to dewater the streambed. 5. When use of gravity fed dewatering is not feasible and pumping is necessary to dewater a work site, a temporary siltation basin and/or use of silt bags may be required to prevent sediment from re-entering the wetted channel. 6. Downstream flows adequate to prevent fish or vertebrate stranding will be maintained at all times during dewatering activities. Bypass pipe diameter will be sized to accommodate, at a minimum, twice the summer baseflow. 7. Diverted and stored water will be protected from maintenance activity-related pollutants, such as soils or equipment lubricants or fuels.

BMP ID	Name	BMP
		8. If necessary, discharged water will pass over some form of energy dissipater to keep erosion of the downstream channel to a minimum. Silt bags will be equipped to the end of discharge hoses and pipes to remove sediment from discharged water. 9. For full channel dewatering, filtration devices or settling basins will be provided as necessary to ensure that the turbidity of discharged water is not visibly more turbid than in the channel upstream of the maintenance site. If increases in turbidity are observed, additional measures shall be implemented such as a larger settling basin or additional filtration. If increases in turbidity persist, turbidity measurements will be taken on a regular (i.e., at least daily) basis up- and downstream of the cofferdam enclosure. Data recorded will be compared against Regional Water Quality Control Board Basin Plan water quality standards. If Basin Plan standards are being exceeded, additional measures shall be installed and monitored to ensure Basin Plan standards are met. 10. When maintenance is completed, the flow diversion structure shall be removed as soon as possible. Impounded water will be released at a reduced velocity to minimize erosion, turbidity, or harm to fish or amphibians downstream. Cofferdams will be removed so surface elevations of water impounded above the cofferdam will not be reduced at a rate greater than one inch per hour. 11. The area disturbed by flow bypass mechanisms will be restored at the completion of the project. This may include, but is not limited to, recontouring the area and planting of riparian vegetation as appropriate.
BR-5	Fish and Amphibian Species Relocation Plan	1. All fish relocation conducted in streams bearing state- or federally-listed salmonids shall comply with the terms and conditions of the Russian River Biological Opinion (summarized in BMP measure BR-18), and any other Biological Opinions and associated Consistency Determinations issued by NMFS or CDFW for the SMP. This measure will also apply to relocation of other special status species aquatic species (i.e., foothill yellow-legged frog and western pond turtle), and native aquatic species that could be relocated. Relocation for California red-legged frog will be conducted in accordance with BMPs BR-10 and BR-11 and any additional measures contained in the forthcoming SMP Biological Opinion issued by the USFWS. 2. Prior to and during dewatering activities, native fish, tadpoles, and other vertebrates will be excluded from the work area by blocking the stream channel above and below the work area with fine-meshed net or screens. The bottom of the screens will be completely secured to the channel bed. Exclusion screening will be placed in areas of low water velocity to minimize fish

BMP ID	Name	BMP
		impingement. Screens will be checked periodically and cleaned of debris to permit free flow of water. 3. The most efficient means for capturing fish will be determined and implemented. Complex stream habitat generally requires the use of electrofishing equipment, whereas in deep pools, fish may be concentrated by pumping-down the pool and then removing the fish by seining or dip netting. Ample time will be scheduled to allow for a reasonable fish removal effort to be conducted. 4. Initial fish relocation efforts will be conducted several days prior to the start of maintenance activities. This provides the biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to maintenance activities. 5. All native captured fish will be allowed to recover from electrofishing before being returned to the stream. 6. During dewatering, a qualified biologist will direct and monitor activities as necessary to net and rescue any additional fish and/or amphibians that may have become stranded throughout the dewatering process. 7. Prior to capturing fish and/or amphibians, the most appropriate release location(s) will be identified and used. The following issues will be considered when selecting release site(s): ▪ proximity to the project area; ▪ similar water temperature as capture location; ▪ ample habitat availability prior to release of captured fish; ▪ presence of other same species so that relocation of new individuals will not upset the existing prey/predation function; ▪ low potential for relocated individual to transport disease; and ▪ low likelihood of fish reentering work site or becoming impinged on exclusion net or screen. 8. In areas where aquatic vertebrates are abundant, to increase survival rates and ensure captured vertebrates are not held overly long, capture will be periodically ceased, and release will occur at predetermined locations.
BR-6	On-Call Wildlife Biologist	A qualified biologist will be on-call in southern Sonoma County and available to visit a project site at any point during maintenance activities in the event a special status species is encountered.

BMP ID	Name	BMP
Species-Related Measures		
BR-7	Special Status Plants	1. For projects located in areas where federally-listed plant species have been identified as potentially occurring (see SMP Manual Table 10-3), a qualified botanist will conduct appropriately timed focused botanical surveys of the project site for these species. If these species are observed in or near the project site, Sonoma Water will follow the measures below as well as any additional measures contained in the Programmatic Biological Opinion issued by the USFWS for the SMP. The USFWS BO does not cover Sonoma white sedge (*Carex albida*), Sonoma Alopecurus (*Alopecurus aequalis* var. *sonomensis*), or many-flowered navarretia (*Navarretia leucocephala* ssp. *plieantha*). If these species are found, SMP activities will halt within the maintenance reach and Sonoma Water will contact USVWS and CDFW within 48 hours of the discovery. Sonoma Water will not continue maintenance activities within that reach until CDFW and USFWS have provided guidance on how to proceed. 2. For projects located in areas where special status plant populations have been identified as potentially occurring (see SMP Manual Table 10-3), a qualified botanist will conduct appropriately timed focused botanical surveys of the project site for special status plant occurrences. A qualified botanist will also assess habitat suitability for the potential occurrence of special status plant species at any newly identified sediment disposal sites or previously unidentified staging areas. 3. If special-status plants are discovered (e.g., Sonoma sunshine, goldfields, or meadowfoam), populations identified during the field surveys and with potential to be impacted will be enumerated, photographed and conspicuously flagged to maximize avoidance, as well as to determine the total number of individuals affected. If feasible, the project shall be redesigned or modified to avoid direct and indirect impacts on special-status plant species. 4. Special-status plant species near the project site (e.g., Sonoma sunshine, goldfields, and meadowfoam) will be protected from temporary disturbance by installing environmentally sensitive area fencing (orange construction barrier fencing) around special-status plant species populations. Protective fencing will be installed under the direction of the botanist as necessary to protect the plant and its habitat; where feasible, the environmentally sensitive area fencing will be installed at least 50 ft. from the edge of the population. Where special-status plant populations are located in wetlands, silt fencing will also be installed. The location of the fencing will be shown on the maintenance design drawings and marked in the field with stakes and flagging. The design specifications will contain clear language that prohibits maintenance-related

BMP ID	Name	BMP
		activities, vehicle operation, material and equipment storage, and other surface-disturbing activities within the fenced environmentally sensitive area. 5. Vegetation management activities in sensitive plant areas will be conducted under the guidance of the botanist. These activities should be timed following the blooming periods of potentially occurring listed species, after the month of June. 6. If impacts to state or federally listed plants (e.g., Sonoma sunshine, goldfields, or meadowfoam) are unavoidable, then Sonoma Water shall coordinate with the appropriate resource agencies and local experts to determine whether transplantation of special-status plant species is feasible. If the agencies concur that it is a feasible mitigation measure, the botanist shall develop and implement a transplantation plan in coordination with the appropriate agencies. As part of the plan, Sonoma Water, in conjunction with a qualified restoration ecologist and CDFW and/or USFWS, shall identify a suitable on- or off-site location for mitigation and appropriate methods for seed collection, propagation, relocation, maintenance and monitoring. If the impacted species are annuals, it is expected that the current seed crop from the individuals to be lost will be collected (as well as immediate soils making up the dormant seed bed) and then sown on appropriate habitat located on the mitigation site. If the species is a perennial, it is expected that both the seed and the plants themselves will be salvaged and relocated to the mitigation site. Seed from the populations that will be impacted may be collected and propagated at a native plant nursery, prior to planting to increase the potential for establishment and survival. Annual monitoring of the mitigation site shall be conducted for 5 years to assess vegetative density, population size, natural recruitment, and plant health and vigor. Monitoring results may trigger management actions such as collection and sowing of additional seed, tillage/disturbance within existing populations to induce establishment, installation of container plants, and control of exotic invasive vegetation such as yellow star thistle to ensure successful plant establishment and survival. The site shall be evaluated at the end of the 5-year monitoring period to determine whether the mitigation has met the success criteria identified in the rare plant relocation, management, and protection plan. 7. If appropriately timed focused botanical surveys cannot be conducted in areas identified as suitable for listed plants (e.g., Sonoma sunshine, goldfields, or meadowfoam) prior to vegetation management activities, then Sonoma Water shall assume presence of the plant species in question and coordinate with the appropriate resource agencies and local experts to develop appropriate mitigation for the impact.

BMP ID	Name	BMP
BR-8	Nesting Migratory Bird and Raptor Pre-maintenance Surveys	1. To the extent feasible, maintenance activities, including tree trimming, will take place outside the migratory bird and raptor nesting period (February 15 through August 15 for most birds). During the nesting bird season, work sites that are less densely vegetated will be prioritized, to facilitate pre-maintenance surveys and decrease the likelihood of disturbing undiscovered nests. 2. If maintenance activities must be scheduled to occur during the nesting season, a qualified wildlife biologist, including trained Sonoma Water staff, familiar with the species and habitats in the program area, will conduct pre-maintenance surveys for raptors and nesting birds within suitable nesting habitat within 500 feet of SMP activities. The surveys should be conducted within one week before initiation of maintenance activities within those habitats. If no active nests are detected during surveys, activities may proceed. Vegetation removal activities will be conducted under the guidance of a biologist. If active nests are detected then measure 3 would be implemented. 3. If active nests are identified within the SMP area, non-disturbance buffers shall be established at a distance sufficient to minimize disturbance based on the nest location, topography, cover and species' tolerance to disturbance. Buffer size shall be determined by a Sonoma Water biologist in cooperation with the CDFW. If active nests are found within 500 feet of the project area, a qualified biologist shall be on site as necessary to monitor the nests for signs of nest disturbance. If it is determined that maintenance activity is resulting in nest disturbance, work shall cease immediately and CDFW shall be contacted. Buffers will be developed through consultation with CDFW. Buffers will remain in place until biologists determine that the young have successfully fledged or nests have been otherwise abandoned.
BR-9	California Freshwater Shrimp Avoidance and Impact Minimization for Vegetation Management	Maintenance activities occurring along streams supporting California freshwater shrimp will be restricted to only conducting vegetation management and/or debris removal above the water level. In addition, vegetation or debris overhanging into pools or glides (slow or slack water) within natural creeks with known occurrences of freshwater shrimp will not be removed or altered.

BMP ID	Name	BMP
		Note: *The primary stream maintained under the SMP that supports California freshwater shrimp is Sonoma Creek. This creek has natural and modified channels along its length, and does not have any engineered channels. Therefore, the only type of activity that will be conducted along Sonoma Creek is vegetation management for hydraulic easement purposes. Applying this BMP will ensure that stream channels which support California freshwater shrimp will retain habitat elements (e.g., undercut banks with exposed, fine roots of willows or alders, trailing vines and overhanging woody vegetation) and continue to provide habitat for this species. Other SMP creeks with freshwater shrimp are Jonive and Hudspeth creeks.*
BR-10	California Red-legged Frog Avoidance and Impact Minimization Measures for Ground-Disturbing Activities	1. For ground-disturbing maintenance activities occurring in areas where California red-legged frog (CRLF) has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will complete focused surveys using the USFWS-approved CRLF protocol level surveys to determine the presence of CRLF. For ground-disturbing maintenance activities occurring in areas where CRLF has been identified as potentially occurring and no protocol level surveys have been conducted, CRLF presence will be assumed. 2. If focused surveys indicate CRLF is not present in the maintenance area, no further CRLF BMPs will be necessary. 3. If CRLF are present or assumed present, a qualified biological monitor, or a biologist with an Incidental Take Permit, will inspect the area daily before the start of work and will be present during maintenance activities in sensitive habitats. If appropriate, Sonoma Water will install exclusionary fencing. 4. In the event that a CRLF is encountered within the maintenance area, the USFWS Sacramento Field Office will be contacted within 48 hours of any CRLF observations, and a qualified biologist will move the frog to a safe location outside of the project area. Actions taken to move CRLF will be consistent with applicable USFWS and CDFW regulations and permits. The biological monitor will have the authority to stop work if a CRLF is encountered until such a time as the frog may be moved to an area outside of the project area fencing. 5. If dewatering of a creek is required, dipnet and seine surveys for CRLF tadpoles will be completed prior to initiation of dewatering. Captured tadpoles will be moved to a safe location elsewhere in the creek.
BR-11	California Red-legged Frog Avoidance and Impact	1. For vegetation maintenance activities occurring in areas where CRLF frog has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will conduct pre-

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	Minimization Measures for Vegetation Management	maintenance surveys of aquatic habitats and identify potential CRLF breeding and foraging areas. These areas will be flagged and avoided by maintenance crews. 2. In areas where CRLF could potentially occur, field crews conducting hand trimming of vegetation will access channel banks by foot only and will avoid entering open water. Vehicles will be restricted to existing access roads. 3. In work sites where potential CRLF breeding and foraging areas were identified during the pre-maintenance survey, a qualified biological monitor or a biologist with an Incidental Take Permit, will be on-site during project activity in sensitive habitats. The biological monitor will have the authority to stop work if a CRLF (or any of its life stages) is encountered until such a time as the frog may be moved to an area away from the project site. 4. The USFWS Sacramento Field Office will be contacted within 48 hours of any CRLF observations.
BR-12	California Tiger Salamander Avoidance and Impact Minimization Measures for Sediment and Debris Removal	1. For sediment and debris removal maintenance activities occurring in areas where California tiger salamander (CTS) has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will conduct pre-maintenance surveys of upland habitats and identify areas with small mammal burrows. Mammal burrows will be flagged and avoided by maintenance crews. 2. Maintenance activities will be restricted to the streambed and avoid disturbance to adjacent upland habitat. 3. Sediment and debris removal activities shall minimize removal of upland vegetation and soil compaction. 4. If upland banks must be traversed by heavy equipment to access a streambed, the route will be located where no small mammal burrows are present and will be delineated by temporary fencing to minimize upland habitat disturbance. 4. If burrows or other suitable aestivation habitat are present where sediment or debris removal activities are proposed, a qualified biological monitor or a biologist with an Incidental Take Permit will be on call during project activity in proximity to upland CTS habitat. The biological monitor will have the authority to stop work if a CTS is encountered until such a time as the animal is moved to an area away from the project site. 6. Maintenance activities located in proximity to upland CTS habitat will be scheduled to avoid the CTS migration season (October 15 – June 30). If work must be completed during the migration season, barrier fencing will be installed to exclude CTS from maintenance areas.

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		7. In the event that a California tiger salamander is encountered within the maintenance area, a biologist with an Incidental Take Permit, or biologist approved by the USFWS, will move the salamander to a safe location with suitable underground refugia (e.g., open burrow of appropriate depth) outside of the maintenance area. Actions taken to move CTS will be consistent with applicable USFWS and CDFW regulations and permits. 8. The USFWS Sacramento Field Office will be contacted within 48 hours of any California tiger salamander observations.
BR-13	California Tiger Salamander Avoidance and Impact Minimization Measures for Bank Stabilization	1. For bank stabilization activities occurring in areas where CTS has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will conduct pre-maintenance surveys of upland habitats and identify areas with burrows and/or other suitable aestivation habitat. 2. If burrows or other suitable aestivation habitat are present where bank stabilization activities are proposed, a qualified biological monitor or a biologist with an Incidental Take Permit, will be on call during project activity in proximity to upland CTS habitat. The biological monitor will have the authority to stop work if a CTS is encountered until such a time as the animal is moved to an area away from the project site. 3. Maintenance activities located in proximity to upland CTS habitat will be scheduled to avoid the CTS migration season (October 15 – June 30). If work must be completed during the migration season, barrier fencing will be installed to exclude CTS from maintenance areas. 4. In the event that a CTS is encountered within the maintenance area, a biologist with an Incidental Take permit, or biologist approved by the USFWS, will move the salamander to a safe location with suitable underground refugia (e.g., open burrow of appropriate depth) outside of the fenced maintenance area. Actions taken to move CTS will be consistent with applicable USFWS and CDFW regulations and permits. 5. The USFWS Sacramento Field Office will be contacted within 48 hours of any California tiger salamander observations.
BR-14	California Tiger Salamander Avoidance and Impact Minimization Measures for Vegetation Management	1. For vegetation management activities occurring in areas where CTS has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will conduct pre-maintenance surveys of upland habitats and identify areas with small mammal burrows. Areas with an abundance of small mammal burrows will be flagged and avoided by maintenance crews.

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		2. Based on surveys, if CTS is identified as potentially present, then access across upland channel banks and adjacent upland habitats will be by foot only. Vehicles will be restricted to existing access roads. 3. A qualified biological monitor, or biologist with an Incidental Take Permit, will be on call during project activity in proximity to upland CTS habitat. The biological monitor will have the authority to stop work if a CTS is encountered until such a time as the animal is moved to an area away from the project site. 4. In the event that a California tiger salamander is encountered within the maintenance area, a biologist with an Incidental Take Permit, or biologist approved by the USFWS, will move the salamander to a safe location with suitable underground refugia (e.g., open burrow of appropriate depth) outside of the fenced maintenance area. Actions taken to move CTS will be consistent with applicable USFWS and CDFW regulations and permits. 5. The USFWS Sacramento Field Office will be contacted within 48 hours of any California tiger salamander observations.
BR-15	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for In-Stream Ground-Disturbing Activities	1. For in-stream ground-disturbing activities occurring in areas where foothill yellow-legged frog has been identified as potentially occurring (see SMP Manual Table 10-3), work will begin on or after June 15 and will be completed by October 31. If more time is needed to complete maintenance activities, the work period may be modified in writing on a week-by-week basis by a CDFW representative. Sonoma Water will submit requests for a work extension consistent with the guidance in the amended Lake or Streambed Alteration Agreement. 2. A qualified biologist will inspect the maintenance area daily before the start of work. If appropriate, Sonoma Water will install exclusionary fencing. In the event that foothill yellow-legged frogs are encountered within the maintenance area, a qualified biologist will move the frog to a safe location outside of the maintenance area. Actions taken to move foothill yellow-legged frog will be consistent with applicable CDFW regulations and permits. 3. If dewatering a creek segment is required, a qualified biologist will conduct visual and dipnet surveys and move captured frogs and tadpoles to a safe location in the creek. Actions taken to move foothill yellow-legged frog will be consistent with applicable CDFW regulations and permits. 4. CDFW will be notified within 48 hours of any foothill yellow-legged frog observations.

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	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management	1. For vegetation maintenance activities occurring in areas where foothill yellow-legged frog has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will conduct pre-maintenance surveys of aquatic habitats and identify potential foothill yellow-legged frog breeding and foraging areas. These areas will be flagged and avoided by maintenance crews. 2. Based on surveys, if foothill yellow-legged frog is identified as potentially present, then field crews will access channel banks by foot only and will avoid entering open water. Vehicles will be restricted to existing access roads.
BR-17	Western Pond Turtle Pre-maintenance Surveys for Ground-Disturbing Activities	1. For projects located in areas where western pond turtle has been identified as potentially occurring (see SMP Manual Table 10-3), a qualified biologist will conduct pre-maintenance surveys to assess habitat within the proposed maintenance area. 2. If suitable instream habitat for the western pond turtle is present in the maintenance area, a qualified biologist will inspect the maintenance area daily before the start of work. In the event that a western pond turtle is encountered before or during the maintenance activity, a qualified biologist will move the turtle to a safe location outside of the work area. Actions taken to move western pond turtle will be consistent with applicable CDFW regulations and permits. 3. If dewatering of a creek segment is required, a qualified biologist will be present and will move turtles – if found – to a safe location in the creek. Actions taken to move western pond turtle will be consistent with applicable CDFW regulations and permits. 4. CDFW will be notified within 48 hours of any western pond turtle observations.
BR-18	Zone 1A Salmonid Avoidance and Impact Minimization Measures (based on NMFS Russian River BO issued on September 24, 2008)	These conditions apply to steelhead-bearing streams identified in the BO as: Laguna de Santa Rosa, Copeland Creek, Santa Rosa Creek, and Windsor Creek. Sonoma Water will not perform any flood control maintenance activities in the Mark West Creek mainstem or tributaries of Mark West Creek upstream of the confluence with its largest tributary, the Laguna de Santa Rosa. As such, maintenance activities conducted on Wikiup or Fulton Creeks are not covered under the Zone 1A BO and will require a separate consultation with NMFS. Sediment maintenance activities conducted in steelhead-bearing streams will comply with the terms and conditions of Reasonable and Prudent Measure 5 of the Russian River BO for Zone 1A, which states: **1. Term and Condition A:** Sonoma Water shall isolate work areas located in aquatic habitat from the flowing stream and relocate listed salmonids prior to proceeding with in-channel work for food control maintenance or habitat enhancement:

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		▪ retain a qualified biologist with expertise in anadromous salmonid biology; ▪ the biologist shall be onsite during all dewatering events; ▪ all captured salmonids will be properly cared for; ▪ if any salmonids are found dead or injured, the Santa Rosa Area NMFS office will be contacted immediately; and ▪ NMFS staff or persons designated by NMFS will be allowed on-site during dewatering activities. **2. Term and Condition B:** at all channel maintenance sites in Zone 1A, Sonoma Water will: ▪ check construction equipment for leaks each day prior to conducting work in the channel; ▪ ensure that all fill material for cofferdams is fully contained; ▪ ensure that all diversion pumps are screened in compliance with NMFS' and CDFW's fish screening criteria; ▪ ensure that coffer dams are properly sized and maintained throughout the duration of maintenance activities; and ▪ ensure that all material is removed after completion of the project. **3. Term and Condition C:** Sonoma Water will provide NMFS and CDFW with reports on construction-related and fish relocation activities by February 15 of the year following maintenance. **4. Term and Condition D:** Sonoma Water will reduce impacts on habitat complexity: ▪ all work in natural channels, except for revegetation activities, will be conducted between June 15 and October 15; ▪ no work will be started that cannot be completed before the onset of a storm event; ▪ vehicles may be driven in the dry streambed only as necessary to accomplish work; ▪ all exposed/disturbed areas on upper stream banks within the project site will be stabilized; ▪ install erosion control measures to divert runoff to stable areas; ▪ all new riprap will be planted with willows or other native trees; ▪ no grouted riprap shall be installed; ▪ bioengineering techniques shall be incorporated into all bank stabilization projects; ▪ when grading gravel bars, a buffer of 25 feet or 10 percent of the maximum bar width, whichever is greater, shall be maintained;

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		▪ Sonoma Water will construct a low flow channel at sediment removal sites in Zone 1A to provide enhanced migration habitat through sediment removal areas. 5. Sediment removal project designs will be submitted to NMFS and CDFW 60 days prior to implementation for approval. 6. The low flow channel shall be monitored at least two times in-between large storm events during the winter period to assess its function as a migration corridor and impact on stream stability.
BR-19	Zone 2A and 3A Salmonid Avoidance and Minimization Measures (based on NMFS BO for Zone 2A and 3A issued on April 5, 2010)	The following apply to steelhead-bearing streams identified in the BO as: Petaluma River (Zone 2A) and Sonoma Creek (Zone 3A) watersheds. Sediment maintenance/removal and bank stabilization activities may require dewatering and subsequent relocation of aquatic species. In most situations, such activities will only occur when the stream reach is completely dry or during the lowest flow of the season. In the event that channel is conveying flow or ponding water during proposed stream maintenance activities, the following dewatering and fish relocation measures will be implemented: **1. Dewatering.** A cofferdam, pump station, and re-routing pipeline will be used to dewater a short section of channel at a time. The following dewatering measures will be employed: ▪ An inflatable cofferdam will be used primarily; however under some circumstances (e.g., inside large culverts), the cofferdams will be constructed using sand or gravel. ▪ Pumping rates will be consistent with the existing stream flow to bypass water around the work site. ▪ Pump intake lines will be protected with screens according to NMFS and CDFW criteria to prevent the entrainment of aquatic species. ▪ Bypass flows will be released back into the channel near the downstream end of the project area. ▪ Silt bags will be used at the end of the diversion pipe to reduce any sediment discharge downstream and to dissipate flow velocity and prevent scour at the discharge site. **2. Fish Relocation**. Before and during the dewatering of a work area, fish will be captured and relocated to avoid injury and mortality and minimize disturbance. The following guidelines will apply: ▪ Before fish relocation begins, a qualified biologist will identify the most appropriate release location(s). Release locations will have water temperatures within 1 degree Celsius to the capture location and offer ample habitat for released fish and should be selected to minimize

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		the likelihood that fish will reenter the work area or become impinged on the exclusion net or screen. ▪ The means of capture will be site-dependent and will be selected by a qualified fisheries biologist who is experienced with fish capture and handling. Complex stream habitat may require the use of electrofishing equipment. Electrofishing will be conducted only by trained personnel following NMFS guidelines dated June 2000. ▪ Handling of salmonids will be limited to permitted personnel. If necessary, personnel will wet hands or nets before touching fish. ▪ Fish will be held temporarily in cool, shaded water in a container with a lid. No more than 25 fish will be kept in each container. Aeration will be provided with a battery-powered external bubbler. Fish will be protected from jostling and noise and will not be removed from the container until the time of release. A thermometer will be placed in each holding container and partial water changes will be conducted as necessary to maintain a stable water temperature. Fish will not be held more than 30 minutes. If water temperature reaches or exceeds NMFS limits, fish will be released and relocation operations will cease. ▪ If fish are abundant, capture will cease periodically to allow release and minimize the time fish spend in holding containers. ▪ Fish will not be anesthetized or measured but will be visually identified to species level, and year classes will be estimated and recorded. ▪ When feasible, initial fish relocation efforts will be performed several days prior to the scheduled start of construction. The fisheries biologist will perform a survey on the same day before construction. ▪ Reports on fish relocation activities will be submitted to CDFW and NMFS in a timely fashion. ▪ If mortality during relocation exceeds 2%, relocation will cease and CDFW and NMFS will be contacted immediately or as soon as feasible. 3. Other Minimization and Avoidance Measures. The following measures will be implemented: ▪ At the beginning of each maintenance season, an environmental training session will be conducted by a qualified biologist. ▪ Access points to the channel will be minimized according to need and should avoid large mature trees, native vegetation, or other significant habitat features.

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		▪ Erosion control measures will be implemented to avoid runoff from staging areas enter waters of the State. ▪ Where the pre-maintenance channel form exhibits desirable features, the channel bed will be regraded to mimic the pre-maintenance channel form. ▪ Instream structures that are determined to benefit aquatic species during high water and/or high velocity events will be avoided during maintenance activities. If these structures are determined to be a detriment to flood conveyance, Sonoma Water will work with NMFS to either modify or relocate the structure (if possible). ▪ Where possible, grading may include channel enhancements (e.g., excavation of a low-flow channel, development of a meander, or riffle/pool configurations). No channel grading will occur below the as-built design for flood control channels that will reduce habitat value. In situations where grading below the as-built design will potentially increase habitat value, Sonoma Water will work with NMFS on the final design. ▪ For focused sediment removal activities, where in-stream gravel or cobble bars are encountered, sediment removal work will aim to preserve the overall shape and form of the existing bar or gravel features. ▪ After sediment removal work, the channel will be graded so that the transition between existing channel both upstream and downstream is smooth and continuous between the maintained and non-maintained areas.
Cultural Resources Protection		
CR-1	Annual Meeting Requirement	The Sonoma Water shall hold an annual meeting, at least once a year, with the appropriate affiliated tribe(s) to discuss the maintenance schedule, proposed activities, and potential interpretation and habitat restoration planning.
CR-2	Cultural Resources Investigation	For activities that require excavation into soils beyond the as-built design (e.g., bank stabilization, culvert replacement) and for all new sediment disposal sites, a cultural resources investigation shall be conducted by a qualified professional archaeologist chosen in consultation with the appropriate affiliated tribe(s) prior to performing the activity. The cultural resources investigation shall include the following elements: 1. *Background Research and Native American Consultation***.** The consulting archaeologist shall begin the background research by reviewing the data acquired for the SMP Environmental Impact Report (EIR) to determine whether the proposed activity will occur within a previously-known

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		culturally-sensitive area. Culturally sensitive areas shall include, but are not limited to; prehistoric sites, sacred and religious sites, gathering sites, and traditional cultural properties. In conjunction with this review, the Sonoma Water shall contact (a) the appropriate affiliated tribe(s) to provide comments or concerns about the specific maintenance activity locations and (b) the Native American Heritage Commission to request information from the Sacred Lands File. The archaeologist shall conduct a records search at the Northwest Information Center (NWIC) to determine if any cultural resources have been recorded since acquisition of cultural resources data presented in the SMP. The records search will identify resources within or near the maintenance or sediment disposal location and determine whether that location has been previously surveyed up to current professional archaeological standards. Sonoma Water will also invite representatives from the appropriate tribe(s) to participate in a field tour of the project sites to identify sensitive resources such culturally significant plants, sacred areas, traditional cultural properties, etc., and inform development of restoration plans. 2. *Pedestrian Survey.* If the Sonoma Water, in consultation with the appropriate affiliated tribe(s) and consulting archaeologist, believes an adequate survey has not been completed for a project location within a ten-year period from the date of scheduled maintenance, a new pedestrian survey will be performed. All areas of exposed ground should be closely inspected for the presence of cultural materials. Areas of dense vegetation should be inspected as closely as possible and any exposed channel banks should be carefully examined for the presence of buried cultural resources. Based on an analysis of site distribution and geomorphology of the project location, the archaeologist shall assess the need to excavate hand-auger borings to test for the presence of subsurface archaeological materials and provide supporting information and a recommendation to the Sonoma Water and affiliated tribe(s). All augured sediments shall be passed through 1/4-inch screen to help identify small obsidian flakes or other stone-tool materials. The borings should be of the minimum depth of 1 foot lower than planned soil disturbance. Any archaeological material recovered in auger holes will be recorded, cataloged, and re-deposited. The auger borings would also provide an initial assessment of the surface integrity of the landform (e.g., is a substantial amount of imported or redeposited fill material present?) and provide additional information about the potential for buried archaeological material. Any subsurface investigation will include monitoring by an appropriate affiliated tribe(s) trained cultural resources monitor. If archaeological materials are encountered on the ground surface or in subsurface context, a preliminary assessment of site boundaries should be made by the archaeologist in consultation

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		with the appropriate affiliated tribe(s). A map should be prepared depicting site boundaries in relation to the project area, and the site should be recorded on a standard archaeological site record (Department of Parks and Recreation 523 form). If there are sufficient archaeological data, and considering the views of the tribal cultural resources monitor, the archaeologist shall prepare a written preliminary determination of the site's eligibility for inclusion in the National Register of Historic Places. 3. *Documentation.* An Archaeological Survey Report (ASR) will be prepared that includes appropriate background research, site records, and recommendations for additional work. The appropriate affiliated tribe(s) will be consulted on the areas of potential effects and identification efforts. The ASR will include results of background research, descriptions of field work, findings, appropriate maps and photos, and a record of views expressed, and activities carried out, by the affiliated tribe(s). A cover letter will detail management recommendations, which could include archaeological and Native American monitoring, site avoidance, or test excavations to determine site significance. The ASR will be submitted to Sonoma Water and the NWIC. All information regarding cultural resources including site locations, Native American human remains, and associated funerary objects will be kept confidential and will not be made available for public disclosure. The final written report will be submitted to the NWIC within 3 months after work has been completed. Studies and findings will be incorporated into a Geographic Information System (GIS) dataset that depicts of cultural resource locations with associated attribute data within Sonoma Water maintenance areas. The GIS dataset and associated reports and site records will be kept confidential according to federal and State regulations protecting cultural resources. *4. Management Requirements.* If a cultural resource is located the following management requirements—based on public law, Tribal cultural practices and the Native American Religious Freedom Act regarding the treatment of known or inadvertently discovered cultural resources—shall be implemented. Other measures may be implemented instead, provided they are at least as protective of the cultural resource in question: ▪ *Archaeological and Native American Monitoring:* Sonoma Water shall retain the services of a Native American monitor or monitors, and a qualified archaeological consultant that has expertise in California prehistory, to monitor ground-disturbing activities within 200 feet of known archaeological sites or in areas designated as having a high potential for encountering archaeological sites. The Cultural Resources Monitoring Plan shall guide this work. If an intact

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		archaeological site is encountered, all soil disturbing activities in the vicinity should stop until the site is evaluated. Site evaluation should occur within five work days from the date of discovery, unless unusual circumstances come into play (e.g. highly significant finds, human burials, etc.) which might require additional time. The archaeological monitor shall immediately notify Sonoma Water, and the United States Army Corps of Engineers (USACE), of the encountered archaeological site. The monitors shall, after making a reasonable effort to assess the identity, integrity, and significance of the encountered archaeological materials, present the findings of this assessment to Sonoma Water and the USACE. ▪ *Cultural Resources Monitoring Plan:* If monitoring is the recommendation, a cultural resource monitoring plan shall be prepared by a qualified professional archaeologist in consultation with the appropriate affiliated tribe(s). The plan should address (but not be limited to) the following issues: – Person(s) responsible for conducting monitoring activities, including Native American monitors; – How the monitoring shall be conducted. During the course of the monitoring, the archaeologist in consultation with the appropriate affiliated tribe(s), may adjust the frequency—from continuous to intermittent—of the monitoring based on the conditions and professional judgment regarding the potential to impact resources. – The required format and content of monitoring reports, including any necessary archaeological re-survey; – Person(s) responsible for overseeing and directing the monitors; – Schedule for submittal of monitoring reports and person(s) responsible for review and approval of monitoring reports; – Procedures and construction methods to avoid sensitive cultural resource areas; – Clear delineation and fencing of sensitive cultural resource areas requiring monitoring; – Physical monitoring boundaries (e.g., 200-foot radius of a known site); – Protocol for notifications and stop-work guidelines in case of encountering of cultural resources, as well as methods of dealing with the encountered resources (e.g., analysis, cataloging, collections management); – Methods to ensure security of cultural resources sites;

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		– Protocol for notifying local authorities (i.e. Sheriff, Police) should site looting and other illegal activities occur during construction. ▪ If Sonoma Water, in consultation with the monitors, determines that a significant archaeological resource is present and that the resource could be *adversely* affected by the project, Sonoma Water shall: – Request USACE to contact the State Historic Preservation Officer (SHPO) and invite the agency to participate; and – Re-design the proposed project to avoid any adverse effect on the significant resource; or, – Implement an archaeological data recovery program (ADRP) (unless the archaeologist determines that the archaeological resource is of greater interpretive than research significance and that interpretive use of the resource is feasible). The project archaeologist, Sonoma Water, and appropriate affiliated tribe(s) shall meet and consult to determine the scope of the ADRP. The archaeologist will prepare a draft ADRP and submit it to Sonoma Water for review and approval, who will provide a copy to the appropriate affiliated tribe(s), USACE, and SHPO for review and comment prior to finalization. The ADRP will identify how the proposed data recovery program will preserve the significant information the archaeological resource is expected to contain. The ADRP will identify the scientific/historic research questions applicable to the expected resource, the data classes the resource is expected to possess, and how the expected data classes will address the applicable research questions. Data recovery, in general, shall be limited to the portions of the historic property that could be adversely affected by the proposed Project. Destructive data recovery methods shall not be applied to portions of the archaeological resources if nondestructive methods are practical. For projects that may involve lands with multiple tribes, in the event that there is a disagreement between two or more tribes about a proposed maintenance activity, its potential effects, or appropriate management requirements; then the USACE would act as a mediator among the tribes to reach a solution which is satisfactory to all parties. If a resolution cannot be reached in a timely manner, the USACE will either decide the appropriate action, or contact another suitable third-party organization to guide the decision-making process.
CR-3	Previously Undiscovered Cultural Resources	*Inadvertent Discoveries:* If discovery is made of items of historical or archaeological interest, activity will immediately cease in the project location (within approximately 50-feet) of discovery.

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		Prehistoric archaeological materials might include obsidian and chert flaked-stone tools (e.g., projectile points, knives, scrapers) or significant (based on criteria as defined by state and federal law) areas of toolmaking debris; culturally darkened soil ("midden") containing heat-affected rocks, artifacts, or shellfish remains; and stone milling equipment (e.g., mortars, pestles, handstones, or milling slabs); and battered stone tools, such as hammerstones and pitted stones. Historic-period materials might include stone, concrete, or adobe footings and walls; filled wells or privies; and deposits of metal, glass, and/or ceramic refuse. After cessation of excavation the contractor shall immediately contact Sonoma Water. Maintenance will not resume until authorization is received from the Sonoma Water. In the event of unanticipated discovery of archaeological indicators during construction, Sonoma Water will retain the services of a qualified professional archaeologist to evaluate, in consultation with the appropriate affiliated tribe(s), the significance of the items prior to resuming any activities that could impact the site. In the case of an unanticipated archaeological discovery that is determined to be potentially eligible for listing in the National and/or California Register, and the site cannot be avoided, Sonoma Water will implement an ADRP, prepared by a qualified archaeologist, as outlined under BMP CR-1. *Discovery of Human Remains:* If potential human remains are encountered, Sonoma Water shall halt work in the vicinity of the find and contact the county coroner in accordance with PRC Section 5097.98 and Health and Safety Code Section 7050.5. Sonoma Water will also notify by telephone the USACE archaeologist and permit manager. If the coroner determines the remains are Native American, the coroner will contact the Native American Heritage Commission (NAHC). As provided in PRC Section 5097.98, the NAHC will identify the person or persons believed to be most likely descended from the deceased Native American. The Most Likely Descendent (MLD) makes recommendations for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in PRC Section 5097.98. Work shall cease in the immediate area until the recommendations of the appropriate MLD are concluded.
CR-4	Previously Undiscovered Paleontological Resources	If fossil remains are encountered during maintenance, the maintenance activity will be stopped until a qualified professional paleontologist can assess the nature and importance of the find and recommend appropriate treatment. Sonoma Water shall retain a consultant who meets the Society for Vertebrate Paleontology's criteria for a "qualified professional paleontologist" (Society of Vertebrate Paleontology1995). Treatment may include preparation and recovery of fossil materials so that they can be housed in an appropriate museum or university collection, and may also include

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		preparation of a report for publication describing the finds. Sonoma Water shall be responsible for ensuring that the recommendations of the paleontologist regarding treatment and reporting are implemented.
CR-5	Staff Cultural Resources Training Program	Project personnel will be alerted to the archaeological sensitivity of the vicinity and the importance of protecting cultural resources. An annual training will be held for Sonoma Water maintenance personnel led by a qualified archaeologist and/or Native American representative that will discuss cultural resources and the history of the vicinity as well as what types of cultural materials could be present in the SMP area.
CR-6	Interpretation Program	Sonoma Water will implement an interpretation program for the SMP related to cultural resources. Public outreach options that the Sonoma Water will consider for the SMP include, but are not limited to: ▪ Interpretive standards developed by the appropriate affiliated tribe(s) ▪ Development of a cultural research program with Anthropological Studies Center (ASC) students and Sonoma Water ▪ A mobile exhibit, or web-based exhibit, that could be installed in various local public facilities, or viewed on-line, to showcase the cultural studies. ▪ A native riparian plant restoration area with interpretive signage depicting how local Native Americans utilized different species. ▪ A permanent exhibit to be housed in an appropriate public location near the project area, such as Sonoma Water Administrative Offices on Aviation Boulevard. ▪ The creation, by a local public school or college, of a video documenting local prehistory, history, oral history interviews, and archaeological remains. ▪ Engagement of a local historical or cultural group to create a public interpretive product. Production of a Web page with an overview of the cultural development of the project area and a synopsis of the archaeological findings.
CR-7	Ecosystem Restoration Program	Sonoma Water's on-site mitigation program includes a variety of planting and habitat enhancement approaches. These approaches include nursery stock planting, understory plantings along the upper bank and channel edge, and the installation of red and Pacific willow cuttings, or other suitable species including alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), and big-leaf maple (*Acer macrophyllum*)) at the toe-of-bank. The primary objective is to enhance riparian habitat through

BMP ID	Name	BMP
		greater canopy cover, shading, and develop a functioning understory along channels that are currently degraded with grass cover dominated by non-native ruderal (disturbance adapted) species. As part of this revegetation program, Sonoma Water intends to incorporate culturally important plant species into the restoration design. The intent is to provide additional source areas along Sonoma Water flood control channels for Native Americans to gather the materials needed for tribal ceremonies and customs, including sources of food, medicine, building and basket making materials. Traditionally, Native Americans gathered a number of native plants associated with stream courses for a wide variety of uses. Sonoma Water restoration designs incorporate many native species that were used extensively by Native Americans including oak (*Quercus* sp.), buckeye (*Aesculus californica*), elderberry (*Sambucus* sp.), willow (*Salix* sp.), redbud (*Cercis occidentalis*), coffeeberry (*Rhamnus californica*), toyon (*Heteromeles arbutifolia*), mugwort (*Artemisia douglasiana*), dogbane (*Apocynum cannabinum*), native brambles (*Rubus* sp.), sedges (*Carex* sp.), rushes (*Juncus* and *Scirpus* sp.), and grasses (traditionally used for "wild wheat" including: *Leymus triticoides, Hordeum bracyantherum, Elymus glauca*, and *Festuca californica*).
Hazardous Materials Safety		
HAZ-1	Spill Prevention and Response Plan	Sonoma Water will develop a Spill Prevention and Response Plan prior to commencement of maintenance activities. The plan will summarize the measures required under BMP measures HAZ-2 through HAZ-6. It will also require that: 1. Equipment and materials for cleanup of spills be available on site and that spills and leaks will be cleaned up immediately and disposed of properly; 2. Prior to entering the work site, all field personnel shall be appropriately trained in spill prevention, hazardous material control, and clean-up of accidental spills. 3. Field personnel shall implement measures to ensure that hazardous materials are properly handled and the quality of water resources is protected by all reasonable means. 4. Spill prevention kits shall always be in close proximity when using hazardous materials (e.g., crew trucks and other logical locations). All field personnel shall be advised of these locations and trained in their appropriate use. Sonoma Water will routinely inspect the work site to verify that the Spill Prevention and Response Plan is properly implemented and maintained. Sonoma Water will notify contractors immediately if there is a noncompliance issue and will require compliance.

<table>
<tr><th>BMP ID</th><th>Name</th><th>BMP</th></tr>
<tr><td></td><td></td><td>Absorbent materials will be used on small spills located on impervious surface rather than hosing down the spill; wash waters shall not discharge to the storm drainage system or surface waters. For small spills on pervious surfaces such as soils, wet materials will be excavated and properly disposed rather than burying it. The absorbent materials will be collected and disposed of properly and promptly.

As defined in 40 CFR 110, a federal reportable spill of petroleum products is the spilled quantity that:

▪ violates applicable water quality standards;
▪ causes a film or sheen on, or discoloration of, the water surface or adjoining shoreline; or
▪ causes a sludge or emulsion to be deposited beneath the surface of the water or adjoining shorelines.
▪ If a spill is reportable, the contractor’s superintendent will notify Sonoma Water, and Sonoma Water will take action to contact the appropriate safety and cleanup crews to ensure that the Spill Prevention and Response Plan is followed. A written description of reportable releases must be submitted to the appropriate RWQCB and the California Department of Toxic Substances Control (DTSC). This submittal must contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases will be documented on a spill report form.
▪ If an appreciable spill has occurred, and results determine that project activities have adversely affected surface water or groundwater quality, a detailed analysis will be performed to the specifications of DTSC to identify the likely cause of contamination. This analysis will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, Sonoma Water or contractors will select and implement measures to control contamination, with a performance standard that surface and groundwater quality must be returned to baseline conditions. These measures will be subject to approval by Sonoma Water, DTSC, and the RWQCB.</td></tr>
<tr><td>HAZ-2</td><td>Equipment and Vehicle Maintenance</td><td>1. All vehicles and equipment will be kept clean. Excessive build-up of oil or grease will be avoided.
2. All equipment used in the creek channel will be inspected for leaks each day prior to initiation of work. Action will be taken to prevent or repair leaks, if necessary.</td></tr>
</table>

BMP ID	Name	BMP
		3. Vehicle and equipment maintenance activities will be conducted off-site or in a designated, protected area away from the channel where vehicle fluids and spills can be handled with reduced risk to water quality. 4. If maintenance must occur on-site, designated areas will not directly connect to the ground, surface waters, or the storm drainage system to prevent the run-on of stormwater and runoff of spills. The service area will be clearly designated with berms, sandbags, or other barriers. 5. Secondary containment, such as a drain pan or drop cloth, to catch spills or leaks will be used when removing or changing fluids. Fluids will be stored in appropriate containers with covers, and properly recycled or disposed of off-site. 6. Cracked batteries will be stored in a non-leaking secondary container and removed from the site. 7. Spill clean-up materials will be stockpiled where they are readily accessible. 8. Incoming vehicles and equipment will be checked for leaking oil and fluids (including delivery trucks, and employee and subcontractor vehicles). Leaking vehicles or equipment will not be allowed on-site.
HAZ-3	Equipment and Vehicle Cleaning	1. Equipment will be cleaned of any sediment or vegetation before transferring and using in a different watershed to avoid spreading pathogens or exotic/invasive species between watersheds. 2. Vehicle and equipment washing will occur on-site as needed to prevent spread of pathogens or exotic/invasive species. No runoff from vehicle or equipment washing will be allowed to enter waters of the State, including the creek channel or storm drains, without being subjected to adequate filtration (e.g., vegetated buffers, hay wattles, or bales, silt screens). The discharge of decant water from any on-site wash areas to waters of the State or to areas outside of the active project site is prohibited. Additional vehicle and equipment washing will occur on an appropriate wash rack at Sonoma Water’s maintenance center.
HAZ-4	Refueling	1. No fueling shall be done in the channel (top-of-bank to top-of-bank) unless equipment stationed in these locations cannot be readily relocated (e.g., pumps and generators). 2. All off-site fueling sites (e.g., on access roads above the top-of-bank) shall be equipped with secondary containment and avoid a direct connection to underlying soil, surface water, or the storm drainage system.

BMP ID	Name	BMP
		3. For stationary equipment that must be fueled on-site, secondary containment, such as a drain pan or drop cloth, shall be provided in such a manner to prevent accidental spill of fuels to underlying soil, surface water, or the storm drainage system.
HAZ-5	On-Site Hazardous Materials Management	1. The products used and/or expected to be used and the end products that are produced and/or expected to be produced after their use will be inventoried. 2. As appropriate, containers will be properly labeled with a "Hazardous Waste" label and hazardous waste will be properly recycled or disposed of off-site. 3. Contact of chemicals with precipitation will be minimized by storing chemicals in watertight containers or in a storage shed (completely enclosed), with appropriate secondary containment to prevent any spillage or leakage. 4. Quantities of toxic materials, such as equipment fuels and lubricants, shall be stored with secondary containment that is capable of containing 110% of the primary container(s). 5. Petroleum products, chemicals, cement, fuels, lubricants, and non-storm drainage water or water contaminated with the aforementioned materials shall not contact soil and not be allowed to enter receiving waters or the storm drainage system. 6. Sanitation facilities (e.g., portable toilets) will be surrounded by a berm, and a direct connection with soil or to the storm drainage system or receiving water will be avoided. 7. Sanitation facilities will be regularly cleaned and/or replaced, and inspected daily for leaks and spills. 8. All toxic materials, including waste disposal containers, will be covered when they are not in use, and located as far away as possible from a direct connection to the storm drainage system or receiving water. 9. All trash that is brought to a project site during maintenance activities (e.g., plastic water bottles, plastic lunch bags) will be removed from the site daily.
HAZ-6	Existing Hazardous Sites or Waste	Upon selection of maintenance project locations, Sonoma Water will conduct a search for existing known contaminated sites on the State Water Resource Control Board's GeoTracker website (www.geotracker.waterboards.ca.gov). For any proposed maintenance sites located within 1,500 feet of any "open" sites where contamination has not been remediated, Sonoma Water will contact the RWQCB case manager listed in the database. Sonoma Water will work with the case manager to ensure maintenance activities would not affect cleanup or monitoring activities or threaten the public or environment.

<table>
<tr><th>BMP ID</th><th>Name</th><th>BMP</th></tr>
<tr><td></td><td></td><td>If hazardous materials, such as oil or paint cans, are encountered at the maintenance sites, Sonoma Water will carefully remove and dispose of them according to the Spill Prevention and Response plan. Sonoma Water staff will wear proper protective gear and store the waste in an appropriate hazardous waste container until it can be disposed at a hazardous waste facility.</td></tr>
<tr><td>HAZ-7</td><td>Fire Prevention</td><td>1. All earthmoving and portable equipment with internal combustion engines will be equipped with spark arrestors.
2. During the high fire danger period (April 1–December 1), work crews will have appropriate fire suppression equipment available at the work site.
3. On days when the fire danger is high and a burn permit is required (as issued by the relevant Air Pollution Control District), flammable materials, including flammable vegetation slash, will be kept at least 10 feet away from any equipment that could produce a spark, fire, or flame.
4. On days when the fire danger is high and a burn permit is required, portable tools powered by gasoline-fueled internal combustion engines will not be used within 25 feet of any flammable materials unless at least one round-point shovel or fire extinguisher is within immediate reach of the work crew (no more 25 feet away from the work area).</td></tr>
<tr><td>HAZ-8</td><td>Testing and Disposal of Spoils</td><td>As specified in the Sediment Sampling and Analysis Guidelines (2009 SMP Manual Appendix B), Sonoma Water will test the sediment to be removed to determine the suitability for disposal based on presence of contaminants. The Regional Water Board will review the test results and their Executive Officer will consider approval of a disposal or reuse site proposed by Sonoma Water. As specified in the Sediment Sampling and Analysis Guidelines, samples will be compared against federal and state environmental screening levels (ESLs) for protection of human health, groundwater quality, and terrestrial receptors.
If hazardous levels of contaminants are present such that disposal at the preferred locations is not feasible, the material will be taken to a permitted hazardous waste facility.
The waste discharge requirements included in the discharge orders issued by the Regional Water Boards dictate the degree of sediment sampling and testing required in order to obtain Executive Officer approval of a sediment disposal or reuse site. Executive Officer approval must be received prior to the initiation of sediment disposal activities. This mitigation measure incorporates these requirements by reference to ensure adequate protection of water quality.</td></tr>
</table>

BMP ID	Name	BMP
Vegetation Management		
VEG-1	Removal of Existing Vegetation	1. Vegetation pruning and removal activities will be conducted under the guidance of a staff biologist or certified arborist and will follow the approaches described in Chapter 7, *Vegetation Management.* For tree relocation activities, a botanist, certified arborist, or other vegetation specialist will be on site to help direct maintenance activities and to consult if questions and/or issues arise. 2. Vegetation that is noxious, invasive, hazardous, public safety, fire concern or could obstruct channel flows will be removed as appropriate. Herbaceous layers that provide erosion protection and habitat value will be left in place. Invasive plant species that inhibit the health and/or growth of native riparian trees will be targeted for removal. 3. Where a choice between species that may be removed to maintain flood conveyance is feasible, slower-growing species such as oaks (*Quercus* spp.) that develop large canopies will be preferentially preserved, because these species take longer to establish, and provide essential nesting habitat for cavity nesters and food sources for a variety of resident and migratory animals and birds. Faster-growing species such as alders (*Alnus* spp.) and cottonwoods (*Populus* spp.) are the second priority for preservation; these single-trunked species offer the benefit of improved flood conveyance and reduced roughness by comparison with multi-trunked species. 4. Vegetation will be removed and/or pruned in such a manner that channel roughness is reduced while allowing the maximum amount of vegetation to remain in place. Trees will be trimmed or pruned to reduce impedance of floodflows while allowing the canopy to develop. Specifics for each site will differ, but typical options include limbing up to remove lower branches that have potential to interfere with floodflows, and pruning into a “fan” roughly parallel to flow direction. In areas where extensive vegetation removal is desirable to maintain flood flow capacity, *phasing of remov*al shall be considered so that some vegetation may remain in place to provide habitat to birds. 5. Vegetation management will emphasize the preservation of large mature trees that provide well developed overstory for bird habitat, canopy closure for stream shading, and add vertical complexity to the riparian corridor. Vegetation management will be conducted in such a manner that maximizes shading over the active channel. Where vegetation is removed from the active channel, removal will target nonnative species and removal of native species that are stiff and/or multi-trunked such as arroyo willow (*Salix lasiolepis*). Trees will never be topped as this encourages shrubby growth and weak branch attachments

BMP ID	Name	BMP
		6. Large woody debris, stumps, or root wads that are fully or partially buried and do not present a flood hazard shall be allowed to remain in place to provide habitat and to maintain bank stability. Only remove logs and debris from streams as a "last resort" when accumulation of debris poses a threat to stability of structures including roads, bridges, and culverts. 7. In natural channels, limit modifications and/or removal of large woody debris to material that extends higher than ~2 feet above the streambed to preserve some instream habitat features unless the log or debris jam is immediately upstream and threatening a culvert or bridge. 8. If vegetation requires removal for access to project site, non-native species and/or quick growing species (Class 2 species) shall be targeted first and Class 3 species next for removal. Removal of native, mature Class 1 trees will be avoided whenever possible. 9. To the extent feasible, removed native vegetation shall be saved to replant after maintenance or plant in other nearby sites. This includes the reuse of mulch and willow sprigs where possible.
VEG-2	Use of Herbicides	1. All herbicide use shall be consistent with all Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) label instructions and any use conditions issued by the Sonoma County Agricultural Commissioner. 2. Herbicide use will be restricted to the minimum amount needed to ensure adequate control of vegetation. 3. Application of herbicides to upland areas shall not be made within 72 hours of predicted rainfall. 4. Herbicides will not be directly applied to waters of the U.S., such as for ludwigia eradication. 5. Herbicides, including AquaMaster© and Renovate©, will not be used within 60 feet of areas identified in the Court-Ordered Stipulated Injunction for the protection of California red-legged frogs. This includes areas in Zones 1A and 3A, as well as Zones 8A and 9A. Sonoma Water will review the details and exceptions in the court order and comply with the herbicide use buffers as appropriate. 6. As required by the Court-Ordered Stipulated Injunction for pesticide use near Pacific salmon-supporting waters in Sonoma County, pesticides specified in the injunction including 1,3-dichloropropene, bromoxynil, carbaryl, chlorpyrifos, diazinon, malathion, methomyl, metolachlor, prometryn will not be used within 20 yards of salmon-supporting waters. Sonoma Water will review the details and exceptions in the court order and comply with the herbicide use buffers as appropriate.

BMP ID	Name	BMP
VEG-3	Planting and Revegetation After Soil Disturbance	1. Sites where maintenance activities result in exposed soil will be stabilized to prevent erosion and revegetated with native vegetation as soon as feasible after maintenance activities are complete. 2. Revegetation will occur at a ratio of at least 1½: 1 to account for initial mortality of plantings. 3. If soil moisture is deficient, new vegetation will be supplied with supplemental water until vegetation is firmly established. 4. To the extent possible, native grass seed will be used when seeding a project site. 5. Erosion control fabric, hydromulch, or other mechanism will be applied as appropriate to provide protection to seeds, hold them in place, and help retain moisture. 6. Revegetation shall be regularly monitored for survival for at five years or until minimum survival/cover is achieved. If invasive species colonize the area, action shall be taken to control their spread; options include hand and mechanical removal and replanting with native species.
Water Quality and Channel Protection		
WQ-1	Apply Erosion Control Fabric to or Hydroseeding of Exposed Soils	1. Upland soils exposed due to maintenance activities will be seeded and stabilized using erosion control fabric or hydroseeding. The channel bed and other areas below ordinary high water mark are exempt from this BMP. 2. Erosion control fabric will consist of natural fibers that will biodegrade over time. No plastic or other non-porous material will be used as part of a permanent erosion control approach. Plastic sheeting may be used to temporarily protect a slope from runoff, but only if there are no indications that special-status species would not be impacted by the application. 3. The site will be properly prepared to make sure the fabric/mat has complete contact with the soil. Sites can be prepared by grading and shaping the installation area; removing all rocks, dirt clods, vegetation, etc.; preparing the seedbed by loosening the top 2- to 3-inches of soil; and applying soil amendments as directed by soil tests, the seeding plan, and manufacturer's recommendations. 4. The area will be seeded before installing the fabric. All areas disturbed during installation will be re-seeded. 5. Erosion control fabric will be anchored in place. Anchors can include U-shaped wire staples, metal geotextiles stake pins or triangular wooden stakes. 6. The manufacturer's installation recommendations will be followed.

BMP ID	Name	BMP
		7. Other erosion control measures shall be implemented as necessary to ensure that sediment or other contaminants do not reach surface water bodies for stockpiled or reused/disposed sediments.
WQ-2	Prevent Scour Downstream of Sediment Removal	After sediment removal, the channel shall be graded so that the transition between the existing channel both upstream and downstream is smooth and continuous between the maintained and non-maintained areas and does not present a "wall" of sediment or other blockage that could erode once flows are restored to the channel.
WQ-3	In-Channel Grading	1. Where pre-maintenance channel form exhibited desirable features, the channel bed will be regraded to mimic the channel form before work was conducted. 2. Where possible, grading may include channel enhancements such as excavation of a low-flow channel, development of a meander, or riffle/pool configurations. No channel grading will occur below the as-built design for the flood control channels. 3. If gravels that have the potential to be utilized for spawning are removed to conduct maintenance activities, the gravels will be carefully removed and stored where maintenance activities will not impact the quality of the gravel. The gravel shall be replaced as close to original conditions as possible upon completion of the maintenance activities. 4. Where in-stream gravel and gravel (or cobble) bars are encountered, sediment removal activities will aim to preserve the overall shape and form of the existing bar or gravel feature. Sediment removal activities will aim to retain the form of the gravel or cobble bar feature, while reducing bar elevations as necessary to accommodate flood conveyance capacity.
Good Neighbor Policies		
GN-1	Work Site Housekeeping	1. Sonoma Water will maintain the work site in a neat and orderly condition, and will leave the site in a neat, clean, and orderly condition when work is complete. To the extent feasible, slash, sawdust, cuttings, etc. will be removed to clear the site of vegetation debris. Paved access roads will be swept and cleared of any residual vegetation or dirt resulting from the maintenance activity. 2. For activities that last more than one day, materials or equipment left on the site overnight will be stored as inconspicuously as possible, and will be neatly arranged.
GN-2	Public Outreach	1. In efforts to keep the public informed about stream maintenance work, why it is necessary, when it occurs, and what a neighborhood can expect when crews arrive to conduct maintenance work,

BMP ID	Name	BMP
		Sonoma Water will post and update information about the SMP and maintenance activities on their website (www.sonomawater.org). 2. Each spring, once maintenance sites have been selected for the annual work season, a newspaper notice will be published with information on the maintenance sites, approximate work dates, and contact information. This information will also be posted on Sonoma Water's website. 3. For high profile projects, at Sonoma Water's discretion, signs will be posted in the neighborhood to notify the public at least one week in advance of maintenance schedules, trail closures, and road/land closures as necessary and as possible. Signage used at work sites will provide contact information for lodging comments and/or complaints regarding the activities.
GN-3	Noise Control	1. With the exception of emergencies, normal work will be limited to normal business hours (8:00 a.m.–5:00 p.m.). Routine activities in residential areas will not occur on Saturdays, Sundays, or Sonoma Water observed state holidays except during emergencies, or with approval by the local jurisdiction and advance notification of surrounding residents. 2. Sonoma Water will ensure that power equipment (vehicles, heavy equipment, and hand equipment such as chainsaws) is equipped with original manufacturer's sound-control devices, or alternate sound control that is no less effective than those provided as original equipment. Equipment will be operated and maintained to meet applicable standards for construction noise generation. No equipment will be operated with an unmuffled exhaust.
GN-4	Traffic Flow, Pedestrians, and Safety Measures	1. To the extent feasible, work will be staged and conducted in a manner that maintains two-way traffic flow on public roadways in the vicinity of the work site. If temporary lane closures are necessary, they will be coordinated with the appropriate jurisdictional agency and scheduled to occur outside of peak traffic hours (7:00 – 10:00 a.m. and 3:00 – 6:00 p.m.) to the maximum extent practicable. Any lane closures will include advance warning signage, a detour route and flaggers will be provided in both directions. When work is conducted on public roads and may have the potential to affect traffic flow, work will be coordinated with local emergency service providers as necessary to ensure that emergency vehicle access and response is not impeded. 2. Public transit access and routes shall be maintained to the extent feasible. If public transit would be affected by temporary road closures and require detours, affected transit authorities will be consulted and kept informed of project activities.

BMP ID	Name	BMP
		3. Heavy equipment and haul traffic will be prohibited in residential areas, except when no other route to and from the site is available. 4. Roadway segments or intersections in the vicinity of project sites will be assessed to determine if they are at, or approaching a level of service (LOS) that exceeds local standards. Maintenance traffic will avoid these locations to the extent feasible, either by traveling different routes or by traveling at non-peak times of day. 5. Adequate off-street parking will be provided or designated public parking areas will be used for maintenance workers' personal vehicles and maintenance-related vehicles not in use through the maintenance period. 6. Access for driveways and private roads will be maintained to the extent feasible. If brief periods of maintenance would temporarily block access, property owners will be notified prior to maintenance activities.
GN-5	Odors	Sediment that is rich in decaying organic matter that could generate assorted malodorous gases such as reduced sulfur compounds shall be handled to minimize impacts on sensitive receptors such as nearby residents and businesses and their patrons. In general, such materials will be hauled off of the site at the time of excavation. Where it needs to be temporarily stockpiled, maintenance personnel shall stockpile potentially odorous sediments as far as possible from residential areas, businesses and their patrons, and other odor sensitive land uses.

Table 10-2. Best Management Practices by Activity

BMP	Name	Sediment Removal	Bank Stabilization	Vegetation Management: Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Other Activities: Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
General Impact Avoidance and Minimization																				
GEN-1	Work Window	X	X	X		X	X	X	X	X		X	X			X	X			X
GEN-2	Staging and Stockpiling of Materials	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GEN-3	Channel Access	X	X	X	X	X	X	X	X	X	X	X	X			X	X			
Air Quality Protection																				
AQ-1	Dust Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Biological Resources Protection																				
BR-1	Area of Disturbance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BR-2	Pre-maintenance Educational Training	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BR-3	Biotechnical Bank Stabilization		X										X		X	X				
BR-4	Impact Avoidance and Minimization During Dewatering	X	X				X						X		X	X				
BR-5	Fish and Amphibian Species Relocation Plan	X	X				X						X		X	X				
BR-6	On-Call Wildlife Biologist	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BR-7	Special Status Plant Survey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

				Vegetation Management									Other Activities							
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
BR-8	Nesting Migratory Bird and Raptor Pre-maintenance Surveys	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
BR-9	California Freshwater Shrimp Avoidance and Impact Minimization for Vegetation Management	X	X	X	X	X	X	X	X			X	X			X	X			X
BR-10	California Red-legged Frog Avoidance and Impact Minimization Measures for Ground-Disturbing Activities	X	X	X	X	X	X	X	X		X		X	X	X	X	X			
BR-11	California Red-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management			X	X	X	X	X	X	X	X	X	X							
BR-12	California Tiger Salamander Avoidance and Impact Minimization Measures for Sediment and Debris Removal	X		X		X	X						X	X	X	X	X			X
BR-13	California Tiger Salamander Avoidance and Impact Minimization Measures for Bank Stabilization		X													X				

				Vegetation Management									Other Activities							
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
BR-14	California Tiger Salamander Avoidance and Impact Minimization Measures for Vegetation Management			X	X			X	X	X	X	X	X	X	X		X	X	X	
BR-15	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for In-Stream Ground-Disturbing Activities	X	X	X	X	X	X						X			X	X			
BR-16	Foothill Yellow-legged Frog Avoidance and Impact Minimization Measures for Vegetation Management			X	X	X	X						X							
BR-17	Western Pond Turtle Pre-maintenance Surveys for Ground-Disturbing Activities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
BR-18	Zone 1A Salmonid Avoidance and Impact Minimization Measures	X	X	X	X	X	X	X	X			X	X			X	X			
BR-19	Zones 2A and 3A Salmonid Avoidance and Impact Minimization Measures	X	X	X	X	X	X	X	X			X	X			X	X			

				Vegetation Management									Other Activities							
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
Cultural Resources Protection																				
CR-1	Phase I Cultural Investigation and Report		X						X				X	X	X	X				X
CR-2	Previously Undiscovered Cultural Resources	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
CR-3	Previously Undiscovered Paleontological Resources	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Hazardous Materials Safety																				
HAZ-1	Spill Prevention and Response	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-2	Equipment and Vehicle Maintenance	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-3	Equipment and Vehicle Cleaning	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-4	Refueling	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-5	On-Site Hazardous Materials Management	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-6	Existing Hazardous Sites or Waste	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-7	Fire Prevention	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HAZ-8	Testing and Disposal of Spoils	X	X										X	X	X	X	X			X

				Vegetation Management									Other Activities							
BMP	**Name**	**Sediment Removal**	**Bank Stabilization**	Willow Removal	Blackberry Removal	Cattail Removal	Ludwigia Removal	Tree Pruning and Exotics Removal	Tree Removal and Relocation	Mowing	Nursery Stock Tree Planting	Herbicide Application	Modified and Natural Channel Maintenance	Access Road Maintenance	V-Ditch Maintenance	Culvert Repair and Installation	Debris Removal	Fence Maintenance	Graffiti Removal	Sediment Disposal
Vegetation Management																				
VEG-1	Removal of Existing Vegetation	X	X	X				X	X		X	X	X	X	X	X				
VEG-2	Use of Herbicides			X	X	X	X	X	X			X	X	X	X			X		
VEG-3	Planting and Revegetation After Soil Disturbance	X	X					X	X		X		X		X	X				
Water Quality and Channel Protection																				
WQ-1	Apply Erosion Control Fabric to or Hydroseeding of Exposed Soils	X	X	X	X	X		X	X				X	X	X	X	X	X		X
WQ-2	Prevent Scour Downstream of Sediment Removal	X											X							
WQ-3	In-Channel Grading	X	X										X			X				
Good Neighbor Policies																				
GN-1	Work Site Housekeeping	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-2	Public Outreach	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-3	Noise Control	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-4	Traffic Flow, Pedestrians, and Safety Measures	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GN-5	Odors	X	X										X		X	X	X	X		X

Table 10-3. Listed Species by Reach

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Zone 1A - Laguna de Santa Rosa Watershed									
Abramson1	U	U	3	U	P	U	U	U	P
Abramson2	U	U	3	U	P	U	U	U	P
Airport1	U	U	U	U	Marg	U	U	U	U
Airport2	U	U	U	U	Marg	U	U	U	P
Austin1	U	U	U	U	Marg/O	SN	U	U	U
Austin2	U	U	U	U	Marg	O (M/R)	U	U	U
Austin3	U	U	U	U	Marg	SN	U	U	U
BellWil1	U	U	3	U	P	U	U	U	P
BellWil2	U	U	2(1,475); 3(513)	U	P	U	U	U	P
BellWil3	U	U	2	U	P	U	U	U	P
BellWil4	U	U	1(900); 2(1,487)	U	P	U	U	U	P
Brush1	U	U	U	U	P/O	M	U	U	U
Brush2A	U	Marg	U	U	P	O (M/R)	U	U	U
Brush2B	U	U	U	U	P	O (M/R)	U	U	U
Brush2C	U	U	U	U	P	O(M/R)	U	U	U
BrushReservoir1	U	U	U	U	P	U	U	U	U
BrushTrib10	U	U	U	U	Marg	O/SN	U	U	U
Coffey1	U	U	U	U	Marg	U	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Coleman1	U	U	3	U	Marg	U	U	U	U
Coleman2	U	U	3	U	Marg	U	U	U	U
Colgan1	U	U	2	U	P	U	U	U	P
Colgan2	U	U	1(5,916); 2(2,003)	U	P	U	U	U	P
Colgan3	U	U	1(2,067); 2(662)	U	P	U	U	U	P
Colgan4	U	U	1(1,415); 2(2,783); 3(1,262)	U	U	U	U	U	P
Colgan5A	U	U	1(2,193); 2(1,586); 3(2,581)	U	P	U	U	U	P
Colgan5B	U	U	3	U	P	U	U	U	U
Colgan5C	U	U	3	U	P	U	U	U	U
Colgan6	U	U	3	U	Marg	U	U	U	U
Colgan7	U	U	3	U	U	U	U	U	U
College1	U	U	3(2,058); U(618)	U	Marg	U	U	U	U
College2	U	U	U	U	Marg	U	U	U	U
College3	U	U	U	U	Marg	U	U	U	U
Cook1	U	U	3	U	U	U	U	U	U
Cook2	U	U	U	U	P	U	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Copeland1	U	U	2(471); 3(2,381)	U	P	M	U	U	U
Copeland2	U	U	3	U	P	O (M/R)	U	U	U
Copeland3	U	U	3	U	P	O (M/R)	U	U	U
Copeland4	U	U	3(498); U(2,272)	Marg	P	O (M/R)	U	U	U
Copeland5	U	U	U	Marg	P	O (M)	U	U	U
Cotati1	U	U	1	U	P	U	U	U	U
Cotati2A	U	U	1	U	Marg	U	U	U	U
Cotati2B	U	U	1(32); 2(1,050)	U	Marg	U	U	U	U
Crane1	U	U	U	U	P	U	U	U	U
Crane2	U	U	U	Marg	P	U	U	U	U
Ducker1	U	U	U	U	Marg	SN	U	U	U
Ducker2	U	U	U	U	Marg	SN	U	U	U
Ducker2A	U	U	U	U	Marg	SN	U	U	U
Ducker2B	U	U	U	U	Marg	SN	U	U	U
Faught1	U	U	U	U	Marg	U	U	U	U
Five1	U	U	3(2,215); U(371)	U	Marg	U	U	U	U
Forestview1	U	U	3	U	Marg	U	U	U	P
Forestview2	U	U	3	U	P	U	U	U	P

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Forestview3	U	U	3	U	P	U	U	U	P
FountainGrove1	U	U	U	U	Marg	U	U	U	U
FountainGrove2	U	U	U	U	Marg	U	U	U	U
FountainGrove4	U	U	U	U	Marg	U	U	U	U
FountainGrove5	U	U	U	U	Marg	U	U	U	U
Fulton0B	U	U	U	U	P	U	U	U	P
Fulton1	U	U	U	U	P	U	U	U	P
Golf1	U	U	1(796); 2(75)	U	Marg	U	U	U	U
Gossage1	U	U	2(1,877); 3(765)	U	P	U	U	U	U
Gossage2A	U	U	2(2,101); 3(177)	U	P	U	U	U	U
Gossage2B	U	U	2(994); 3(687)	U	P	U	U	U	U
Gossage3	U	U	2	U	P	U	U	U	U
Hinebaugh1	U	U	3	U	P	U	U	U	U
Hinebaugh2	U	U	3	U	P	U	U	U	U
Hinebaugh3A	U	U	3	U	P	U	U	U	U
Hinebaugh3B	U	U	3	U	P	U	U	U	U
Hinebaugh4	U	U	3	U	P	U	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Hinebaugh5A	U	U	3(392); U(396)	U	P	U	U	U	U
Hinebaugh5B	U	U	U	U	P	U	U	U	U
Hinebaugh5C	U	U	U	U	P	U	U	U	U
Hinebaugh6	U	U	U	U	P	U	U	U	U
Hinebaugh7A	U	U	U	U	P	U	U	U	U
Hinebaugh7B	U	U	U	U	P	U	U	U	U
Hinebaugh8	U	U	U	U	P	U	U	U	U
Hunter1	U	U	3	U	Marg	U	U	U	P
Hunter2	U	U	1(990); 2(2,145); 3(166)	U	Marg	U	U	U	P
Hunter3	U	U	3	U	U	U	U	U	P
Indian1	U	U	U	U	P	U	U	U	U
Kawana1A	U	U	3	U	Marg	U	U	U	U
Kawana1B	U	U	3(1,796); U(543)	U	Marg	U	U	U	U
Labath1	U	U	2(108); 3(94)	U	Marg	U	U	U	U
Labath2	U	U	3	U	Marg	U	U	U	U
Laguna0A	U	U	3	U	P/O	M	U	U	P
Laguna1	U	U	3	U	P	M	U	U	P

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Laguna2	U	U	2(1,271); 3(5,307)	U	P	M	U	U	P
Laguna3	U	U	2(966); 3(2,741)	U	P	U	U	U	P
Laguna3A	U	U	2(22); 3(425)	U	P	U	U	U	U
Laguna4	U	Marg	2(303); 3(1,746)	U	P	U	U	U	U
Laguna5	U	U	2(2,007); 3(233)	U	P	U	U	U	U
Laguna6	U	U	2(70); 3(282)	U	P	U	U	U	U
Laguna7	U	U	2(1,288); 3(1,416)	U	P	U	U	U	U
LornaDell1	U	U	U	U	Marg	U	U	U	U
LornaDell2	U	U	U	U	Marg	U	U	U	U
LornaDell3	U	U	U	U	Marg	U	U	U	U
Matanzas1	U	U	U	P	Marg	U	U	U	P
MatanzasReservoir1	U	U	U	U	P	U	U	U	U
MatanzasReservoir2	U	U	U	U	P	U	U	U	U
MatanzasReservoir3	U	U	U	P	P	U	U	U	U
MiddleBrush1	U	U	U	U	Marg	SN	U	U	U
MiddleBrush2	U	U	U	U	Marg	SN	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Moorland1A	U	U	1(323); 2(266)	U	Marg	U	U	U	U
Moorland1B	U	U	1(1,011); 2(103)	U	Marg	U	U	U	U
Moorland1C	U	U	1(320); 2(457)	U	Marg	U	U	U	U
Moorland2	U	U	2(1,302); 3(833)	U	Marg	U	U	U	U
Oakmont4	U	U	U	U	Marg	U	U	U	U
Oakmont5	U	U	U	U	Marg	U	U	U	U
Paulin1	U	U	U	U	P	M	U	U	U
Paulin2	U	U	U	U	P	M	U	U	U
Paulin3	U	U	U	U	P	M	U	U	U
Paulin4	U	U	U	U	P	M	U	U	U
Paulin5	U	U	U	U	P	M	U	U	U
Paulin6A	U	U	U	U	P	O	U	U	U
Paulin6B	U	U	U	U	P	O	U	U	U
Paulin7	U	U	U	U	Marg	O	U	U	U
Paulin8	U	U	U	Marg	Marg	O	U	U	U
Peterson1	U	U	3	U	Marg	U	U	U	U
Peterson2	U	U	3	U	Marg	U	U	U	P
Piner1	U	U	3	U	P/O	M	U	U	P

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Piner2	U	U	3(2,287); U(984)	U	P/O	M	U	U	U
Piner3A	U	U	U	U	P	M	U	U	U
Piner3B	U	U	U	U	P	O	U	U	U
Piner4	U	U	U	U	P	U	U	U	U
Piner5	U	U	U	U	P	U	U	U	U
Piner6	U	U	U	U	P	U	U	U	U
Piner7	U	U	U	U	P	U	U	U	U
Piner8	U	U	U	U	P	U	U	U	U
PinerReservoir1	U	U	U	U	U	U	U	U	U
Pruit1	U	U	U	U	P	U	U	U	P
Roseland1	U	U	1(475); 2(2,534); 3(3,051)	U	P	U	U	U	P
Roseland1A	U	U	1(248); 2(1,611)	U	P	U	U	U	P
Roseland2	U	U	1(1,467); 2(830); 3(5,784); U(137)	U	P	U	U	U	P
Roseland3	U	U	1(3,519); 2(3,049); 3(1,885)	U	P	U	U	U	P

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Roseland4	U	U	1(212); 2(1,453); 3(1,641)	U	P	U	U	U	P
Roseland5	U	U	3	U	Marg	U	U	U	P
Russell1A	U	U	U	U	P	U	U	U	U
Russell1B	U	U	U	U	P	U	U	U	U
Russell2	U	U	U	U	P	U	U	U	U
SantaRosa0	U	U	U	Marg	P	O (M/R)	U	U	P
SantaRosa1	U	U	3(3,322); U(5,113)	U	P	M	M	U	P
SantaRosa2	U	U	3	U	P	O (M/R)	M/R/S	U	P
SantaRosa3	U	U	3	U	P	O (M/R)	M/R/S	U	U
SantaRosa4	U	U	3(1,316); U(5,421)	U	P	O (M/R)	M/R/S	U	U
SantaRosa5	U	U	U	U	P	O (M/R)	M/R/S	U	U
SantaRosa6	U	U	U	U	O	O (M/R)	M/R/S	U	U
SantaRosa8	U	U	U	U	P	O (M/R)	U	U	U
SantaRosa13	U	U	U	P	P	O (M/R)	U	U	U
SantaRosa14	U	U	U	P	P	O (M/R)	U	U	U
SantaRosaDiv1	U	U	U	U	P	U	U	U	U
SantaRosaDiv2	U	U	U	P	P	O (M/R)	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
SantaRosaReservoirSpillway1	U	U	U	U	P	U	U	U	U
SFCope1	U	U	3	U	P	U	U	U	U
SFCope2	U	U	3	U	P	U	U	U	U
SierraPark1	U	U	U	U	Marg	U	U	U	U
SierraPark2	U	U	U	U	Marg	U	U	U	U
SierraPark3	U	U	U	U	Marg	U	U	U	U
Spring1	U	U	U	U	Marg	U	U	U	U
Spring3	U	U	U	U	Marg	U	U	U	U
SpringDiv1	U	U	U	U	U	U	U	U	U
SpringLake1	U	U	U	U	P	U	U	U	U
Starr1	U	U	U	U	Marg	U	U	U	U
Starr2	U	U	U	U	Marg	U	U	U	U
StarrTrib1	U	U	U	U	Marg	U	U	U	U
Steele1A	U	U	U	U	Marg	U	U	U	U
Steele1B	U	U	U	U	Marg	U	U	U	U
Steele2	U	U	U	U	Marg	U	U	U	U
Steele3	U	U	U	U	Marg	U	U	U	U
Steele4	U	U	U	U	Marg	U	U	U	U
Steele5	U	U	U	U	Marg	U	U	U	U
Todd1	U	U	1(674); 2(1,340)	U	P	U	U	U	P

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Todd2	U	U	2	U	P	U	U	U	U
Todd3	U	U	2(338); 3(336)	U	P	U	U	U	U
Todd4A	U	U	3	U	P	U	U	U	U
Todd4B	U	U	3	U	P	U	U	U	U
Todd5A	U	Marg	3	U	P	U	U	U	U
Todd5B	U	Marg	3	U	P	U	U	U	U
Washoe1	U	U	2	U	P	U	U	U	U
Wikiup1	U	U	U	Marg	Marg	U	U	U	U
Wilfred1A	U	U	2(736); 3(459)	U	P	U	U	U	P
Wilfred1B	U	U	2(2,076); 3(488)	U	P	U	U	U	P
Wilfred1C	U	U	2(887); 3(1,701)	U	P	U	U	U	P
WilfredExt1	U	U	1(1,274); 2(55)	U	P	U	U	U	P
WilfredExt2	U	U	3	U	P	U	U	U	P
Windsor1A	U	U	U	U	P	O (M/R)	U	U	P
Windsor1B	U	U	U	U	P	O (M/R)	U	U	P
Windsor3	U	U	U	Marg	Marg	U	U	U	U
Windsor4	U	U	U	Marg	Marg	U	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Zone 2A - Petaluma River Watershed									
Adobe1	U	U	U	U	Marg	O (M)	U	U	U
Adobe2	U	U	U	Marg/O	Marg	O (M)	U	U	U
Adobe3	U	Marg	U	Marg/O	Marg	O (M)	U	U	U
Adobe4	U	Marg	U	Marg	Marg	O (M)/SN	U	U	U
Adobe5	U	U	U	P	P	O (M)/SN	U	U	P
Capri1	U	U	U	U	Marg/O	U	U	U	U
Capri2A	U	U	U	U	Marg	U	U	U	U
Capri2B	U	U	U	U	Marg	U	U	U	U
Capri3	U	U	U	U	Marg	U	U	U	U
Capri4	U	U	U	U	Marg	U	U	U	U
Corona1	U	U	U	U	Marg	U	U	U	U
Corona2	U	U	U	U	Marg	U	U	U	U
Corona3	U	U	U	U	Marg	U	U	U	U
Corona4	U	U	U	U	Marg	U	U	U	U
Corona5	U	U	U	U	Marg	U	U	U	U
Corona6	U	U	U	U	Marg	U	U	U	U
Corona7	U	U	U	U	Marg	U	U	U	U
CoronaTrib1	U	U	U	U	Marg	U	U	U	U
CoronaTrib2A	U	U	U	U	Marg	U	U	U	U
CoronaTrib2B	U	U	U	U	Marg	U	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
CoronaTrib3	U	U	U	U	Marg	U	U	U	U
EastForkMcDowell1	U	U	U	U	P	U	U	U	U
EastWashington1	U	U	U	U	Marg	U	U	U	U
EastWashington2	U	U	U	U	Marg	U	U	U	U
EastWashington3	U	U	U	U	Marg	U	U	U	U
EastWashington4	U	U	U	U	Marg	U	U	U	U
EastWashington5	U	U	U	U	Marg	U	U	U	U
JessieLane1	U	U	U	U	Marg	U	U	U	U
Lichau1	U	U	U	U	P	M/SN	U	U	U
Lichau2	U	U	U	U	P	O (M)/SN	U	U	U
Lichau3	U	U	U	U	P	O (M)/SN	U	U	U
Lichau4	U	U	U	U	P	O/SN	U	U	P
Lichau5	U	U	U	U	P	O/SN	U	U	P
Lynch0B	U	U	U	Marg	P	P	U	U	P
Lynch1A	U	U	U	U	P	O (M)/SN	U	U	P
Lynch1B	U	U	U	U	P	O (M)/SN	U	U	P
Lynch2	U	U	U	U	P	SN	U	U	P
McDowell1	U	U	U	U	P	U	U	U	U
McDowell2A	U	U	U	U	P	U	U	U	U
McDowell2B	U	U	U	U	P	U	U	U	U
Petaluma1	U	U	U	U	P	M	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
SanAntonio1	SN	Marg	U	U	P	H	U	U	P
Thompson1	U	P	U	U	Marg	SN	U	U	U
Washington1	U	U	U	U	P	U	U	U	U
Washington2	U	U	U	U	P	U	U	U	U
Washington3	U	U	U	U	P	U	U	U	U
Washington4	U	U	U	U	P	U	U	U	U
Washington5	U	U	U	U	Marg	U	U	U	U
Washington6	U	U	U	U	Marg	U	U	U	U
Washington7	U	U	U	U	Marg	U	U	U	U
Zone 3A - Sonoma Creek Watershed									
Fryer1	U	U	U	U	P	U	U	U	P
Fryer2	U	U	U	U	Marg	U	U	U	U
Fryer3	U	U	U	U	Marg	U	U	U	U
Fryer4	U	U	U	U	U	U	U	U	U
LowerEastforkFryer1	U	U	U	U	P	U	U	U	U
LowerEastforkFryer1A	U	U	U	U	Marg	U	U	U	U
LowerEastforkFryer2	U	U	U	U	Marg	U	U	U	U
Nathanson8	U	U	U	U	Marg	O (M)/SN	U	U	P
Nathanson9	U	U	U	U	Marg	O (M)/SN	U	U	P
NathansonBypass1	U	U	U	Marg	Marg	U	U	U	U
Rodgers0A	U	O	U	Marg	Marg/O	M	U	U	U

Reach	California freshwater shrimp	California red-legged frog	California tiger salamander	Foothill yellow-legged frog	Western pond turtle	Central California Coast Steelhead	California Coastal Chinook	Central California Coast Coho	Special status plants
Rodgers1	U	O	U	Marg	Marg/O	M	U	U	U
Rodgers1A	U	U	U	Marg	Marg	M	U	U	U
Rodgers1B	U	U	U	Marg	U	M	U	U	U
Rodgers2	U	U	U	Marg	U	M	U	U	U
Sonoma1	P	U	U	P	P	O	U	U	U
Zone 4A - Petaluma River Watershed									
Gill1	U	SN	U	P	SN	SN	U	U	U
Lytton1	U	U	U	Marg	P	SN	U	U	U
Wood0B	U	U	U	U	Marg	SN	U	U	U
Wood1	U	U	U	U	Marg	U	U	U	U
Zone 5A - Lower Russian River Watershed									
Fife8	SN	P	U	P	Marg	M/R	U	U	U
Zone 6A - Dry Creek Watershed									
WestSlough0	U	U	U	U	P	P	U	U	U
WestSlough1	U	U	U	U	P	P	U	U	U
Zone 8A - South Coastal Watershed									
Bloomfield1	U	P/O	U	U	P	U	U	U	U

Legend

O	Known occurrence in reach
P	Potential habitat
Marg	Marginal habitat
M	Migration corridor (fish only)
S	Known or potential spawning habitat (fish only)
R	Known or potential rearing habitat (fish only).
H	Historic occurrence; recent occurrence not confirmed
U	Unsuitable habitat, unlikely to occur and/or no known occurrence
SN	Survey needed (habitat conditions not recently documented)

California tiger salamander habitat rankings*

1	Moderate-High likelihood for occurrence in potential upland habitat (less than 500 feet from a known historic occurrence)
2	Moderate likelihood for occurrence in potential upland habitat (within 500-2,199 feet from a known historic occurrence)
3	Low likelihood for occurrence in potential upland habitat (within 2,200 feet -1.3 miles from a known historic occurrence)
U	Unsuitable habitat, unlikely to occur and/or no known occurrence within 1.3 miles

*Based on annual (2019) California Natural Diversity Database information. If a reach includes multiple tiger salamander habitat rankings, the length (linear feet) of reach within that rank is provided in brackets ().

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Chapter 11
PROGRAM MITIGATION

11.1 Introduction

Sonoma Water's general approach in conducting routine maintenance activities is to first avoid and/or minimize potential impacts wherever possible. Impact avoidance can often be achieved through minimizing the maintenance area footprint, phasing work efforts, conducting maintenance activities during less sensitive time periods, focusing maintenance areas to specific targeted locations, and conducting routine repairs and maintenance when needed such that small problems do not become larger issues requiring more intensive and widespread maintenance activities.

Potential impacts can also be minimized through site-specific decisions on how to conduct maintenance at particular facilities, as well as more program-wide protocols on how to minimize potential impacts. The impact avoidance and minimization measures and best management practices (BMPs) described in Chapter 10, *Impact Reduction, Minimization Measures, and Best Management Practices (BMPs), and Best Management Practices (BMPs)* are used to avoid and reduce potential environmental effects.

Sonoma Water aims to know and understand the natural resources and physical and biological processes that occur at each of its maintenance reaches and facilities and to conduct maintenance in the least impactful manner according to the natural resources and conditions present at the work site. Appendix C provides resource assessment descriptions for Sonoma Water maintenance reaches, providing detailed information on the setting, physical conditions, and natural resources.

In many ways, the SMP maintenance activities improve overall ecologic conditions at Sonoma Water's maintenance reaches. Now that the SMP has been in operation for several years, habitat conditions, including increased riparian vegetation and canopy in many channels are better than pre-maintenance conditions for plant and animal species as shown in Figures 11-1 through 11-3.

However, residual impacts that are neither avoided nor minimized completely through other measures may require compensatory mitigation, depending upon the nature of the impact, the resources potentially affected, and the regulatory authority involved. Compensatory mitigation is one element within the program's overall impact avoidance, minimization, and mitigation approach. A comprehensive description of program impacts is provided in the SMP's Environmental Impact Report (EIR) (Sonoma Water 2009).

11.2 Regulatory Guidance

The Stream Maintenance Program (SMP or Program) was developed to meet the mitigation requirements of the authorizing regulatory agencies including the U.S. Army Corps of Engineers

(USACE), the North Coast and San Francisco Bay Regional Water Quality Control Boards (RWQCBs), California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), and National Marine Fisheries Service (NMFS).

The SMP's mitigation approach was developed through multiple meetings and discussions with agency representatives from the USACE, RWQCBs, CDFW, USFWS, and NMFS. Meetings were held with individual agencies and also collectively through meetings of the Inter-Agency Working Group (IAWG). The SMP mitigation approach was also developed and evaluated over three years of interim permitting when proposed mitigation approaches were used and tested. During that period, individual maintenance projects were developed, submitted for agency review, permitted, and implemented. The interim permitting period was used to demonstrate and refine program maintenance activities, including the program's mitigation approaches.

Since permits were originally issued for the Program in 2010 and 2011, Sonoma Water has met and communicated with representatives from USACE, RWQCBs, CDFW, USFWS, and NMFS regularly about the Program, including discussions on how to revised or adaptively manage elements of the Program to do things better. For example, over time, Sonoma Water has learned how to improve specific maintenance techniques for removing invasive plants. Sonoma Water keeps regulatory agencies apprised of proposed updates to the Program through annual notifications, annual summary reports, and annual meetings and field trips to review and discuss SMP updates that can be tested out and applied in the coming maintenance year.

11.2.1 Guidance from USACE

For aquatic resources including wetlands and waters of the United States, compensatory mitigation may involve the restoration, establishment, enhancement, and/or in certain circumstances, preservation of aquatic resources for the purposes of off-setting unavoidable adverse impacts (hereafter "residual impacts") which remain after all appropriate and practicable avoidance and minimization have been achieved. The primary guidance document describing mitigation for impacts to aquatic resources is found in the 2008 USACE/U.S. Environmental Protection Agency (USEPA) "Final Mitigation Rule" which describes the range of mitigation methods and options available based on specific project and resource conditions, *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* (2008 USACE 33 Code of Federal Regulations [CFR], Parts 325 and 332 [2008]; and USEPA 40 CFR Part 230 [2008]).

Guidance provided in Regulatory Guidance Letter (RGL) 02-2 (USACE 2002) recommends that watershed and ecosystem approaches be used in developing mitigation programs. More specifically, a watershed-based approach should consider how the watershed physically functions, the overall resource conditions and needs within the watershed, and the relationship between program impacts and overall watershed processes. In other words, the relevance and significance of potential program impacts should be viewed within a comprehensive watershed context. In this way, the most appropriate and effective avoidance, minimization, and compensatory mitigation actions can be made. Guidance in RGL 02-2 (USACE 2002) additionally encourages applicants to provide compensatory mitigation through a mix of habitats including open water, wetlands, and adjacent uplands throughout the affected watershed. Multiple mitigation targets can provide a greater variety of ecosystem functions and opportunities for success to compensate for lost or impacted functions.

The SMP was developed to follow a watershed approach as referenced in the USACE's guidance above. Essential to the SMP is recognizing how specific sites or reaches function as components within the larger watershed system. This watershed approach enabled improved understanding of resources and the management of those resources across the whole watershed system. A watershed-based approach was also used in recognizing program impacts and designing appropriate avoidance and minimization measures.

Watershed processes were also considered in developing compensatory mitigation approaches to provide integrated watershed solutions and benefits. Off-site compensatory mitigation for the SMP occurs through funding watershed projects such as erosion control and habitat conservation and restoration in headwater watershed areas upstream of the engineered flood control channels in the program area (Section 11.5 below). By reducing sediment inputs from the watershed upstream, the frequency of sediment removal activities (and impacts) occurring in downstream flood control channels is reduced over time.

11.2.2 Guidance from RWQCBs

Compliance with Clean Water Act (CWA) Section 401 and the California Porter-Cologne Water Quality Control Act (Porter-Cologne Act) occurs via implementing the provisions of the program's 401 water quality certification and waste discharge requirements (WDR). In considering potential impacts to wetlands and adequate mitigation, the RWQCB follows the California Wetlands Conservation Policy (Executive Order W-59-93). The objectives of this policy are:

- To ensure no overall net loss and long-term net gain in the quantity, quality, and permanence of wetland acreage and values in California in a manner that fosters creativity, stewardship, and respect for private property.
- To reduce procedural complexity in the administration of state and federal wetland conservation programs.
- To encourage partnerships to make restoration, landowner incentive programs, and cooperative planning efforts the primary focus of wetland conservation.

The North Coast Regional Water Quality Control Board (NCRWQCB) and San Francisco Regional Water Quality Control Board (SFRWQCB) also provided specific guidance to help shape the Program's mitigation approach, including:

- SMP mitigation should address the impacts caused by maintenance activities.
- Mitigation provided on-site, near-site, or in the watershed is preferred versus more distant off-site or out-of-watershed mitigation approaches. Mitigation activities should occur at, or as near to as possible, to the maintenance site.
- The SMP should utilize the least-damaging practicable alternatives for the various types of channel and habitat maintenance activities. Bank stabilization projects that utilize biotechnical stabilization measures may be considered self-mitigating.
- SMP should prioritize in-kind mitigation for impacts to particular habitat types, and beneficial uses lost as a result of specific activities must be restored. Mitigation for

impacts on already degraded habitats (e.g., *Typha*-dominated channels) should focus on replacement with more beneficial habitats, such as creation of low-flow channels, planting of shade species, etc.

- The RWQCBs strongly support establishment of riparian canopy and healthy understory vegetation, which serves as habitat and helps mitigate impacts of sheet flow runoff.
- Other recommended mitigation approaches include habitat creation, habitat restoration which incorporates spawning gravels and/or pool creation, restoring hardened or culverted channels, sloping back banks to reduce erosion, removing instream reservoirs/dams where feasible, and establishing more natural stream/floodplain systems.
- Mitigation targets should be developed which reflect the intensity and duration of impact. Long-term impacts (those with a duration of more than a year) can be addressed through on-site restoration of the maintenance site. Short-term impacts which remain unmitigated while on-site restoration is established will require off-site mitigation. A 1:10 mitigation ratio of acres restored to acres impacted is an appropriate metric for short-term impacts.
- Sonoma Water should provide assurances that mitigation projects will succeed and be appropriately monitored. A complete description of each mitigation project needs to be submitted, and should include a monitoring and reporting plan which is implemented for 5 years after mitigation project completion. Clear performance standards should be identified, and remedial measures should performance standards not be met.
- Mitigation projects need to be reviewed for their own water quality impacts, and may require their own permitting.
- The SMP should consider measures to avoid the need for channel maintenance, including off-stream flood storage, high flow bypass, floodplain restoration, focused sediment collection areas, and runoff minimization. Watershed-level mitigation should be considered that addresses source control of sediments and flow where possible.

11.2.3 Guidance from California Department of Fish and Wildlife

CDFW is mandated with protecting the State's fish and wildlife resources. For the SMP, this protection is articulated through two primary regulations. Impacts to aquatic and riparian habitat are regulated by CDFW through Fish and Game Code Section 1600 et seq. the Streambed Alteration Program. Under the California Endangered Species Act (CESA), CDFW regulates "take" of species listed by the state as threatened or endangered. These two regulations are described in more detail in Chapter 2.

CDFW applies mitigation requirements through various sections of the Fish and Game Code and associated regulations related to lake and streambed habitats and species receiving protection under the CESA. Mitigation may be required for impacts to sensitive habitats (e.g., riparian habitats), permanent impacts to beneficial uses, and impacts to certain special-status species and their habitats (e.g., CTS).

CDFW provided direct guidance regarding mitigation preferences for the SMP as follows:

- Maintenance activities may have beneficial impacts. Activities which lead a channel away from cattail dominance towards a more varied and complete riparian corridor with overstory canopy and understory shrubs are encouraged.
- In-kind mitigation should be guided by reach ecologic needs (e.g., removal of cattails should not be mitigated by planting cattails) and should focus on replacement or improvement of stream function.
- Mitigation should consider existing high-quality stream areas and avoid impacts to such habitat values.
- While a historic reference condition may not be available, channels should be maintained to function hydraulically as well as provide habitat value.
- As a goal, mitigation should be implemented in the same year that the impact occurs, to reduce the time between the impact and the mitigation.
- SMP mitigation projects should only account for impacts resulting from SMP maintenance projects. To prevent redundancy in mitigation crediting, SMP mitigation projects should not be used to fulfill mitigation requirements for other Streambed Alteration Agreements or CESA permits.
- The monetary contribution to mitigation projects needs to be translated to ecological benefit that can sufficiently offset the impacts of SMP projects. Mitigation projects shouldn't have to rely on other monetary sources for successful implementation.
- Mitigation projects should be limited to the planning and implementation of on-the-ground habitat restoration and enhancement activities. Education and outreach may be considered in the future if sufficient evidence demonstrates a clear correlation between education and outreach programs and reduced work re-occurrence intervals.

11.3 General Mitigation Approach

The compensatory mitigation approach for the SMP is organized according to three tiers. Mitigation is first and foremost directed to address the maintenance impacts on-site at the specific project reach (Tier 1). Tier 1 mitigation seeks to restore or enhance the beneficial uses and ecological functions and values that were provided by a site in its pre-maintenance condition. Tier 1 mitigation also addresses long-term impacts of SMP activities and is conducted at a 1:1 ratio of acres restored to acres disturbed. Details of the specific Tier 1 type mitigation activities are further described in Section 11.4 below.

Tier 2 mitigation provides in-kind mitigation at neighboring SMP reaches that provide additional opportunities for mitigation. Tier 2 mitigation is very similar to Tier 1 on-site mitigation in that the focus is to provide reach-based in-kind habitat, stream function, or water quality benefits. The key difference is that Tier 2 mitigation occurs at another managed reach and not at the specific reach where the maintenance occurred. The mitigation activities described below in Section 11.5 for Tier 1 type mitigation are also potentially applied as Tier 2 mitigation at other channel locations. Tier 2 provides the mitigation program flexibility in finding other nearby stream channels to restore, in addition to off-site watershed mitigation (Tier 3).

Tier 3 mitigation occurs through partnership with other watershed stakeholders and organizations. Tiers 2 and 3 mitigation are used to address the temporary loss of Beneficial Uses and ecological functions and values during the time gap between when SMP maintenance activities occur and when Tier 1 mitigation is implemented and the on-site mitigation has become fully functional and the temporary impacts have been eliminated.

Tier 3 are funded through a contribution by Sonoma Water of 10 percent of the total cost of maintenance activities, and provide a 0.1:1 ratio of acres restored to acres disturbed, at a minimum. For Tier 3 mitigation, the 10 percent matching contribution by Sonoma Water goes to the partnering stakeholder or watershed organization. The annual area required to be restored or enhanced off-site as mitigation shall not be less than 10 percent of the annual area impacted by on-site sediment removal.

Note that mitigation for impacts to listed species does not fall specifically within this 3-tiered mitigation system. If species- or habitat-specific mitigation is required to address additional impacts to listed species, it would be conducted following the terms of the relevant Biological Opinions (BOs) and/or permits issued for the program. However, where feasible, Tier 2 and Tier 3 mitigation approaches would be first sought to provide the specific species/habitat mitigation functions. If this cannot be achieved through Tier 2 or Tier 3 mitigation projects, then additional mitigation are implemented to address impacts to listed species and fulfill mitigation requirements in the BOs. Section 11.7 describes the mitigation requirements for impacts to CTS according to the SMP's Programmatic BO and the extent of species-specific mitigation implemented for CTS through the purchase of mitigation credits.

11.4 On-Site Mitigation (Tier 1)

On-site mitigation is evaluated and designed to address impacts at the immediate maintenance project area. The general approach is to restore habitat that is affected by the routine maintenance activities in the same reach where the disturbance has occurred. This approach also seeks in-kind or functional agreement between impacts and mitigation. If riparian habitats are affected, then the mitigation strategy is to re-establish riparian habitat. If instream aquatic habitats are impacted, then instream aquatic habitat is the mitigation target.

While mitigation targets are sought based on in-kind or ecosystem functions, it is important to recognize that due to the constraints of a particular site (e.g., concrete-lined channel), such functions may not be the most appropriate targets for restoration or enhancement activities. Likewise, the on-site mitigation approach considers what the most appropriate restorative activities are for a particular reach, given the design capacity of the channel. For example, would the particular reach benefit more from planting of taller canopy species, or more understory species, or both? Based on engineering evaluations, in larger channels where there is sufficient capacity, both overstory and understory trees and shrubs can be planted. In smaller tributary channel systems, planting may be focused on tall trees on the upper bank with little or nothing but sedges and grasses on the side slopes and in channel.

As described below, Tier 1 on-site mitigation activities include a robust planting program to develop a fuller riparian corridor, the removal of exotic and invasive species, and the construction of low-flow channels and other geomorphic features to enhance instream habitat and remove migration barriers. Since 2008, Sonoma Water has conducted numerous on-site (Tier 1) mitigation projects resulting in a total of:

- 99,044 linear feet of channel plantings
- 7,016 trees installed
- 2,609 shrubs installed between 2008 and 2013

For a more current summary of Tier 1 mitigation projects completed, please refer to the SMP Database.

11.4.1 Planting Program and Canopy Development

General Approach and Benefits

Sonoma Water's on-site mitigation program includes a variety of planting and habitat enhancement approaches. These approaches include natural recruitment techniques as well as nursery stock tree and acorn planting, understory plantings along the bank and channel edge, and the installation of red and Pacific willow cuttings and nursery stock at the toe-of-bank. The primary objective is to enhance riparian habitat through greater canopy cover, shading, and develop a functioning understory along channels that are currently degraded with grass cover dominated by non-native ruderal species.

As illustrated in **Figure 4-2**, the ability to improve riparian canopy reflects existing habitat conditions and prevailing constraints. A riparian canopy can be developed very successfully, as illustrated at Upper Corona Creek (**Figure 11-1**), Wilfred Creek (**Figure 11-2**), Todd Creek (**Figure 11-3**). Since the Program has been established, riparian canopy cover conditions, and development toward a more mature vegetated riparian corridor, have greatly improved through riparian planting efforts. Also refer to Figures 7-5 and 7-8 to see how canopy cover condition have improved along Forestview Creek and Santa Rosa Creek, respectively.

Sonoma Water installs trees and understory plants as on-site mitigation at all reach scale sediment removal and bank stabilization projects. Localized sediment removal or culvert repair projects also include a tree planting component if there is available room to plant. Many maintenance projects are located within concrete channels or facilities where planting is not available.

Planting new trees or enabling natural recruitment of trees along reaches where vegetation was thinned or removed helps mitigate the temporary impacts of maintenance activities. As these planted or recruited trees mature, they provide shade to the active channel, provide nesting and foraging habitat for many birds and small mammals, moderate water temperatures and provide forage for aquatic species, and help reduce the need for future sediment management as the shade discourages cattail establishment which in turn traps sediment.

When considered at the watershed scale the planting program provides ecologic connectivity, via a vegetated corridor, from the headwaters of the watershed to the receiving water body at the downstream end of the program area. Connected landscapes provide enhanced habitat for local and migrating species. In addition, increased vegetation along the streambanks improves water quality through shading the stream and cooling water temperatures, and through filtering runoff entering the creek. While the constraints of an urban system (where the majority of Sonoma Water's engineered maintenance reaches are located) may limit the degree to which water quality is improved, even small improvements may provide a more hospitable environment for aquatic invertebrates which in turn provide the food source for birds, bats, and other species.

Planting Plan Templates

Since 2013, the SMP Annual Report introduced planting plan templates. These templates introduce the terms "permanent trees" and "temporary trees." The planting plan templates identify the target density numbers for upper bank and in-channel riparian toe trees (permanent trees) used for restoration. Examples of planting plan templates can be found in the SMP database.

Sonoma Water has developed planting plan template for different types of channels, including different channel sizes, forms, flow capacities, and channels with a range of existing instream vegetation and roughness conditions. Target planting densities also consider the future trajectory of vegetation in the vicinity of the plantings and what the successional trend is for the channel.

In general, woody species create the greatest roughness in the channel, so in-stream planted or naturally recruited trees are managed for longer-term sustainable densities, that won't create roughness conditions in exceedance of what the channel can convey. The general SMP approach focuses on moving the successional stage of riparian vegetation from an early seral stage (less than 10-20 years old) to a manageable climax stage and then maintain (to the template) the diversified canopy and understory into the future. These stages vary between reaches and different creeks but can be clearly differentiated by age and size of the vegetation.

At some locations, however, establishing mature, closed riparian canopy along all SMP creek corridors may not be ideal for certain species. At some locations the preferred seral stage may be different than a climax stage (mature trees with closed canopy) to improve conditions for sensitive species or to accommodate natural modification by wildlife. Managing for a lower (non-climax) seral stage may be needed to enhance habitat for species that are dependent on disturbance to maintain or create suitable habitat. For example, western pond turtle and foothill yellow legged-frog prefer patches of open riparian canopy that requires disturbance to maintain. Beavers will lower the riparian seral stage where they become established. This occurs from downing and consuming riparian trees. Beavers also use downed riparian vegetation to construct dams, which creates lotic aquatic habitat and the resulting summer inundation can smother riparian trees.

In many (but not all) cases, restoration following sediment removal brings a channel back into an early successional stage. Early seral vegetation is generally composed of numerous young willows, at a relatively high density. In the early stages, general habitat function (wildlife habitat, geomorphic interactions, leaf input, shading, etc.) is provided by numerous small saplings. As these saplings grow, they naturally thin to a lesser, more sustainable, number (based on available resources). Early in the process, many smaller plants provide the habitat equivalent of fewer large plants. But as time passes and vegetation grows, not all the initially installed plants are retained because of roughness considerations. Over time, planted or recruited vegetation is thinned and retained as appropriate based on allowable roughness and flow conditions. The general management trend is to transition from an early stage vegetation to a later stage with a denser canopy cover over the channel. Because of this, some initially installed or recruited plants need to be thinned or removed to make space for maturing larger vegetation.

Note that in some cases depending upon channel vegetation and sediment conditions, some mature vegetation is retained during sediment removal projects and so the channel is not always brought back to an early successional stage. For example, as shown in **Figure 11-4**, mature riparian vegetation was retained along the banks of Five Creek and vegetation was retained along the channel thalweg of Laguna Creek during sediment removal activities conducted in 2019. Sonoma Water seeks to maintain as much existing vegetation as possible when conducting maintenance activities, following the goals and objectives as described above in Chapter 8, *Other Maintenance Activities.*

The planting plan templates guide Sonoma Water in managing the vegetation successional process, establishing the baseline standards for allowable vegetation from initial planting through maturity. The planting plans indicate how vegetation is anticipated to mature over time by displaying tree arrangements and plantings at periods of 1, 7, and 15 years of growth.

Because a successional process is incorporated into the planting plans, and more trees are planted/recruited than ultimately retained in the longer-term, each planting project can have variable success rates. In general, initial tree spacing varies between 15 and 25 feet, but final (permanent or climax) spacing for trees varies from 30 to 50 feet on center depending on the creek, it's capacity, morphology, needed access points, utilities and infrastructure. These target densities for permanent trees are used to measure success of the project over time.

Tree target densities and planting plans (or use of a planting template) are developed for each stream reach during the restoration planning and the vegetation management process to determine the allowable number of trees, the appropriate species, and their arrangement, for both in-stream and along the top of bank.

Planting Zones

Two standard planning zones are identified in the planting plan templates. These zones are Upper Bank (Figure 8-1) and Lower Bank. The planting plant template for the Lower Bank zone can be found in the SMP database. These two zones are distinguished based on topography, elevation, and the frequency of saturation and inundation of the bank zone.

Upper Bank Zone (Top of Bank)

The upper bank zone is the area within Sonoma Water's authority between the top-of-bank (i.e., the upper hinge-point in an engineered channel) and three to four feet below the top-of-bank. Where conditions are suitable, the goal for this zone is to develop into upland and riparian forest approaching 75 percent or greater canopy cover. The upper bank zone is planted with upper floodplain and upland tree species including buckeye, oaks, bay and walnut. Additionally, this zone is planted with groupings of upland graminoid and herbaceous perennial species including California fescue (*Festuca californica*), creeping wild rye (*Leymus triticoides*), common yarrow (*Achillea millefolium*), and Sonoma sage (*Salvia sonomensis*).

Lower Bank Zone (Toe)

The lower bank zone is typically the area between the ordinary high water mark (OHWM) and the channel bed (i.e. the lower hinge point or toe). Depending on the specific hydrological conditions present in the channel, this zone may extend into the channel bottom and along the thalweg. If the channel has adequate flow conveyance capacity, the lower bank zone is intended to develop into riparian forest and is planted with tree species typically found immediately adjacent to the stream channel such as willow (*Salis* spp.), alder (*Alnus* spp.), poplar (*Populus* spp.), and ash (*Fraxinus* spp.).

Additionally, and where conditions are suitable, the lower bank zone is planted with grass, sedge, rush and herbaceous perennial species that are suited for emergent freshwater wetland or a naturally intermittently wet stream, as appropriate per the channel hydrology. Most program channels have water or are at least moist in the channel bottom year-round. These wet streams are planted with wetland species amenable to the hydraulic management needs of a flood control channel that receives urban runoff during the dry season and potentially large winter flows (e.g. small in stature, perennial, rhizomatous, and can survive being submerged for long periods). Species planted on intermittent channels include wet meadow species rather than emergent wetland species. The understory plantings are plugged (in appropriate groupings) on 5-10-foot centers in appropriate groupings and locations within the lower bank zone.

Plant stature is an important consideration, and is related to how the plant is anticipated to behave during periods of higher flows. Herbaceous species tend to bend over in higher flows, allowing debris and sediment to pass over rather than being caught in unyielding stems. The lower the plant, the less debris and sediment it catches. **Figure 11-5** and **Figure 11-6** include a list of the species proposed to be used in SMP flood control channels for restoring aquatic habitat following sediment removal. The species in these figures are all native to Northern California (and typically native to Sonoma County); those used in the in-channel zone are generally less than three feet tall, and have all or most of the desired characteristics anticipated to perform well in the program's flood control channels.

Graminoid and herbaceous perennial species for planting in the lower bank and upper bank zones may either be from locally-sourced nursery stock or collected propagules. One-gallon sized plants are used preferentially, however 4-inch sized plantings or plugs may be substituted if gallons are unavailable. Plantings on the lower bank zones are generally installed in a linear fashion and on 5- to 10-foot spacings, as allowed by site conditions at the time of planting. Upper bank plantings are installed in appropriate groupings, with species less tolerant of mowing being planted below the upper bank trees.

Nursery Stock Tree Planting

Planting of nursery stock trees typically occurs from December 1st to May 31st. This is timed during the typically wetter months of the year so that newly planted trees have the opportunity to establish before the hotter and drier summer months. Planted nursery stock trees are generally planted as 1- to 15-gallon container trees. Once planted, trees are monitored and watered by hand during the dry season as necessary for approximately 2 to 3 years or until established. Trees planted on the upper bank require irrigation longer than those located closer to the toe-of-slope. Some trees planted near the toe-of-slope may not require irrigation (although all planted trees are monitored for watering needs).

Trees are planted just up from the toe-of-slope and along the top of the bank slope. Trees planted along the top-of-bank may include big leaf maple, oaks, and buckeye. Trees planted at the OHWM, slightly above the toe-of-slope may include alders, ash, maples, Fremont poplar, box elder, and red or Pacific willows. Trees are spaced appropriately to allow room for a mature tree canopy to develop (typically 15 to 30 feet on center) and thinned later as necessary to maximize canopy yet retain channel capacity.

Recommended plant palettes are provided according to channel geomorphic form in Table 11-1, Figure 11-5, and Figure 11-6 (at the end of the chapter). All listed plants are native riparian species found in Sonoma County waterways. Not all species are equally appropriate for all sites. The planting list for any given site should be developed in consideration of the current and known historic native flora of the site and the local subwatershed area. Sonoma Water also tries to install plants that were once collected by Native Americans in the area.

Trees are installed in the native soil and an irrigation basin one to two feet in diameter is formed around each hole where feasible. Holes are prepared using hand tools or a mechanical auger. Trees are installed and mulched so that root crowns are at, or slightly above, the soil surface. Additionally, upper bank trees (trees installed in the overbank zone) are top dressed with a one-inch thick layer of mulch to reduce weed growth and retain moisture. Landscape fabric is used for erosion control on slopes and disturbed areas.

Trees and shrubs are irrigated manually during the dry season for three years. Irrigation frequency is approximately weekly the first year, every two weeks the second year, and monthly during the third year.

Natural Recruitment and Alternative Restoration Techniques

The SMP concentrates on developing beneficial stream-side vegetation along the toe of the channel as well as along the upper bank. Natural recruitment is an effective process to establish trees that are well suited to flood control channels. In addition to direct seeding in the fall by Sonoma Water or its partners, many of the existing trees in SMP channels were recruited naturally and purposely retained in place to provide habitat benefits. Trees established from seed are arguably better adapted to site conditions overall than any tree installed from nursery stock.

Upper bank plantings installed after 2008 by the program have been slow to mature and are expensive to maintain (requiring watering, mulching, weeding). Average growth on planted oaks is measured by annual inches in gain. While these plantings are of upmost importance to the long- term riparian corridor of program flood control channels, even greater strides in canopy cover have been made through selective tree preservation and natural recruitment.

Sonoma Water collects native acorns in the fall from local sources. Collected acorns are float tested and any acorns that float or are soft are discarded. If not planting immediately, acorns are cold stored with a dampened moisture-holding medium (such as sawdust or vermiculite). Planting are timed with the advent of the rainy season, typically in late fall or early winter.

For planting, a two to three-foot diameter water basin depression is dug in existing soil to pool water slightly around the acorns. Weeds are removed within this area through hand-removal at the time of planting or foliar treatment with herbicide prior to planting. At the center of the water basin a planting pit is prepared by turning over the soil to a depth of at least one foot using hand tools or a mechanical auger. Prior to the installation if acorns, the turned soil is lightly tamped. Acorns are planted in the center of the prepared planting pit. Acorns are planted on their sides and in groupings of three, approximately one-fourth of an inch below the surface. Mulch may be added to the area around the planting pit to help suppress weed growth. Additional planting hardware may include weed mats, aviary or gopher wire, or protective tree tubes, depending on the site conditions. Stakes or pin flags may also be added to mark the planting site.

In the fall of the year following the initial planting, multiple-germinating acorns within a single planting pit are thinned to the most vigorous individual. While planted acorns may not require supplemental watering, the need for watering to improve germination or establishment rates are evaluated on a seasonal basis.

Monitoring and Success Criteria for Restoration Planting

Monitoring is conducted at the project site for five years following construction and planting. Information collected includes the number and species planted at each site, linear feet of channel planted, and number or percent of planted trees and shrubs surviving. Site conditions are documented annually by taking repeat photographs at set reference locations. The monitoring data is reviewed annually to evaluate the overall success of the revegetation approach.

For vegetation planting projects, the overall goal is 75 percent survival. For in-channel plantings, setting the appropriate criteria for survival is difficult due to lack of reference criteria and the dynamic environment of the channel bottom. Depending upon winter flow conditions, in-channel plantings could be covered in sediment or scoured and eroded by the following next year. Instead of establishing strict survival criteria for the in-channel zone, projects are monitored and the presence of the planted species in the channel is documented. Initial goals for in-channel plantings are some level of survival, retention, and successful colonization into the subsequent years.

In the event of poor plant survival or failure to meet stated performance criteria, corrective measures are implemented, including replanting to reach the 75 percent goal. Such remedial measures are monitored for a 5-year period following implementation to ensure that the project is successful. In the event of poor tree survival, corrective measures include replanting to reach the 75 percent goal in the upper bank and lower bank zones. For understory species, selective replanting is conducted to ensure some level of establishment within the planting zones.

11.4.2 Invasive and Exotic Plant Removal

Sonoma Water removes invasive and exotic plants as part of its on-site mitigation program. This beneficial activity occurs in tandem while general vegetation maintenance activities are occurring on–site, including vegetation thinning, pruning, and removal. Because the removal of invasive and exotic plants is closely integrated with the general vegetation management activities, it is described in the vegetation maintenance description of Chapter 7, Sections 7.3.3 through 7.3.6.

Specific mitigation activities include the targeted removal of invasive and exotic species such as Himalayan blackberry (*Rubus armeniacus*) and tree of heaven (*Ailanthus altissima*). The removal of invasive and exotic species provides more room for desirable native species to establish. An increase in abundance of native vegetation over non-native vegetation improves overall riparian health. For example, native vegetation can provide more habitat opportunities to insects and birds that show preferential treatment for use of native plant species. Removing exotic species also helps prevent the monoculture common to areas dominated with exotics. When replaced with a diverse selection of native vegetation, the channels of the program area can support a more diverse set of species including insects, birds, small mammals, amphibians, and reptiles.

11.4.3 Low-Flow Channel Development

Where appropriate during reach scale sediment removal projects, Sonoma Water designs and implements a low-flow inset channel along the bed of the flood control channel. The low-flow channel provides on-site mitigation through multiple benefits. Because low-flow channels are created together with sediment removal activities, they are also described above in Chapter 5, *Sediment Management and Removal*.

A key objective of a low-flow channel is to successfully transport sediment under lower flow conditions (annual flows and smaller). This is achieved through increased flow depth and velocity under low-flow conditions which are adequate to convey and pass sediment under the smaller flow conditions. Sedimentation at many engineered flood control channels results in uniform bed aggradation, with an even channel bed surface rising and accumulating sediment over time. When this happens, under lower flow conditions, water depth may only be a few inches deep and is spread diffusely across the entire channel bed width. Developing a low-flow channel can improve this situation greatly by focusing flows into a narrower and deeper channel that is able to pass fine sediment downstream, improve water quality, maintain lower water temperatures, and very importantly – preserve and enable a migration corridor for fish. When conditions are suitable, and a low-flow channel can be developed, it can provide these many benefits. Where low-flow channels currently exist, Sonoma Water seeks to maintain them by scraping the bar.

Developing a low-flow channel to enable fish migration is particularly important in the program's steelhead-supporting streams such as Copeland Creek. Copeland Creek's engineered flood control channel is an important transport reach that leads steelhead to spawning areas in the upstream watershed and enhances smolt emigration. Reaches along Copeland Creek where low-flow channels have been installed maintain an open water unblocked corridor. In other reaches without a low-flow channel, the channel bed is typically blocked with deposited sediment and cattails which inhibits steelhead migration. **Figure 5-1** provides photographs from Copeland Creek before and after sediment removal activities and shows the blocked channel condition prior to development of the low-flow channel.

The habitat and fish migration benefits of low-flow channels are described in the Russian River Watershed Biological Opinion (NMFS 2008). Additionally, the use of low-flow channels is a specifically mentioned term of the BO's Reasonable and Prudent Measures (RPM). RPM 5 includes measures to reduce harm to listed salmonids resulting from activities along the Russian River, Dry Creek, and maintenance activities in Zone 1A of the SMP Area. Condition D of RPM 5 includes the requirement that "at sediment removal sites in Zone 1A, Sonoma Water shall construct a low-flow channel to provide enhanced migration habitat through sediment removal areas" (NMFS 2008 p. 327). The BO also requires that low-flow channels be monitored at least two times between large storms during the winter period to assess their function as migration corridors and the possible effects of the low-flow channel on overall channel conditions. The SMP approach is consistent with the terms and conditions of the BO, and the SMP will comply with those terms. Similarly, the SMP considers the use of low-flow channels as an appropriate mitigation measure to be used with sediment removal projects of the SMP.

11.5 Off-site Watershed Mitigation (Tier 3)

11.5.1 Rationale and Purpose

Off-site watershed mitigation (Tier 3) addresses the temporary loss of Beneficial Uses and ecological functions and values during the time gap between SMP maintenance activities and when on-site Tier 1 mitigation occurs, and the time when Tier 1 mitigation becomes functional. Off-site mitigation projects provide restorative and mitigating watershed solutions that address SMP's temporary impacts. Examples of off-site mitigation projects include native riparian plant revegetation, large woody debris installation, invasive plant removal, bioengineering/erosion control, and watershed-based sediment or other contaminant reduction actions.

The great majority of SMP activities and temporary impacts occur in the engineered channels of Zones 1A, 2A, and 3A. These SMP channels typically occupy the developed alluvial plain areas of Santa Rosa, Rohnert Park, Cotati, and Petaluma. The actively maintained SMP channels are typically located downstream of headwater source areas for runoff and sediment (see Figures 3-1 and 3-2) and also downstream of potential steelhead spawning and rearing habitats. However, the SMP channels are also upstream of important watershed lowlands such as the Laguna de Santa Rosa, Petaluma River marsh and baylands, and the Sonoma Creek marsh and baylands. These lower watershed and estuarine systems provide several important natural habitats and flood management functions. From a watershed perspective, the area of most SMP activities is found between headwater source areas upstream and valuable creek, marsh, or estuarine resources downstream. After SMP activities are completed, in most cases, overall habitat conditions have been improved for sensitive species.

In recognizing the connectivity of these relationships, the SMP's watershed mitigation approach provides an excellent opportunity to reduce runoff and erosion in the headwater source areas while also reducing sediment loading to downstream systems. Off-site watershed mitigation also provides sustainability benefits. Reducing sediment loads from upstream sources can reduce the overall need for in-channel maintenance over time. This approach is consistent with Sonoma Water's commitment toward environmentally sustainable solutions (Maintenance Principle 6). Looking downstream, Tier 3 mitigation provides the opportunity to preserve, enhance, and restore the most valuable aquatic ecosystems in the program area.

11.5.2 Watershed Partnerships Program

SMP off-site watershed mitigation is led and funded by Sonoma Water through a grant program to distribute funding to partnering agencies. A Watershed Partnerships Program (WPP) was formed by Sonoma Water to fund and implement projects collaboratively with local non-profit agencies and Resource Conservation Districts (RCDs). The WPP assists non-profit organizations and landowners to implement projects that improve water quality and restore habitats and ecosystem functions.

The SMP's Tier 3 mitigation program is a subset of the WPP projects that Sonoma Water funds, and the WPP projects funded by the SMP are linked to SMP impacts. The WPP may fund other projects that do not serve as mitigation for the SMP (for instance, education and outreach projects). Such projects are not counted as mitigation for the SMP.

To provide mitigation for temporary impacts (and more specifically the temporal gap between when maintenance activities occur and when site conditions are recovered or mitigation is established and functioning) Sonoma Water contributes 10 percent of the annual cost of implementing SMP sediment removal and bank stabilization projects into a fund to distribute annually to WPP partners and to conduct Tier 2 mitigation described above. Additionally, the annual area required to be restored or enhanced off-site as mitigation shall not be less than 10 percent of the annual area impacted by on-site sediment removal. Watershed projects are selected based on their ability to provide water quality, habitat, and ecosystem benefits as suitable mitigation for SMP impacts.

Organizations funded through the WPP are required to sign a contractual agreement with Sonoma Water to ensure that mitigation projects are implemented as described in the application.

While the WPP is a compensatory mitigation program to offset SMP temporary impacts, it bears resemblance to an in-lieu fee arrangement. This is due to the fact that the entities implementing compensatory mitigation projects may not be the same entity that incurred the impacts (namely, Sonoma Water). However, this program is stronger than typical in-lieu fee programs, since: (1) it is administered by Sonoma Water, rather than another entity, providing increased oversight over the use of funds; (2) it funds specific mitigation projects that are directly tied to the specific activities conducted under the SMP, rather than supplying a general fund that implements projects that are currently undefined; and (3) mitigation projects are implemented within a specified period after the impact has occurred (typically within the same year), rather than at an unspecified point in the future.

These nuances notwithstanding, regulatory guidance on the use of in-lieu fee arrangements was considered relevant in designing the mitigation program for the SMP. Regulatory guidance on the use of in-lieu fee arrangements is provided under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act in *Federal Register Vol. 65, No. 216, pp. 66914-66917* (November 7, 2000). In-lieu-fee mitigation can be used where funds are paid to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development. In-lieu-fee arrangements differ from mitigation banking in that they typically do not provide compensatory mitigation in advance of project impacts. In-lieu-fees can be used to provide compensatory mitigation under Individual Permits or General Permits issued by USACE. The WPP was developed to be consistent and uphold these general guidelines and provide a mitigation program that is geographically flexible, pragmatic, and responsive to the entire watershed area of program activities.

As program administrator, Sonoma Water oversees and ensures that all grant recipients are qualified contractors. Sonoma Water is responsible, together with the partnering agencies, to monitor the mitigation projects. Sonoma Water is responsible to provide the relevant regulatory agencies with mitigation reporting as discussed in Sections 12.6 and 12.8.

WPP Partners and Projects Implemented

In addition to Sonoma Water, the WPP currently includes the following Partners:

- Point Blue Conservation Science (Point Blue)
- Friends of the Petaluma River
- Gold Ridge Resource Conservation District
- Laguna de Santa Rosa Foundation (Laguna Foundation)
- Natural Resources Conservation Service
- Rohnert Park and Cotati Creeks Council
- Sonoma County Regional Parks
- Sonoma Ecology Center
- Sonoma Resource Conservation District (Sonoma RCD)
- Sonoma State University
- Russian Riverkeeper
- The Center for Social and Environmental Stewardship (The Center)
- The City of Santa Rosa
- United Anglers of Casa Grande High School

Since 2009, the Partners listed above along with Sonoma Water's support, have implemented nearly 40 habitat restoration, erosion control, and water quality improvement projects in the SMP watersheds. Since inception of the WPP, Sonoma Water has:

- Helped restore approximately 68 acres of habitat; and
- Spent over $1.9 million on local watershed WPP projects.

Refer to the SMP Database for details regarding Sonoma Water's contribution to specific WPP projects.

11.5.3 Monitoring and Success Criteria for Watershed Mitigation Projects

Tier 3 watershed mitigation projects are monitored and reported for five years. Monitoring of site conditions is the responsibility of the respective partner overseeing a given project. Sonoma

Water is responsible to communicate monitoring results annually as part of the SMP reporting process (see Chapter 12, Sections 12.6 and 12.8).

Monitoring reports for watershed mitigation projects are prepared by the project partner and submitted to Sonoma Water. The monitoring reports include a description of the project and its objectives, how the project develops over time, and if the project requires adaptive management or maintenance. More specifically, data to be tracked and collected for watershed mitigation projects includes:

For erosion control projects: The status of the erosion control treatments and their effectiveness are monitored annually. Key questions addressed include: are the treatments working effectively, is sediment actively eroding at the mitigation site beyond and above expected natural rates, are additional management or maintenance actions required? Photographs are taken annually at consistent and referenced locations to allow comparisons of site conditions.

For planting and habitat enhancement projects: Monitoring includes the number and type of species planted per project site, linear feet of channel planted or acres of area restored per project site, and percent canopy cover. Monitoring includes a complete survival count each year during the five-year maintenance period. The first count occurs at the end of the first growing season. The final count occurs at the end of the fifth year maintenance period. Monitoring includes the survival, percent cover, and height of both tree and planted shrub species. Monitoring includes the number by species of plants replaced, an overview of the revegetation effort, and the monitoring methodology should be described as necessary. Reference photos from designated locations are taken annually. If invasive species removal is a component of the mitigation project, then monitoring includes: the number and type of invasive trees removed, square feet of removal for shrub or ground-cover species, and the percent of managed area re-colonized by invasive plants.

Success criteria for off-site watershed mitigation projects is similar to the success criteria described above in Section 11.4.1 for Tier 1 on-site mitigation. For vegetation mitigation projects, the overall goal is 75 percent survival. For in-channel plantings, setting the appropriate criteria for survival is difficult due to lack of reference criteria and the dynamic environment of the channel bottom. Depending upon winter flow conditions, in-channel plantings could be covered in sediment or scoured and eroded by the following next year. Instead of establishing strict survival criteria for the in-channel zone, projects are monitored and the presence of the planted species in the channel is documented. Initial goals for in-channel plantings are some level of survival, retention, and successful colonization into the subsequent years. Sonoma Water determines if and when a Tier 3 mitigation project is complete based on monitoring and remedial actions, if necessary. Remedial actions, if outside the scope of funding of the original WPP project, are funded by Sonoma Water.

If the whole area of the Tier 3 watershed mitigation project achieves the success criteria, then the entire area of the mitigation project is used for mitigation accounting purposes. If a smaller vegetation success percentage rate is observed, less than the target 75 percent success rate, then the mitigation area is scaled down appropriately for use in mitigation accounting.

11.6 Mitigation Accounting and Requirements

11.6.1 General Mitigation Ratio

Compensatory mitigation under the SMP is provided at a minimum of 1.1:1 (area restored to area disturbed). The first increment of 1:1 is provided by on-site Tier 1 mitigation, which directly addresses the affected maintenance area. Due to the degraded nature of many of the SMP channels, in most cases Tier 1 mitigation results in improved conditions to these sites over the longer term (ecological lift concept). As such, the restored reaches provide a greater than 1:1 mitigation ratio when considering functions and values over the longer-term, and not just acreage.

The next increment of 0.1:1 is provided by Tier 2 or Tier 3 off-site mitigation. In other words, at a minimum, the 10 percent contribution described above provides a 0.1:1 acreage ratio. Based on the implementation of mitigation projects to date, the 10 percent contribution typically provides a mitigation area and ratio which exceeds 0.1:1. This additional 0.1 increment mitigates for the temporal lag, the time gap between when temporary impacts occur and when Tier 2 or 3 mitigation becomes established. This mitigation ratio approach was developed and demonstrated through the mitigation projects implemented during the 2006-2008 interim permitting period while the SMP was under development and for the many mitigation projects that have been implemented by the program since 2009.

11.6.2 Specific Mitigation Requirements for Sediment Removal Activities

This section includes specific mitigation requirements for sediment removal activities that were developed for the program in coordination with the North Coast and San Francisco Bay Regional Water Quality Control Boards (RWQCBs).

- Localized, intermediate-scale sediment removal, reach-scale sediment removal, and bank stabilization projects shall include on-site habitat enhancement and restoration activities (as described in Section 11.4) at no less than a 1:1 ratio for areas impacted to areas restored.
- On-site restoration activities need not occur within concrete flood control channels or other concrete/hardened flood control facilities. However, the cost of removal of sediment from such concrete facilities is included in the calculation of Sonoma Water’s contribution to the off-site watershed restoration projects fund (Section 11.5).
- On-site and off-site mitigation activities shall be observed and monitored for 5 years as described in Sections 11.4 and 11.5.
- Annual costs for the implementation of localized sediment removal, reach-scale sediment removal, reservoir inlet clearing sediment removal, and bank stabilization projects shall be used as the basis to fund off-site mitigation projects. Off-site mitigation projects are selected and funded that provide beneficial watershed functions of restored habitat, erosion control, or other suitable watershed benefits as described in Section 11.5 Ten percent of the annual costs for the sediment removal and bank stabilization projects shall be contributed to a mitigation fund to be used by watershed partners as described in Section 11.5. The area to be restored or enhanced off-site as

mitigation shall not be less than 10 percent of the impacted on-site sediment removal area (resulting in a total mitigation ratio of 1.1:1, considering both on-site and off-site mitigation). For example, if the impact to the SMP channel is 1 acre, then the off-site mitigation area should not be less than 0.1 acre.

- The RWQCBs support the 10 percent compensatory off-site mitigation rate, as described above to address the temporary loss of beneficial uses during the time gap between when on-site impacts occur and when on-site restoration activities occur. Due to this "temporal gap" the additional 10 percent mitigation requirement is applied off-site.
- The costs for conducting localized sediment removal areas (that are used as a preferential approach to reduce the need for reach-scale sediment removal projects) are included when calculating the financial contribution to Tier 3 off-site mitigation by Sonoma Water. However, the area of impact for localized sediment removal zones does not require on-site restoration on an area or linear basis.

11.6.3 Specific Mitigation Requirements for Vegetation Management Activities

This section includes specific mitigation requirements for vegetation management activities that were developed for the program in coordination with the North Coast and San Francisco Bay RWQCBs and the CDFW.

- Sonoma Water shall mitigate for the loss of beneficial uses due to SMP vegetation management activities.
- The SMP categorizes vegetation according to three classes, including: (1) Class 1- Native Riparian Vegetation, (2) Class 2- Problematic In-Channel Vegetation, and (3) Class 3- Other Non-Native Vegetation. These vegetation classes are further described in Chapter 7, Section 7.2.1. Table 11-1 identifies common example species of the three vegetation classes.
- *Class 1: Native Riparian Vegetation:* Class 1 native vegetation (except for those species listed under Class 2, below) shall be retained wherever possible, and pruned or thinned where necessary to foster the development of a riparian canopy. The removal of native riparian vegetation is avoided to the greatest extent possible. Where such native vegetation has to be removed due to flood management considerations, the following limitations and mitigation shall apply. The removal of native vegetation with any single stem greater than 4" dbh (diameter at breast height) are monitored, recorded, and mitigated at a 2:1 ratio, whereby 2 trees are replaced for every tree removed. Replacement trees shall include, but not be limited to, suitable riparian species such as alder, willow, Oregon ash, etc.
- *Class 2: Problematic In-Channel Vegetation*: Class 2 vegetation is particularly problematic for in-channel flood management purposes. Class 2 vegetation is also ecologically problematic, limiting the growth of native riparian vegetation, constraining the establishment of a native riparian canopy, and reducing other beneficial uses. Table 11-1 identifies common examples of Class 2 vegetation types. Impact avoidance and minimization approaches applied for the removal and thinning of Class 2 vegetation is described in Sections 7.3.2 through 7.3.6. Regulatory provisions for the removal and

management of these species are included in the program's Agreement for Routine Maintenance (ARM) with the CDFW. The thinning and removal of these species do not require any additional specific mitigation requirements.

- *Class 3: Other Non-Native Vegetation*: Class 3 vegetation consists of non-native species that are not listed under Class 2 (see Section 7.2.1). Examples of Class 3 vegetation include: various landscaping Ash species (green ash, raywood ash), London plane (Sycamore), and Carolina poplar. While these species are not as ecologically preferred as Class 1 vegetation, it is acknowledged that they may provide beneficial uses. As such, the removal of Class 3 vegetation with any single stem greater than 4" dbh (diameter at breast height) is monitored, recorded, and mitigated at a 1.5:1 ratio.
- When replacing Class 1 and Class 3 trees, replacement trees shall consist of native riparian species such as alder, willow, Oregon ash, or other suitable species. The mitigation replacement of trees may either occur at the reach under maintenance or at another suitable Sonoma Water channel reach in need of riparian canopy. The number of removed trees is reported in the annual summary report of maintenance activities and the replacement of trees as mitigation is reported through the annual maintenance reports as well. Since, 2009, Sonoma Water has planted over 5,500 trees to meet their mitigation requirements. A detailed summary of the number of Class 1 and Class 3 trees removed, mitigation requirements, and replacement trees planted annually, can be found in the SMP Database. Similar to the requirements for on-site and off-site mitigation and restoration activities, the performance criteria for replacement planting for vegetation mitigation shall be 75 percent success, and mitigation plantings shall be monitored for 5 years. In addition to overall success, planted trees shall be evaluated for their overall health and vigor.
- The pruning of trees, including native trees, in order to promote a more upright, mature riparian canopy does not require mitigation.
- Grass mowing and shrub thinning activities are not anticipated to adversely affect shade or habitat benefits, and as such, do not require mitigation.

11.7 California Tiger Salamander Mitigation

The Programmatic Biological Opinion from USFWS requires compensation for adverse effects of SMP activities to CTS. Compensation may include either contribution to a USFWS-approved preservation bank, contribution to a species fund, contribution to research to further the recovery of CTS, or contribution to habitat enhancement and restoration for CTS. Alternatively, Sonoma Water may compensate through protection, in perpetuity, of Sonoma Water-owned CTS habitat within the SMP. Preservation bank compensation is purchased based on the following criteria:

- Actions less than 500 feet from a known CTS occurrence would be compensated for at a ratio of 2:1.
- Actions greater than 500 feet and less than 2,200 feet from a known CTS occurrence would be compensated for at a ratio of 1:1.

- Actions greater than 2,200 feet and less than 1.3 miles from a known CTS occurrence would be compensated for at a ratio of 0.2:1.

Compensation at the above-referenced ratios is only applied to SMP activities resulting in ground disturbing effects located above the OHWM and within potential upland CTS habitat. If Sonoma Water choses to compensate by funding research or conducting restoration activities, the monetary value of compensation equals the going rate of purchasing preservation credits. Since 2010, Sonoma Water has purchased 1.74 CTS mitigation credits (acres) and spent over $272,000 on these credits. Refer to the SMP Database for a detailed summary of CTS mitigation credits purchased annually, costs, amount used, and remaining balance of purchased credits available for future use as mitigation for the program.

11.8 Trash Removal

While not necessarily considered a mitigation action, Sonoma Water also removes trash twice per week along and within channels on which Sonoma Water has a maintenance easement. Removing trash helps improve water quality and aquatic habitat for plant and terrestrial species. Since 2010, Sonoma Water has removed approximately 250,600 pounds of trash. In the last few years (between 2017 and 2019) in which more trash removal data has been collected, Sonoma Water has removed on average 72,100 pounds of trash per year. For more details regarding Sonoma Water's trash clean-up activities, refer to the SMP database.

11.9 Mitigation Notification and Reporting

Mitigation planning, design, implementation, and monitoring activities are notified and reported to the relevant permitting agencies through the course of the regular program communications. Notification and reporting details for the overall program are described in Chapter 12, Sections 12.6 and 12.8. Sonoma Water submits an annual maintenance project workplan notification in the spring of each year. This notification includes a description of maintenance project details, including locations, activities, and impact avoidance and minimization measures. The notification packet also includes information regarding the annual mitigation process.

Mitigation information to be included in the annual notification packet includes:

- A description of on-site (Tier 1) restoration activities planned for the coming year including locations, lengths, areas, and other project details;
- If necessary, a description of Tier 2 restoration activities (if occurring) on other Sonoma Water channels planned for the coming year including locations, lengths, areas, and other project details;
- The proposed off-site watershed mitigation plan (Tier 3), including:
  - a description of each candidate off-site restoration project, including the project name, project partners, project cost, length and area of mitigating activities;
  - a description of how the proposed off-site watershed projects improve or enhance watershed processes and functions to provide suitable mitigation for the year's maintenance activities;

- schedule for implementation of mitigation activities;
- a statement describing the status of permit approvals necessary to perform project (if applicable); and
- a monitoring and reporting plan.

Permitting agencies have the opportunity to review and comment on the proposed annual mitigation plan. The SMP annual mitigation plans are consistent with the mitigation approaches and requirements described in this manual.

In the fall of each year, Sonoma Water submits an annual report on SMP activities including summary descriptions of the maintenance activities conducted in the past year. The annual report also includes status reporting on the program's mitigation activities, including the submittal of follow up monitoring reports.

Table 11-1. SMP Plant Palette

Common Name	Scientific Name	Planting Area/Zone	Location in Watershed	Habit and Suitability for Flood Control Channels
Trees				
Arroyo willow	*Salix lasiolepis* (not preferred but may be used on a case by case basis at the discretion of environmental staff)	Toe to Mid Bank	Throughout watershed	Fast growth, spreading, use only along upper banks to offset vigorous branching
Big leaf maple	Acer macrophyllum	Mid to Upper Bank	Middle to upper watershed	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings. Prefers sandy or gravelly soils.
Box elder*	Acer negundo	Mid to Upper Bank	Middle to lower watershed	Spreading, well adapted to heavy soils
California bay laurel	Umbellularia californica	Upper Bank	Throughout watershed	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
California buckeye	Aesculus californica	Upper Bank	Upper to middle watershed	Adds diversity, important native nectar source
Coast live oak*	Quercus agrifolia	Upper Bank	Throughout watershed	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
Coast redwood	Sequoia sempervirens	Mid to Upper Bank	Middle to lower watershed	Generally only used in areas redwoods be found naturally. Used sometimes to augment landscape plantings
Fremont cottonwood*	Populus fremontii fremontii	Toe to Mid Bank	Throughout watershed	Relatively upright growth, wide spreading, well adapted to toe, mid and upper bank plantings

Common Name	Scientific Name	Planting Area/Zone	Location in Watershed	Habit and Suitability for Flood Control Channels
N. California black walnut	Juglans californica	Mid to Upper Bank	Throughout watershed	Adds diversity. Tolerates heavy soils
Oregon ash*	Fraxinus latifolia	Toe to Mid Bank	Middle to lower watershed	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings. Tolerates heavy soils.
Pacific willow*	Salix lucida lasiandra	Toe to Mid Bank	Throughout watershed	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
Red willow*	Salix laevigata	Toe to Mid Bank	Throughout watershed	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings
Valley oak*	Quercus lobata	Upper Bank	Throughout watershed	Relatively upright growth, wide spreading, well adapted to mid and upper bank plantings
White alder*	Alnus rhombifolia	Toe to Mid Bank	Throughout watershed (needs sandy or gravelly lens)	Preferred species, relatively upright growth, wide spreading, well adapted to toe and mid bank plantings. Needs adequate drainage.
Shrubs				
Blue elderberry*	Sambucus mexicana	Upper Bank	Throughout watershed	Suitable, adds diversity and forage, may need to control stem density over time, forms 15 foot tree.
California hazelnut	Corylus cornuta californica	Mid to Upper Bank	Throughout watershed	Suitable, adds diversity and forage
California wild rose*	Rosa californica	Toe to Upper Bank	Throughout watershed	Suitable, relatively small, bends over in high flows
Coffeeberry	Rhamnus californica	Upper Bank	Throughout watershed	Suitable, adds diversity and forage. Can grow to small tree
Marsh baccharis	Baccharis douglasii	Toe to Mid Bank	Throughout watershed	Suitable, rhizomatous, may need to control stem density over time

Common Name	Scientific Name	Planting Area/Zone	Location in Watershed	Habit and Suitability for Flood Control Channels
Ocean spray	Holodiscus dicolor	Mid to Upper Bank	Throughout watershed	Suitable, flexible stems bend in flows
Snowberry	Symphoricarpos albus laevigatus	Mid to Upper Bank	Throughout watershed	Suitable, flexible stems bend in flows ,adds diversity and forage
Stream dogwood	Cornus sericea	Toe to Mid Bank	Throughout watershed	Suitable, may need to control stem density over time,
Toyon	Heteromeles arbutifolia	Upper Bank	Throughout watershed	Suitable, adds diversity and forage. Can grow to small tree
Twinberry	Lonicera involucrata	Toe to Upper Bank	Throughout watershed	Suitable, flexible stems bend in flows ,adds diversity and forage
Western spicebush	Calycanthus occidentalis	Toe to Upper Bank	Throughout watershed	Suitable, may need to control stem density over time
Herbaceous perennials				
California aster*	Symphyotrichum chilense	Toe to Mid Bank	Throughout watershed	Suitable, adds diversity and forage, nectar source
California figwort	Scrophularia californica	Toe to Mid Bank	Throughout watershed	Suitable, adds diversity and forage, nectar source
Common selfheal	Prunella vulgaris	Toe to Mid Bank	Throughout watershed	Suitable, adds diversity and forage, nectar source
Common yarrow	Achillea millefolium	Mid to Upper Bank	Throughout watershed	Suitable, adds diversity and forage
Gumweed	Grindelia hirsutula , G. camporum, G. stricta	Toe to Upper Bank	Throughout watershed	Suitable, adds diversity and forage, brackish conditions
Indian hemp	Apocynum cannabinum	Toe to Mid Bank	Throughout watershed	Suitable, may need to control stem density over time

Common Name	Scientific Name	Planting Area/Zone	Location in Watershed	Habit and Suitability for Flood Control Channels
Mugwort*	Artemisia douglasiana	Mid to Upper Bank	Throughout watershed	Suitable, adds diversity and forage
Water parsley*	Oenanthe sarmentosa	Toe to In-Channel	Throughout watershed	Suitable, adds diversity and forage
Western goldenrod	Euthamia occidentalis	Toe to Mid Bank	Throughout watershed	Suitable, adds diversity and forage
Grasses/Sedges				
All the species of grasses and sedges below are perennial and were selected based on soil, moisture tolerance, growth habit, performance in high flows (flexibility, minimal sediment entrainment), and ability to recolonize after being buried. Rhizomatous, spreading and invasive species are preferred.				
Blue wild rye	Elymus glaucus	Mid to Upper Bank	Throughout watershed	Clumping, heavy seeder
Bulrush, Tule	Scirpus acutus occidentalis, S. californicus	Toe to in-Channel	Throughout watershed	Rizomatous, cattail competitor, emergent, use only in largest channels
California fescue*	Festuca californica	Mid to Upper Bank	Throughout watershed	Excellent understory grass for oaks
Common rush*	Juncus patens	Toe to In-Channel	Throughout watershed	Clumping heavy seeder, encourages diverse channel structure
Creeping wild rye*	Elymus triticoides	Toe to Upper Bank	Throughout watershed	Rhizomatous, invasive, soil binder, encouraged by mid-summer mowing.
Leafy bent grass	Agrostis pallens	Toe to Upper Bank	Throughout watershed	Rhizomatous, soil binder
Meadow barley	Hordeum brachyantherum	Toe to Mid Bank	Throughout watershed	Tufted, heavy seeder

Common Name	Scientific Name	Planting Area/Zone	Location in Watershed	Habit and Suitability for Flood Control Channels
Pacific rush*	Juncus effusus	Toe to In-Channel	Throughout watershed	Clumping heavy seeder, encourages diverse channel structure
Pale spikerush*	Eleocharis macrostachya	Toe to In-Channel	Throughout watershed	Rhizomatous, invasive, emergent
Purple needle grass	Stipa pulchra	Mid to Upper Bank	Throughout watershed	Suitable, adds diversity and forage
Red fescue*	Festuca rubra	Toe to upper bank	Throughout watershed	Rhizomatous, invasive, soil binder
Rice cut grass*	Leersia oryzoides	In-Channel	Throughout watershed	Rizomatous, cattail competitor
Santa Barbara sedge (or equivalent) *	Carex barbarae, C. obnupta, C. bolanderi	Toe to Upper Bank	Throughout watershed	Rhizomatous, invasive, soil binder,
Sloughgrass	Beckmannia syzgachne	In Channel to Mid Bank	Throughout watershed	Rhizomatous, invasive, annual
Small fruited bulrush*	Scirpus microcarpus	Toe to Mid Bank		Rizomatous, cattail competitor, emergent
Spike bent	Agrostis exharta	In Channel to Mid Bank	Throughout watershed	Rhizomatous, invasive, excellent soil binder
Torrent sedge	Carex nudata	Toe to In-Channel	Throughout watershed	Forms in-stream hummocks, Use in higher gradient gravel and cobble substrate, emergent
Wire rush*	Juncus balticus	Toe to In-Channel	Throughout watershed	Rhizomatous, invasive, soil binder, cattail competitor
Vines				
California blackberry	Rubus ursinus	Toe to Mid Bank		Himalayan blackberry competitor

Common Name	Scientific Name	Planting Area/Zone	Location in Watershed	Habit and Suitability for Flood Control Channels
Ferns/Other				
Bracken fern	Pteridium aquilinum	Mid to Upper Bank	Throughout watershed	Suitable, adds diversity and forage
Sword fern	Polystichum californicum	Toe	Throughout watershed	Suitable, adds diversity and forage
Western chain fern (in forested locations)	Woodwardia fimbriata	Toe	Throughout watershed	Suitable, adds diversity and forage

* Indicates plant species is a Channel Restoration All-Star. Channel Restoration All-Stars include the most suitable plant species for SMP flood control channels based on ten years (2009-2018) of restoration project monitoring.

Notes

1. Species for each project should be chosen based on native flora (current and historic) of project area.
2. Seeds, cuttings, seedlings and saplings used for revegetation should be obtained from local (Russian River Watershed or North Coast Floristic Province as defined in Jepson 1993) stock (local native plant nurseries should be used, or plants can be collected using appropriate collection techniques from adjacent sites - willow sprigs should be collected from adjacent sites and planted on the same day as collection).
3. Timing of planting should be appropriate for species and source (e.g. broadcast seeding of herbs and grasses in fall before first rains, cuttings planted when soil moist to at least 10 inches from rainfall, etc.).

Photo a. Corona Creek (Reach 5), 2008, looking upstream from pedestrian bridge.

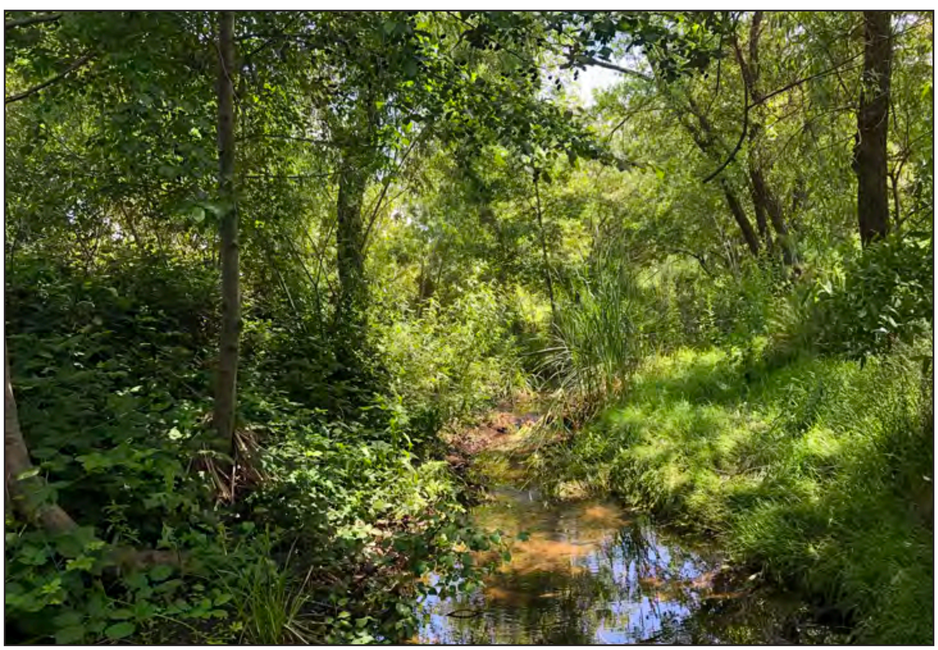

Photo b. Corona Creek (Reach 5), 2019, looking upstream from pedestrian bridge.

Figure 11-1
Upper Corona Creek in 2008 and 2019

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Photo a. Wilfred Creek (Reach 1), 2007, looking upstream toward Snyder Lane.

Photo b. Wilfred Creek (Reach 1), 2019, looking upstream toward Snyder Lane.

Figure 11-2
Wilfred Creek in 2007 and 2019

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Photo a. Todd Creek (Reach 4), 2007, looking upstream from Hunter Creek confluence.

Photo b. Todd Creek (Reach 4), 2019, looking upstream from Hunter Creek confluence.

Figure 11-3
Todd Creek in 2007 and 2019

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Photo a. Reach-scale sediment removal project at Five Creek (Reach 1) showing retention of mature riparian vegetation along the banks (October 2019)

Photo b. Localized sediment removal project at Laguna Creek (Reach 3) showing retention of vegetation in the thalweg while removing gravel bars. (October 2019)

Horizon WATER and ENVIRONMENT

Figure 11-4
Example Channels where Vegetation is Retained During Sediment Removal

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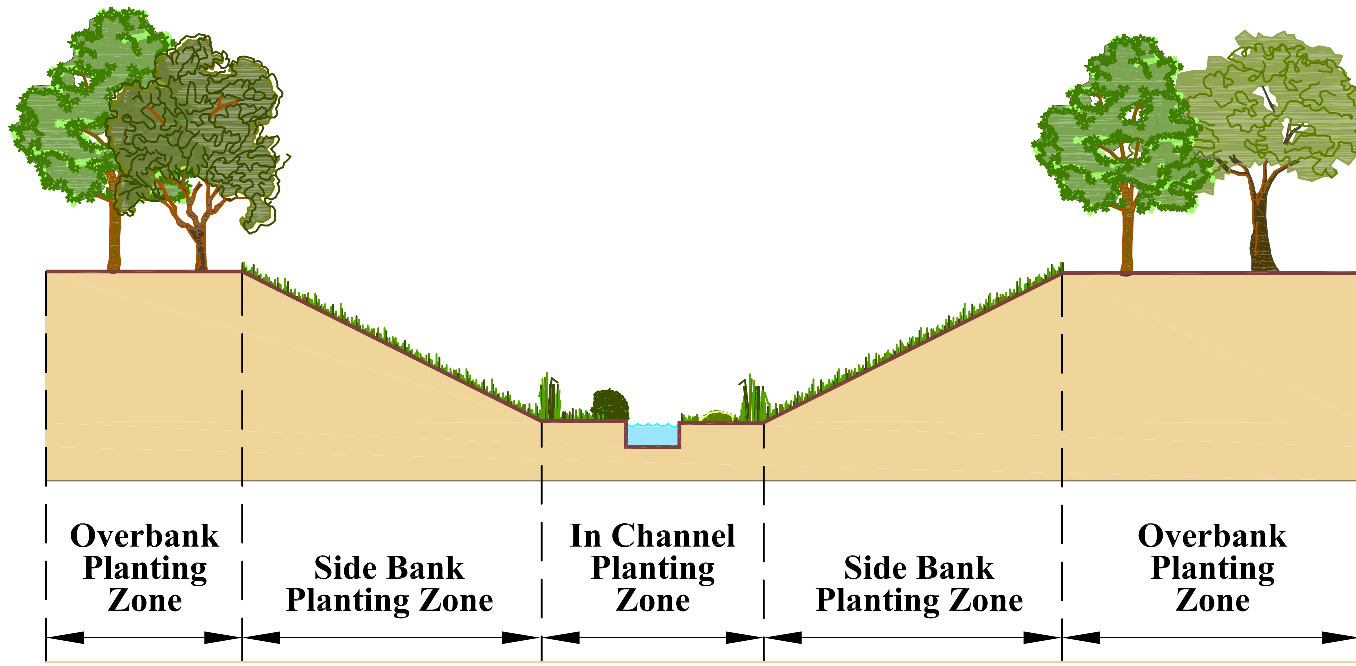
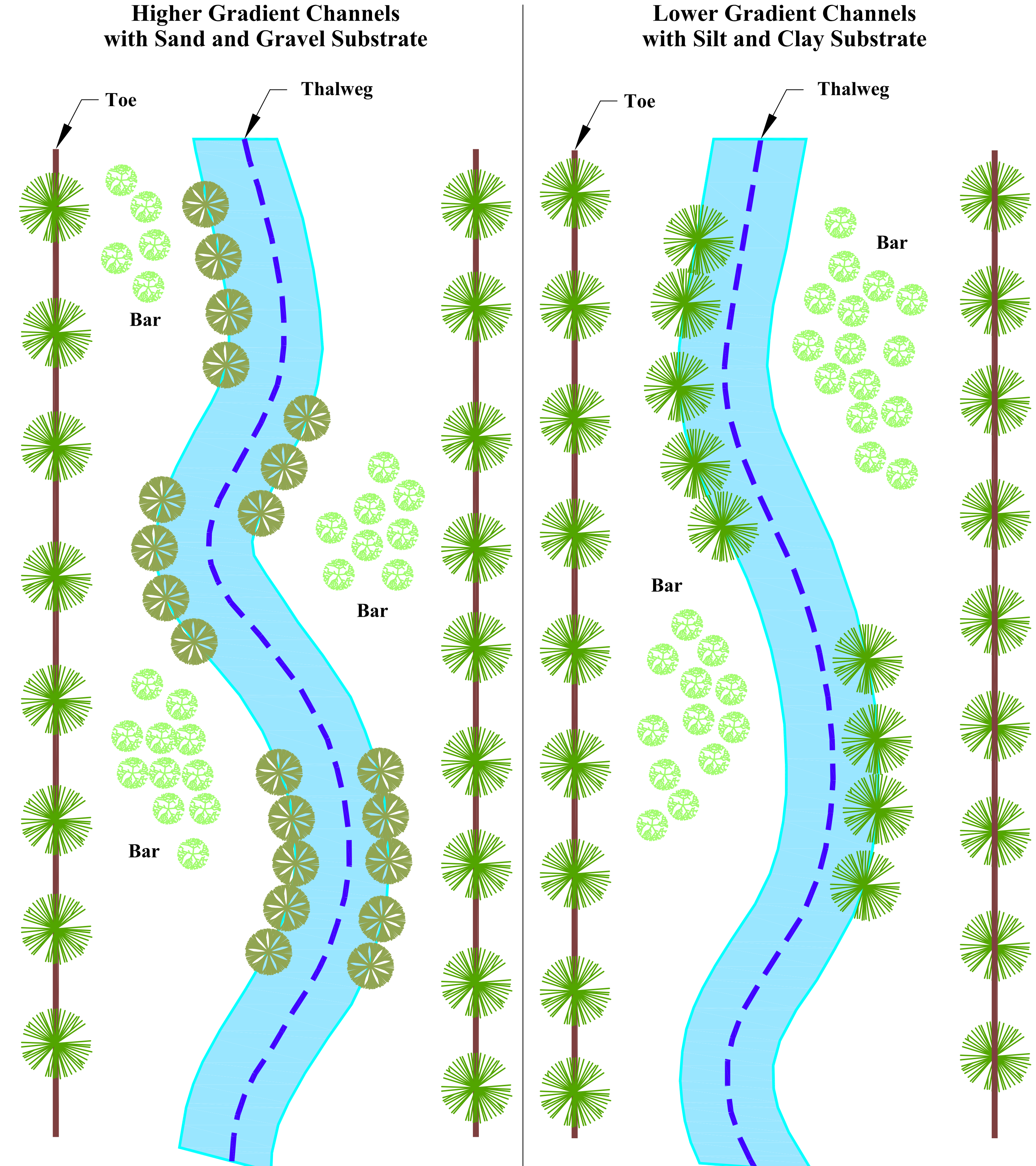
Cross Section View



Legend

- Carex barbarae (or equivalent)
- Carex nudata (or equivalent)
- Mix of Species in Table Below

In-Channel Planting Approach



Fresh Water Marsh and Transitional Habitat Species for In-Channel Revegetation

Scientific Name	Common Name	Planting Location: Bar	Planting Location: Edge of Thalweg	Planting Location: Toe	Planting Location: Side slope	Approximate Height	Notes:
Agrostis exarate	Spike bent	X				< 1 ft	Wetland grass, spreads via rhizomes, can form turf
Carex nudata	Torrent sedge	X	X			1-3 ft	Use in higher gradient reaches to armor thalweg, sand and gravel substrate, cespitose growth habit
Carex barbarae	Santa Barbara sedge		X	X		1-3 ft	Use to armor tow in low gradient reaches, spreads via creeping rhizomes
Eleocharis macrostachya	Pale spikerush	X	X			1-1.5 ft	Bar plantings, spreads via creeping rhizomes
Elymus glaucus	Blue wild rye			X	X	1-2 ft	Wetland transitional and upland grass, clumping heavy seeder
Festuca californica	California fescue				X	1-2 ft	Upland grass, clump forming, adds diversity, performs best with some shade
Festuca rubra	Red fescue			X	X	< 1 ft	Wetland transitional and upland grass for shady areas, spreads via rhizomes, can form turf
Hordeum brachyantherum	Meadow barley	X		X	X	< 1ft	Wetland transitional grass
Juncus balticus	Wire rush	X	X	X		1-1.5 ft	Plant anywhere in channel bottom, spreads via creeping rhizomes
Juncus effusus	Pacific rush	X	X	X		1-3 feet	Plant anywhere in channel bottom, clumping heavy seeder, adds diversity
Juncus patens	Common rush	X	X	X		1-2 feet	Bar and toe planting, clumping habit, shade tolerant, drought tolerant once established

Conceptual In-Stream Planting Diagram

Figure 11-5

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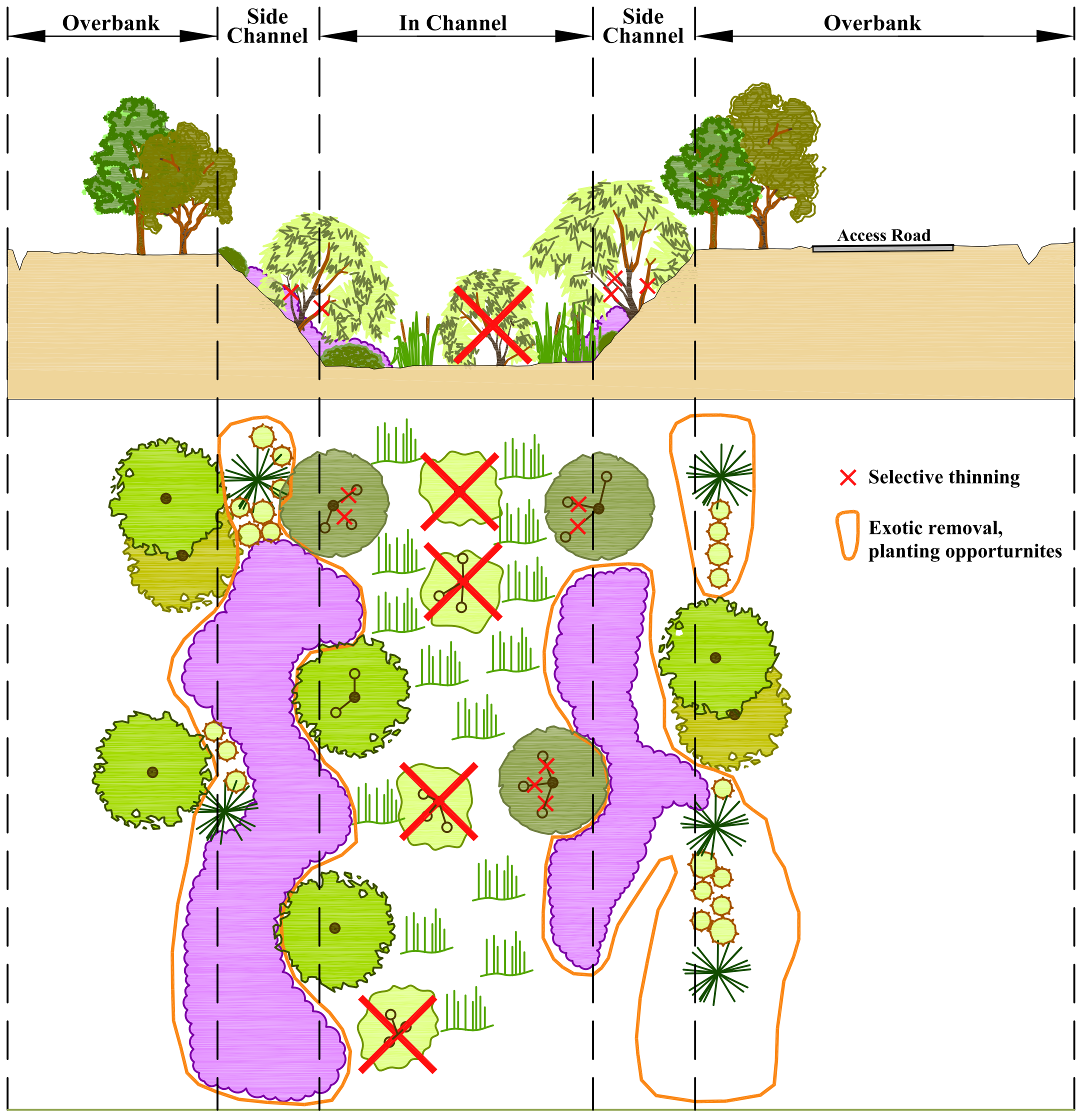
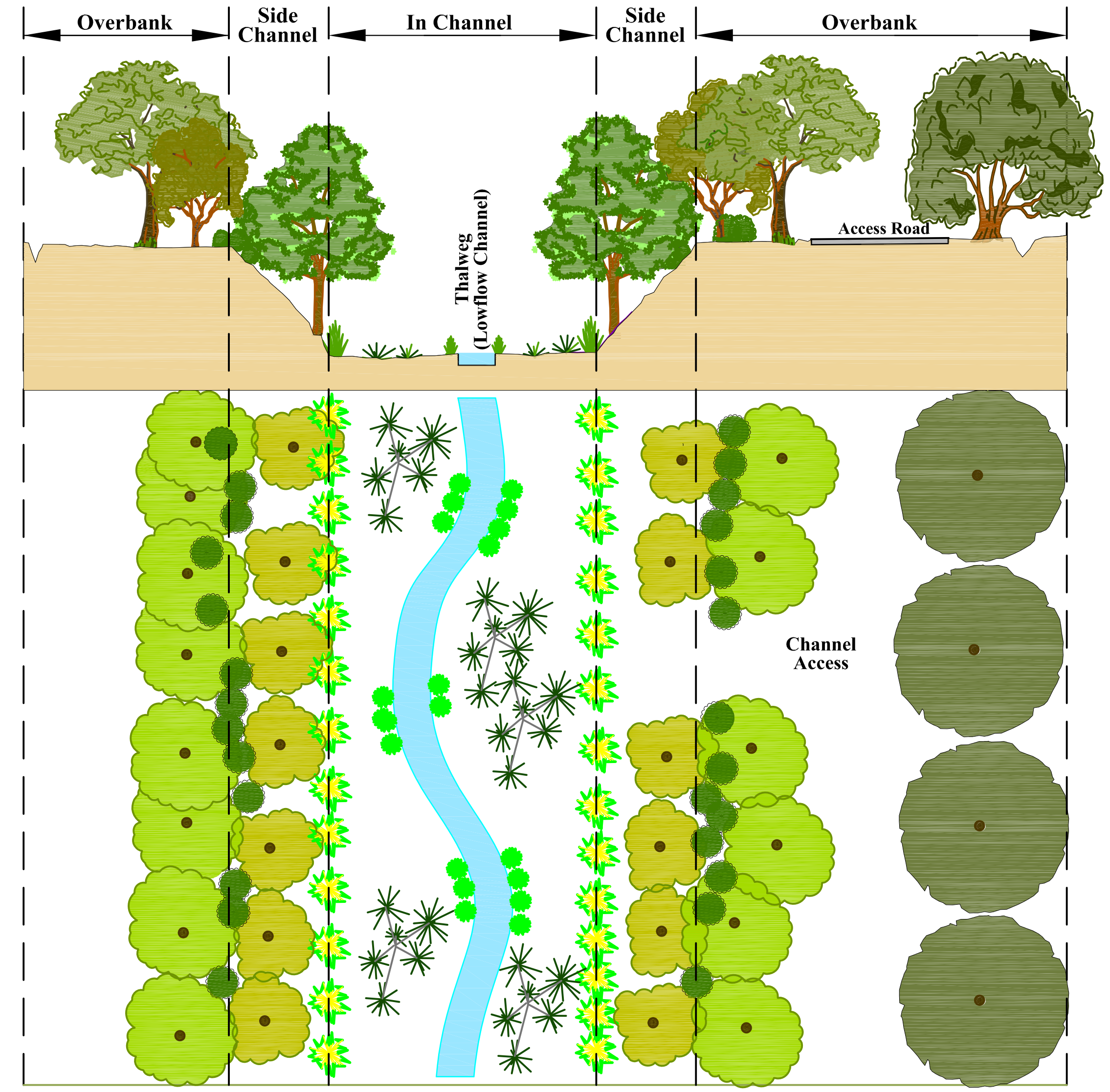
Typical Flood Control Channel Under Existing Conditions



Side Channel Dominants	In Channel Dominants	Overbank Dominants
Multi-trunked willow Himalaya blackberry Exotic shrubs Non-native Grassland	Multi-trunked arroyo & other willow Cattail Cocklebar Ludwigia Various WIS grasses	Exotic schrubs & trees, vines privet, plum, pyrocantha cotoneaster, Ivy, pampass grass

Enhanced SMP Channel Following Native Planting, Exotic Removal, and Canopy Development



Side Channel Dominants	Preferred In Channel Dominants	Overbank Dominants
Single-trunk riparian trees planted in a linear row or existing willows pruned to a single trunk	Native Sedges and Rushes planted to help stabilize lowflow channel	Redwoods or oaks

Stream Maintenance Program Plant Palette

Common Name	Scientific Name	Planting Area	Planting Source
Trees			
Big leaf maple	*Acer macrophyllum*	Mid to Upper Bank	Container
Box elder	*Acer negundo*	Mid to Upper Bank	Container
California buckeye	*Aesculus californica*	Upper Bank	Container
White alder	*Alnus rhombifolia*	Toe to Mid Bank	Container
Oregon ash	*Fraxinus latifolia*	Toe to Mid Bank	Container
N. California black walnut	*Juglans californica*	Mid to Upper Bank	Seed (fresh) or Container
Fremont cottonwood	*Populus fremontii fremontii*	Toe to Mid Bank	Cutting or Container
Coast live oak	*Quercus agrifolia*	Upper Bank	Container
Valley oak	*Quercus lobata*	Upper Bank	Container
Red willow	*Salix laevigata*	Toe to Mid Bank	Sprigs
Arroyo willow ***	*Salix lasiolepis*	Toe to Mid Bank	Cutting
Pacific willow	*Salix lucida lasiandra*	Toe to Mid Bank	Cutting
Coast redwood	*Sequoia sempervirens*	Mid to Upper Bank	Container
California bay laurel	*Umbellularia californica*	Upper Bank	Container
Vines			
California blackberry	*Rubus ursinus*	Toe to Mid Bank	Seed or Container

Common Name	Scientific Name	Planting Area	Planting Source
Herbs/Grasses			
Spike bent	*Agrostis exharta*	Toe to Mid Bank	Seed
Leafy bent grass	*Agrostis pallens*	Toe to Upper Bank	Seed or Container
Sloughgrass	*Beckmannia syzgachne*	Toe to Mid Bank	Seed
Santa Barbara sedge**	*Carex barbarae, C. obnupta, C. bolanderi*	Toe	Seed or Cutting
Torrent sedge	*Carex nudata*	Toe	Seed or Cutting
Pale spikerush	*Eleocharis macrostachya*	Toe	Seed or Cutting
Blue wild rye	*Elymus glaucus*	Mid to Upper Bank	Seed
California fescue	*Festuca californica*	Mid to Upper Bank	Seed
Red fescue	*Festuca rubra*	Toe	Seed
Meadow barley	*Hordeum brachyantherum*	Toe to Mid Bank	Seed or Container
Wire rush	*Juncus balticus*	Toe	Cutting or Container
Pacific rush	*Juncus effusus*	Toe	Cutting or Container
Common rush	*Juncus patens*	Toe	Seed or Container
Rice cut grass	*Leersia oryzoides*	In-Channel	Seed or Container
Creeping wild rye	*Leymus triticoides*	Toe	Seed
Bulrush, Tule	*Scirpus acutus occidentalis, S. californicus*	Toe to Mid Bank	Cutting or Container
Small fruited bulrush	*Scirpus microcarpus*	Toe to Mid Bank	Cutting or Container
Purple needle grass	*Stipa pulchra*	Mid to Upper Bank	Cutting or Container

Common Name	Scientific Name	Planting Area	Planting Source
Shrubs			
Western spicebush	*Calycanthus occidentalis*	Toe to Upper Bank	Seed
Stream dogwood	*Cornus sericea*	Toe to Mid Bank	Container
California hazelnut	*Corylus cornuta californica*	Mid to Upper Bank	Container
Toyon	*Heteromeles arbutifolia*	Upper Bank	Container
Ocean spray	*Holodiscus dicolor*	Mid to Upper Bank	Container
Twinberry	*Lonicera involucrata*	Toe to Upper Bank	Container
Coffeeberry	*Rhamnus californica*	Upper Bank	Container
California wild rose	*Rosa californica*	Toe to Upper Bank	Seed or Container
Blue elderberry	*Sambucus mexicana*	Upper Bank	Container
Snowberry	*Symphoricarpos albus laevigatus*	Mid to Upper Bank	Container
Ferns/Other			
Bracken fern	*Polystichum aquilinum*	Mid to Upper Bank	Cutting or Container
Sword fern	*Polystichum californicum*	Toe	Container
Western chain fern*	*Woodwardia fimbriata*	Toe	Container

* In forested locations.
** Or equivelent.
*** Not preferred but can be used on case by case basis.

Notes

1. Species for each project should be chosen based on native flora (current and historic) of project area.
2. Seeds, cuttings, seedlings and saplings used for revegetation should be obtained from local (Russian River Watershed or North Coast Floristic Province as defined in Jepson 1993) stock (local native plant nurseries should be used, or plants can be collected using appropriate collection techniques from adjacent sites – willow sprigs should be collected from adjacent sites and planted on the same day as collection).
3. Timing of planting should be appropriate for species and source (e.g. broadcast seeding of herbs and grasses in fall before first rains, cuttings planted when soil moist to at least 10 inches from rainfall, etc.).

SONOMA COUNTY WATER AGENCY

Sonoma County Water Agency
Stream Maintenance Program
Conceptual Planting Diagram

Figure 11-6

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Chapter 12
PROGRAM MANAGEMENT

12.1 Stream Maintenance Program Work Cycle

This chapter outlines and describes how the Stream Maintenance Program (SMP) is implemented and administered by Sonoma County Water Agency (Sonoma Water). The management and operation of the SMP occurs as an annual cycle of activities described in this chapter as the "work cycle." As shown in **Figure 12-1**, the work cycle begins each year with a field-based stream reconnaissance and assessment. The components of the SMP work cycle are described in greater detail in **Table 12-1** and in the sections below.

The work cycle begins with the program wide stream assessment. The stream assessment guides the development of that year's workplan. Projects such as vegetation maintenance, localized sediment removal at culvert crossings, or minor bank repairs do not generally require additional engineering or design details. Such routine maintenance activities which do not require additional engineering design represents the large majority of SMP projects. Reach-scale sediment removal projects and some larger scale bank stabilization projects may require site assessment and/or detailed engineering drawings. In these cases, the physical site conditions, erosion or deposition causes, and the maintenance requirements guide the appropriate project design. As described previously in Chapters 5 through 9, activities or projects that require this level of analysis and engineering are designed with a consideration of sustainable solutions that can reduce future maintenance needs.

Sediment disposal planning also occurs in the work cycle, with annual disposal plans developed and implemented yearly in support of planned maintenance projects. All maintenance activities utilize the appropriate programmatic impact avoidance, minimization, and mitigation programs outlined in this manual.

The anticipated calendar sequence for maintenance projects is shown in **Figure 12-2**. Stream reconnaissance and assessment begins in late winter or early spring with the development of the project workplan in the spring. Project descriptions are then developed, and mitigation planning occurs through the remainder of the spring. The relevant regulatory agencies are notified of the year's projects in late spring and provided information on project locations, activities, mitigation, sediment disposal, and any other key issues. Projects are then implemented during the summer season with follow up annual reporting due January 31.

Sonoma Water manages the SMP throughout all steps of the work cycle under the leadership of the SMP Manager whose responsibility is to supervise the program. A key responsibility for the SMP Manager is to provide communication and coordination between Sonoma Water and the relevant regulatory agencies throughout the work cycle. The SMP is administered in a consistent manner with the goals, principles, and activities as described in this manual. In addition to the annual work cycle, every five years the SMP is reviewed for its overall effectiveness and adequacy.

Table 12-1. SMP Work Cycle Process

Step 1. Stream Assessment	
Maintenance Work	▪ Review photo history of reach ▪ Review historic x-sections of reach ▪ Review maintenance history of reach ▪ Complete Creek Assessment Sheets
Sediment Disposal	▪ Conduct pre-disposal outreach to locate interested landowners in need of sediment ▪ Conduct pre-disposal outreach to landfills to identify quantity and quality of sediment they accept for landfill cover
Resources	▪ Review sensitive species/habitats maps ▪ Review Reach Sheets ▪ Survey for presence of sensitive species and habitat
Permitting/Compliance	▪ Review history of any past permitting and permit conditions at reach
Restoration/Mitigation	▪ Review history of any past restoration/mitigation work at reach
Step 2. Develop Workplan	
Maintenance Work	▪ Consider channel roughness conditions for Zones 2A and 3A per the Channel Maintenance Objectives (compare existing vegetation and sediment conditions against vegetation templates). ▪ Identify potential projects for given year (identify project type) ▪ Map project locations for given year ▪ Identify extent (area and stream length) of projects (survey x-sections)
Resources	▪ Evaluate project locations, types, and existing resources ▪ Identify potential impacts on species ▪ Identify area and length of impacts (including waters of the US/state delineation)
Permitting/Compliance	▪ Identify whether the project is covered under any permit conditions, including Biological Opinions (BOs) ▪ Identify whether the project is subject to use restrictions for herbicides, if applicable
Restoration/Mitigation	▪ Develop restoration concepts for on-site restoration activities ▪ Review Watershed Partnerships Program (WPP) off-site project options (and locations) for given year ▪ If WPP options are limited, announce "call for projects" for WPP members

Step 3. Project Design and Description	
Maintenance Work	▪ Refine project list (types and locations) ▪ Identify locations of vegetation to be removed ▪ Select specific treatments for bank stabilization projects ▪ Calculate volume and exact locations of sediment and vegetation to be removed ▪ Estimate project costs
Sediment Disposal	1) Identify the total amount of sediment for off-site disposal 2) Identify the sediment disposal options: A) On-site reuse B) Other Sonoma Water Channel Reuse C) Wetland or Floodplain Restoration or Enhancement D) Upland Agricultural or Commercial Reuse (dry) E) Upland Agricultural or Commercial Reuse (wet) F) Landfill Disposal G) Hazardous Waste Disposal 3) Conduct sediment testing based on acceptance criteria for options selected in Step 2. 4) Select appropriate disposal site based on test results
Resources	▪ Refine project designs based on resource considerations ▪ Review specific best management practices (BMPs) according to reaches and potential resources
Permitting/Compliance	▪ For steelhead bearing streams in Zone 1A, document number of times maintenance has been conducted in this reach and the linear feet of maintenance. Compare this to Russian River BO Compliance table. Coordinate technical assistance with National Marine Fisheries Service (NMFS) if needed. ▪ Complete Project Specific Notification (PSN) requirements for maintenance work in modified or natural channels in Zones 2A and 3A, and reach scale activities in engineered channels (e.g. additional photo documentation, maintenance triggers).
Restoration/Mitigation	▪ On-site restoration: develop restoration design (planting palate and locations) ▪ Off-site restoration: review WPP project designs
Step 4. Develop Mitigation Plan	
Sediment Disposal	▪ Verify that sediment disposal is consistent with existing requirements at the disposal site (pre-established BMPs), if appropriate.
Resources	▪ Identify the species/resources and area impacted by the projects ▪ Review species, habitat, or other environmental sensitivities of off-site mitigation areas

Permitting/Compliance	▪ Consider any special permitting or environmental compliance requirements for off-site mitigation projects
Restoration/Mitigation	▪ Refine on-site restoration planning based on finalized project designs ▪ Identify area and length of on-site restoration activities (if different than maintenance areas/lengths) ▪ Finalize off-site mitigation projects contributions based on maintenance cost calculation ▪ Identify area and length of off-site mitigation areas
Step 5. Agency Notification	
Maintenance Work	▪ Provide agencies with a notification package containing details of project locations and types ▪ Provide agencies with reach specific and species/habitat specific BMPs for given year's workplan ▪ Submit notification package at least 60 days prior to implementation (Russian River BO requirement)
Sediment Disposal	▪ Include location and characteristics of disposal sites, as well as BMPs implemented, in the notification package, as appropriate.
Resources	▪ Provide agencies with maps relating given year's workplan to sensitive species/habitat locations ▪ Provide agencies with maps of potential impact zones ▪ Provide agencies with pre-construction survey information, what surveys are necessary, etc.
Permitting/Compliance	▪ Collect and organize information within Agency Notification rows into a concise and easy to follow Agency Notification Package; incorporate additional PSN information in the Notification Package (e.g. additional photo documentation) ▪ Track sent and received dates of Notification Packages sent to agencies
Restoration/Mitigation	▪ Provide agencies with on-site and off-site mitigation plan (as developed above) ▪ Describe each candidate off-site restoration project includes project names, project partners, project costs, length and area of mitigating activities ▪ Describe how proposed off-site watershed mitigation projects address watershed functions and processes to provide mitigation ▪ Provide agencies with timeline for completion of on-site and off-site restoration and mitigation activities ▪ Provide agencies with timeline for monitoring of on-site and off-site mitigation activities ▪ Provide agencies statement describing status of permit approvals if necessary for mitigation projects

Step 6. Project Implementation	
Maintenance Work	▪ Track dates of project implementation activities (beginning and completion) ▪ Photos of pre and post project implementation ▪ Channel x-sections after sediment removal projects ▪ Document deviations from original project design
Resources	▪ Implement resource protective BMPs ▪ Conduct resource surveys, track results, and input any updated results to SMP Database ▪ Conduct fish relocation activities according to terms/conditions of the Russian River BO
Permitting/Compliance	▪ For steelhead streams in Zone 1A, monitor low flow channels at least two times in-between large storms during the winter period (Russian River BO requirement) ▪ Track frequency of maintenance activities at specific creeks to comply with creek specific conditions of the Russian River BO
Restoration/Mitigation	▪ Track on-site and off-site mitigation activities in SMP Database ▪ Pre and post photos of restoration and mitigation activities ▪ Confirmation of completed on-site and off-site mitigation activities
Step 7. Annual Reporting	
Permitting/Compliance	▪ Prepare Annual Report summarizing work completed, on-site and off-site mitigation performed, the initiation of monitoring activities, and any other relevant information. Include summary photographs of work completed, results of resource surveys, cross sections as needed, and any final mapping of activities as necessary. ▪ The Annual Report contain a description of construction related activities, any effects on salmonids, steps taken to minimize impacts, number of salmonids killed/injured, photographs before, during, and after; and a description of fish relocation, if necessary (Russian River BO requirements) ▪ Annual Report can include program updates and recommendations such as modifications in BMPs, anticipated projects or issues for the coming maintenance year, etc. ▪ Submit Annual Report to agencies by January 31 or no later than February 15th of the following year (Russian River BO requirement)

Another key element to supporting an effective stream maintenance program is to establish and maintain a comprehensive SMP Database. Data management is required throughout the SMP work cycle from organizing the initial stream assessment and inventory, to charting reach conditions and project requirements, to providing post project monitoring and reporting. Data management for the SMP occurs through the SMP Database as described below in Section 12.9. Data that is tracked for each stage in the work flow process is shown in Table 12-1.

12.2 Stream Reconnaissance and Assessment

Sonoma Water conducts reconnaissance of the engineered channels included in the SMP on a reach-by-reach basis to assess potential maintenance needs. The Water Agency conducts reconnaissance of maintenance reaches (typically between February and April) to identify maintenance needs and develops the high priority sites workplan for the coming year.

Conditions in natural and modified channels are assessed on an as-needed basis. As described in Chapter 7, *Vegetation Management,* vegetation maintenance activities in natural and modified channels occur less frequently and typically follow specific landowner requests. When requested or planned, maintenance activities in natural and modified channels are included in the annual workplan along with other SMP maintenance activities.

Sonoma Water staff familiar with the guidelines and principles of the SMP conduct the stream channel assessments. Sonoma Water uses an assessment checklist to help organize and prioritize maintenance activities. A sample assessment checklist is shown in **Figure 12-3**.

The initial assessment process evaluates the need for maintenance and follows the guidance questions and maintenance triggers described in Chapters 5 through 9. Sonoma Water evaluates whether site conditions trigger maintenance needs based on the criteria provided in Chapters 5 through 9. As shown in the sample assessment sheet in Figure 12-3, assessment categories receive rankings ranging from 1 (high priority) to 4 (low priority).

Channel vegetation conditions are assessed for the presence of cattails, blackberries, willows, exotics, etc. and need for vegetation removal or management. The stream assessment process is also supported by information provided by the reach characterization sheets (Appendix C), geographic information system (GIS) mapping, and aerial photography.

Information from the assessment sheets is integrated into the SMP Database. The database is accessed during the stream assessment process to query past maintenance activities, identify specific resource conditions, and prioritize maintenance activities by reach to develop the year's workplan.

Based on the field reconnaissance, review of the channel characterization sheets, site surveys, completion of the reach assessment checklist, and subsequent prioritization using the SMP Database, an initial listing of reaches requiring maintenance for the current work cycle is compiled. Based on past experience, it is anticipated that in a typical year, approximately 40-60 (out of 170 total reaches in the SMP area) may be identified as potential candidates for maintenance activities through the first-round assessment process.

12.3 Prioritize Maintenance Sites and Develop Workplan

The preliminary list of project sites developed during the reconnaissance process are reviewed and further prioritized based on:

- the relative severity of reach conditions and need for maintenance;

- SMP framing considerations, management goals, public safety triggers, channel maintenance objectives, and other management triggers, as described in Chapters 5 through 8;
- consideration of past/recent flooding conditions; and
- overall maintenance needs in the program area.

12.3.1 Vegetation and Sediment Maintenance Evaluation Pursuant to Channel Maintenance Objectives, Zones 2A-3A

In addition to the site assessment and prioritization process described above, in Zones 2A and 3A, Sonoma Water additionally considers channel roughness conditions, per the development of Channel Maintenance Objectives to help guide the maintenance decision-making process. Through this process, Sonoma Water compares existing vegetation and sediment conditions with templates developed specifically for the reach. The process of developing reach-specific vegetation templates is ongoing and is focused on evaluating established patterns of trees for function and sustainability. This ongoing study indicates how far overgrown the reach might be, compared to the post-maintenance condition, or compared to the "ideal" condition shown in the template. The comparison between existing condition vegetation and the vegetation template informs the maintenance decision process.

Where developed, nomographs, as shown in **Figure 12-4** can help further inform the maintenance decision-making and prioritization process. As shown in Figure 12-4, the existing vegetation roughness is plotted based on estimates from direct site visits and observations, as well as reference to site photographs from previous channel conditions and related documents. Plotting the range of values on the nomograph illustrates the range of current conditions along the reach. The dashed line in the nomographs indicates where the beginning of the freeboard zone is entered. When the plotted data cross the dashed freeboard zone indicated on the nomograph, then roughness or sediment removal actions may be necessary to return channel capacity to a condition where freeboard is not encroached upon. Some reaches may only require vegetation management, other reaches only sediment removal, and some reaches include both actions.

For reaches that are candidates for sediment work, Sonoma Water evaluates the reach carefully and surveys the existing cross section. This is compared to the last surveyed cross-section in this location. Current conditions are compared to design conditions, and an evaluation of how much channel capacity has been reduced to the reduction in cross sectional area is estimated. With the new vegetative roughness information and new cross-section information, Sonoma Water uses the nomographs in conjunction with action triggers to further inform the maintenance decision making process.

As an example, while no nomograph is shown for Corona 7, assessments estimate existing roughness over Corona 6 and 7 to be between 0.071 and 0.09. This roughness plotted on the nomograph for Corona 6 (Figure 12-4) indicates vegetation management is needed to reduce roughness. Assessments indicate invasive plants are providing more than 20 percent of the cover, sight lines are obstructed and willows are recruiting out of compliance with the channel form. Vegetation management involves thinning willow recruits coming between established toe trees and along the side bank. Vegetation is thinned or cleared on the fence line and upper bank and trees are pruned for public safety as well as addressing dead and dying trees that pose a public hazard.

12.3.2 Other Factors Involved in Decision-Making Process

The maintenance prioritization process also integrates other regional and local flood related work into ongoing work planning and operations. Annually, SMP managers meet with city officials to discuss maintenance priorities as well as collaborate on regional planning efforts that may influence maintenance needs. Public safety factors including homelessness, criminal activity, and fire risk management are also be considered to protect the public. Sonoma Water also considers adjacent land uses to the channel, potential risks or damages in light of flood risk, and the history of flooding at the channel to provide additional context for prioritizing the year's maintenance activities.

12.3.3 Prioritize Maintenance Activities

Following the maintenance assessment process as described above, the list of potential projects are prioritized into a smaller set of projects to serve as the workplan for the given year. As described in Chapters 5 through 9, the number of projects prioritized in any given year is dependent on several factors, most notably climatic conditions of the preceding years. Projects that are marked as low priority and not included in the current cycle's workplan are noted for inspection and assessment during the next seasons' work cycle.

The following list provides an estimated range and number of project types anticipated to be conducted annually. This list is based on the maintenance activity descriptions provided in Chapters 5 through 8, and informed by the recent history of permitted activities. It is expected that annual workplans may include:

- 1-3 reach scale sediment removal projects per year,
- 3 localized sediment removal projects at culverts and crossings per year,
- 1-2 bank stabilization projects per year,
- 2 reservoir sediment inlet clearing projects per year,
- 6 in-stream sediment basin clearing projects per year,
- 1-2 sediment removal projects per year at engineered basins,
- vegetation management at multiple reaches on an ongoing, annual basis.

Maintenance activities are expected to generate from 20,000 to 25,000 cubic yards of sediment and debris per year. Because the amount of sediment requiring offsite disposal and the disposal locations may vary, annual sediment disposal planning occurs concurrently with developing the workplan. Selection of disposal sites also occurs as part of long-term planning efforts, described in Chapter 9. Following the approach described in Chapter 9, the workplan identifies disposal locations available for use in the given year and the associated criteria for disposal at those locations. A preferred location and alternate locations may be identified to allow disposal flexibility and ensure adequate capacity as the projects are implemented. The annual workplan identifies sediment sampling locations at the sites and obtain representative sediment samples from each to characterize the existing sediment conditions at the site. As required by the Waste Discharge Order issued by the Regional Water Quality Control Board (RWQCB), the sediment disposal sites must be approved by the RWQCB Executive Officer prior to use.

12.4 Project Design and Description

Once the workplan is developed, projects that require engineering design, including reach-scale sediment removal or large bank stabilization projects, undergo a design process whereby site conditions are analyzed, more specific maintenance requirements are identified, and treatments and BMPs are conceptualized, designed, and then refined. These steps are described in more detail below.

It is anticipated that approximately one to three reach-scale sediment removal projects that require this level of design would be planned and implemented annually. As discussed in Chapter 6, the number of bank stabilization projects implemented annually, as well as the severity of the failure, vary depending on weather and hydrologic conditions of the current and previous winter. Vegetation management activities in the lower bank and channel zone and at other engineered structures are described in Chapter 7 for anticipated maintenance needs. Vegetation management projects do not require any pre-work engineering design but may require consideration of the Channel Objectives Report for Zones 2A-3A per Section 12.3.1 above. The annual workplan identifies reach locations for vegetation management activities, the general type of vegetation to be worked on, and a reference to the standard SMP maintenance activities from Chapter 7.

12.4.1 Identify Site Context

Project design begins with considering the reach setting and context, as discussed in Chapters 5 through 7. Relevant site information to be reviewed (as available) includes reach descriptive sheets, reach assessment SMP Database entries, channel engineering designs and as-built designs, the most recent channel cross section surveys, hydraulics and flow capacity information (as available), and information on environmental resources and adjacent land uses. If necessary, these existing data sources are updated, or data gaps completed as needed.

For reach-scale sediment removal projects, understanding the reach context in relation to sediment supply and delivery in the overall subbasin or watershed is very important. Also necessary is to understand the governing physical processes influencing flows and sediment deposition in the reach. The *Framing Considerations*, *Sediment Management Goals*, *Sediment Management Triggers,* and *Design Guidance for Sediment Removal Projects* provided in Chapter 5, *Sediment Management and Removal*, are used to assess sediment and geomorphic conditions to provide appropriate design guidance.

To further guide the design process, reach- and site-based constraints are identified. For example, site- or reach-scale constraints such as a narrow corridor width, the presence of infrastructure like pipelines or road crossings, the presence of threatened or endangered species, or the existing channel already being in a degraded or incised condition could all influence the maintenance approach and which treatments to use. Site and reach constraints may also influence the need for special access or equipment that may differ from the approaches described in Chapters 5 through 9. If site constraints and environmental considerations result in the need to use equipment or approaches other than those described in Chapters 5 through 9, a detailed description of the necessary approach are included in the project description and discussed with regulatory agency staff during the notification process (see Section 12.6, “Agency Notification” for more detail on this process).

The SMP channel design engineer makes use of all relevant information including the observed field conditions, understanding of sediment and reach processes, results of channel cross section surveys, hydraulic analysis (as available), and the consideration of site constraints to design an appropriate approach to either sediment removal or bank stabilization.

12.4.2 Identify Treatments and BMPs

Based on the identified site conditions, the key fluvial processes, and other influencing constraints, treatment approaches are then identified. Reach-scale sediment removal project descriptions include information on the amount of sediment to be removed and the target locations for removal. Site-appropriate treatments are selected based on the design approaches described in Chapters 5-9 (i.e., low-flow channel, meandering channel, south bank alignment, sediment reduction across the full bed of the channel, etc.). Vegetation management projects are designed to remove enough vegetation to provide necessary channel capacity while maintaining as much habitat and creek shading as possible. Bank stabilization projects utilize bioengineered treatments that respond to the cause and degree of the bank failure to develop a sustainable design.

Following the identification and selection of initial concept level approaches, the design of maintenance activities is then refined to provide specific sizing and location of treatments.

Following design refinement, activity-specific BMPs are identified based on the practices listed in Table 10-2. All projects utilize appropriate program-wide BMPs for impact avoidance and minimization as identified in Chapter 10 and Table 10-1. The SMP Manager also refers to Table 10-3 to determine where special-status species have potential to occur near maintenance reaches and which species-specific BMPs may be applicable.

Identification of the specific project treatments and locations for sediment removal assist SMP Managers in selecting sediment testing locations and disposal options. As described in Chapter 9, *Sediment Disposal and Reuse*, locations for sediment disposal depend on sediment characteristics. The workplan identifies sampling locations within each work site or reach to adequately characterize the sediment to be removed. Samples of the sediment to be removed are collected and sent to a lab for analysis. The level of analysis conducted is determined by the land disposal criteria established by regulatory agencies and landowners for the selected sediment disposal sites. The lab analysis informs or affirms the appropriateness of disposal at these sites for that year’s maintenance activities. If the quality of sediment is deemed hazardous, it is taken to an appropriate hazardous waste facility for disposal.

12.4.3 Develop Project Description

Following the analysis of site context and the development of treatment designs, a summary project description is developed for each sediment removal or bank stabilization project. The project description serves as the formal characterization of project activities and supports permitting requirements. The project description includes the following information:

- Project type (i.e., sediment removal, bank stabilization, or vegetation work)
- Project location address and/or location description
- Project site map
- Updated channel characterization sheet for project reach (as needed)
- If maintenance activities are conducted differently from the activity description in Chapters 5 through 9, identify differences and provide an explanation of why the different approach is required.
- Linear feet of creek and acres of channel that will be disturbed by activities.
- Acres of waters of the United States and waters of the State that will be affected
- For sediment removal projects, identify quantity of sediment to be removed.
- For reach-scale sediment removal projects, provide cross section of existing channel condition vs. as-built condition
- For bank stabilization projects, identify how much material will be placed in the bank slope
- For all projects, identify how much sediment and other debris requires disposal
- Any appropriate figures including cross sections, design details of structures to be maintained, and plan view maps for activities as appropriate.
- Project cost estimate to develop a fee assessment for permitting agencies and a basis for mitigation calculation (Watershed Partnership Program, etc.).

Figure 12-5 provides a template for developing project descriptions. This template is designed to identify necessary site-specific project information while relying on the SMP Manual to provide information on maintenance activities and approach. In this manner, project descriptions are informative while being kept relatively brief and consistent.

For the RWQCB, Sonoma Water provides sediment sampling, testing, and disposal/reuse plans for review and approval. The sediment samples are tested in accordance with the requirements outlined in the according to the MRP attached to the authorizations issued by the San Francisco Bay RWQCB (WDR Order No. R2-2016-0020) and the North Coast RWQCB (WDR No. R1-2009-0049 and Section 401 Water Quality Certification WDID No. 1B09026WNSO, ECM PIN CW-735104). Based on results from the sediment samples, Sonoma Water selects the final sediment disposal sites and identifies the available capacity at each site. Also, the routes for vehicle transport from the maintenance sites to the disposal sites are identified.

12.4.4 Develop Project Specific Notification Requirements

In addition to developing the project description, to comply with Sonoma Water's permit requirements under Waste Discharge Requirements (WDR) Order No. R2-2016-0020, PSNs are developed for maintenance work in modified or natural channels in Zones 2A and 3A, as well as for reach scale activities on engineered channels (not localized or targeted or other facilities maintenance activities). For the purposes of the SMP and adherence to Sonoma Water's WDR Order No. R2-2011-0020, vegetation removal is defined as "the complete removal of the above-ground portions of vegetation including any individual tree, shrub, and herbaceous plant in the channel cross-section area (i.e., instream, side bank, and top of bank) consistent with the vegetation management triggers described in the SMP Manual. Vegetation removal does not include exotic vegetation removal, spot-thinning and pruning of vegetation, or mowing." These distinctions are important in considering what information needs to be included in annual notifications, and when PSNs are required under WDR Order No. R2-2011-0020.

PSNs require photo documentation of existing site conditions, a description of proposed maintenance activities, a description of potential effects on habitat for special-status species, identification of significant habitat features to be retained, mitigation to be implemented, identification of appropriate BMPs, and post-project photos to document BMP success. Because most of the required information is similar to what's included in the annual work plan, the PSN information is integrated into the agency notification and annual reports to provide more efficient reporting and to reduce the need for multiple, separate document submittals. See Appendix B for report outlines of the agency notification and annual report.

12.5 Develop Mitigation Plan

In parallel with developing the annual project workplan, Sonoma Water develops the annual mitigation plan. The annual mitigation plan describes the on-site and off-site planned mitigation activities for the given work cycle. It includes the topics described in Chapter 11, Section 11.9, "Mitigation Notification and Reporting," regarding the information to be provided for the regulatory agency notification. This information includes:

- A description of on-site (Tier 1) restoration activities planned for the coming year including locations, lengths, areas, and other project details;
- A description of Tier 2 restoration activities (if occurring) on other Sonoma Water channels planned for the coming year including locations, lengths, areas, and other project details;
- The proposed off-site watershed mitigation plan (Tier 3), including:
  - a description of each candidate off-site restoration or watershed health project, including the project name, project partners, project cost, length and area of mitigating activities;
  - a description of how the proposed off-site watershed projects address watershed processes and functions to provide suitable mitigation for the year's maintenance activities;
  - schedule for implementation of mitigation activities;
  - a statement describing the status of permit approvals necessary to perform project (if applicable); and
  - a monitoring and reporting plan.

As described in Section 11.9, permitting agencies have the opportunity to review and comment on the proposed annual mitigation plan. The SMP annual mitigation plans are consistent with the mitigation approaches and requirements described in this manual. Annual mitigation projects are envisioned to be consistent with the types of projects developed during the SMP interim period, as described above.

12.6 Agency Notification

By April 30th, Sonoma Water notifies the relevant regulatory agencies about the planned projects for that year's workplan (see Figure 12-2) through submittal of the workplan notification report. The notification report contains the workplan, project descriptions, PSN requirements, sediment disposal plan, and supporting materials described above in Section 12.4. The notification report also contains a cover letter directing each regulatory agency to the projects and project descriptions that fall within their jurisdiction. This notification report contains a complete project list (i.e., the workplan) including vegetation management planned for modified and natural channels. The notification report includes details of the annual mitigation plan as described above. An outline for the annual notification is provided in Appendix B-1.

The notification report also provides details if any of the planned maintenance activities should deviate from the description of routine activities as described in this manual. If such deviations are anticipated to implement the annual workplan, then they are described along with any relevant impact avoidance measures, BMPs, or mitigation considerations that are necessary. Similarly, if during the implementation of maintenance activities, something arises during the course of executing the maintenance work that requires a different treatment or approach than described in the notification package, then the SMP Manager updates the notification and sends to the relevant agencies.

The relevant regulatory agencies have 30 days to review the notification report and respond back to Sonoma Water by June 15th to confirm the annual workplan and provide a notice to proceed. Sediment removal activities do not proceed until the disposal site has been approved by the RWQCB.

The SMP Manager also invites agency representatives to a pre-implementation field tour and meeting. The purpose of this field tour is to ensure understanding by the regulatory agency staff of the project setting and scope of maintenance activities for the given year. Any residual questions regarding the submitted notification packet can be addressed during this meeting or through subsequent communication and information exchange.

12.7 Project Implementation

Following receipt of a notice to proceed from the relevant regulatory agencies, maintenance activities may be initiated. If Sonoma Water does not receive a response to the notification packet by June 15th, Sonoma Water assumes that the workplan was reviewed and proceeds with initiating the planned maintenance work. All maintenance activities are conducted in accordance with the project description, program-wide and activity-specific BMPs, and terms of the SMP programmatic permits. This includes conducting preconstruction surveys for fish and wildlife and other resources if activities may affect these resources.

An on-site project supervisor trained in the SMP Manual oversees and guides all maintenance activities and ensures that the proper Maintenance Principles and avoidance and minimization approaches as described in Chapters 4 and 10 are employed.

When projects are implemented, data is collected at the project site prior to, during, and immediately after, project implementation, as required by regulatory permits. Data collected includes: water quality monitoring data; before, during, and after photos; cross section surveys after sediment removal is conducted; quantification of material removed (for sediment removal projects) or placed (for bank stabilization projects); length of stream channel maintained; sensitive species or other resources encountered at the site during preconstruction surveys or during project implementation; quantity, characteristics, and location of any debris disposed off-site; and any additional information as required to update the SMP Database. Recording and monitoring data collected following project implementation is collected within seven working days of final maintenance activities.

12.8 Annual Reporting

During the fall and winter, Sonoma Water develops an annual summary report describing the maintenance activities recently conducted in the previous work period. This annual report is submitted to the relevant regulatory agencies by January 31st. The report includes the information listed below and complies with permitting requirements. An outline for the annual report is provided in Appendix B-2.

- The extent to which the workplan was completed (i.e., identify projects that were or were not implemented). If projects were not implemented, note why and if the project is incorporated into the following year's workplan or if the project is placed on a watch list.
- If activities were conducted according to the project description, and if not, how the actual project varied from the project description.
- Site photos before and after project completion.
- Total length of stream channel that was maintained for the individual projects in the workplan. In Zone 2A/3A this includes sub-distance worked during vegetation management.
- How much sediment and vegetation were removed and acres affected, if applicable.
- How much material was placed on-site and acres affected, if applicable.
- How much material was disposed off-site, disposal locations, and acres affected, if applicable. A sediment sampling report is submitted. An outline for the annual sediment sampling report is provided in Appendix B-3.
- If any species or other sensitive resources were encountered during construction and if so, what impact avoidance steps Sonoma Water took in response.
- A brief description of on-site and off-site mitigation enacted.
- A brief description of site monitoring, including bank stabilization and revegetation monitoring requirements established in the RWQCB permit.

- Any lessons learned from that year's activities including treatments that were not effective, administrative difficulties, and proposed steps to facilitate the process.
- Recommended updates (if any) to the BMPs identified in the BMP Manual.

Following submittal of the annual report, the SMP Manager invites regulatory agency staff to a summary meeting (or call) to discuss the events, maintenance activities, and lessons learned over the past work cycle. This meeting may also include a site visit to see the project sites after project completion.

The annual report also includes status reporting on the program's mitigation activities, including the submittal of follow up monitoring reports. Topics to be addressed in the monitoring reports are described in Chapter 11, Section 11.9.

At the conclusion of the annual work cycle, Sonoma Water also updates the SMP Database, and the BMP list (Table 10-1) as appropriate to include any updates or changes made over the recent work cycle. In this way, developing the following year's workplan is built on updated information across the program.

12.9 Data Management

Data collection and monitoring efforts are critical to measuring the success of SMP implementation. In order to properly track the progress of management activities towards achieving the SMP's goals and compliance with programmatic permit conditions, the SMP Database was developed. The SMP Database is a GIS database and serves as the central storage location for multiple types of information gathered as part of annual and long-term SMP implementation. The following data is collected or updated at various stages in the project notification, implementation, or reporting process, as shown in Table 12-1:

- GIS reach mapping
- maintenance activities to date
- BMP tracking
- pre- and post-project photos
- channel characterizations
- channel cross sections
- mitigation projects
- sediment disposal sites
- specific data required by permits (including Biological Opinions)
- notification packages
- annual reports

The SMP Database can be queried to identify past maintenance activities or prioritize future actions. The database stores many types of files, including photos (.jpeg), Acrobat (.pdf), and

Word (.doc) and serves as the central data repository for all SMP activities. Photographs from maintenance sites are particularly important information sources in tracking maintenance needs, effectiveness of past actions, and success of on-site planting and restoration work.

The SMP Database contains back-up technical information documentation for the agency notification packages and annual reports. As described in Chapter 10, SMP implementation requires tracking of important items or tasks to avoid and minimize potential impacts to sensitive species, such as pre-construction survey dates, meeting the terms and conditions of issued Biological Opinions, and tabulating annual mitigation funding and implementation. Sonoma Water uses the SMP Database to provide regulatory agencies with necessary information on the maintenance activities (based on the permit requirements and the description of activities in this manual).

12.10 Program Review

Periodically, Sonoma Water and the relevant regulatory agencies review the Stream Maintenance Program for its overall effectiveness. This review includes an assessment of maintenance activities conducted to date, BMPs employed, adequacy of the SMP Mitigation Program, SMP data management, adequacy of SMP adaptive updates and revisions, and overall program coordination and communication between Sonoma Water and the regulatory agencies.

SMP Work Cycle

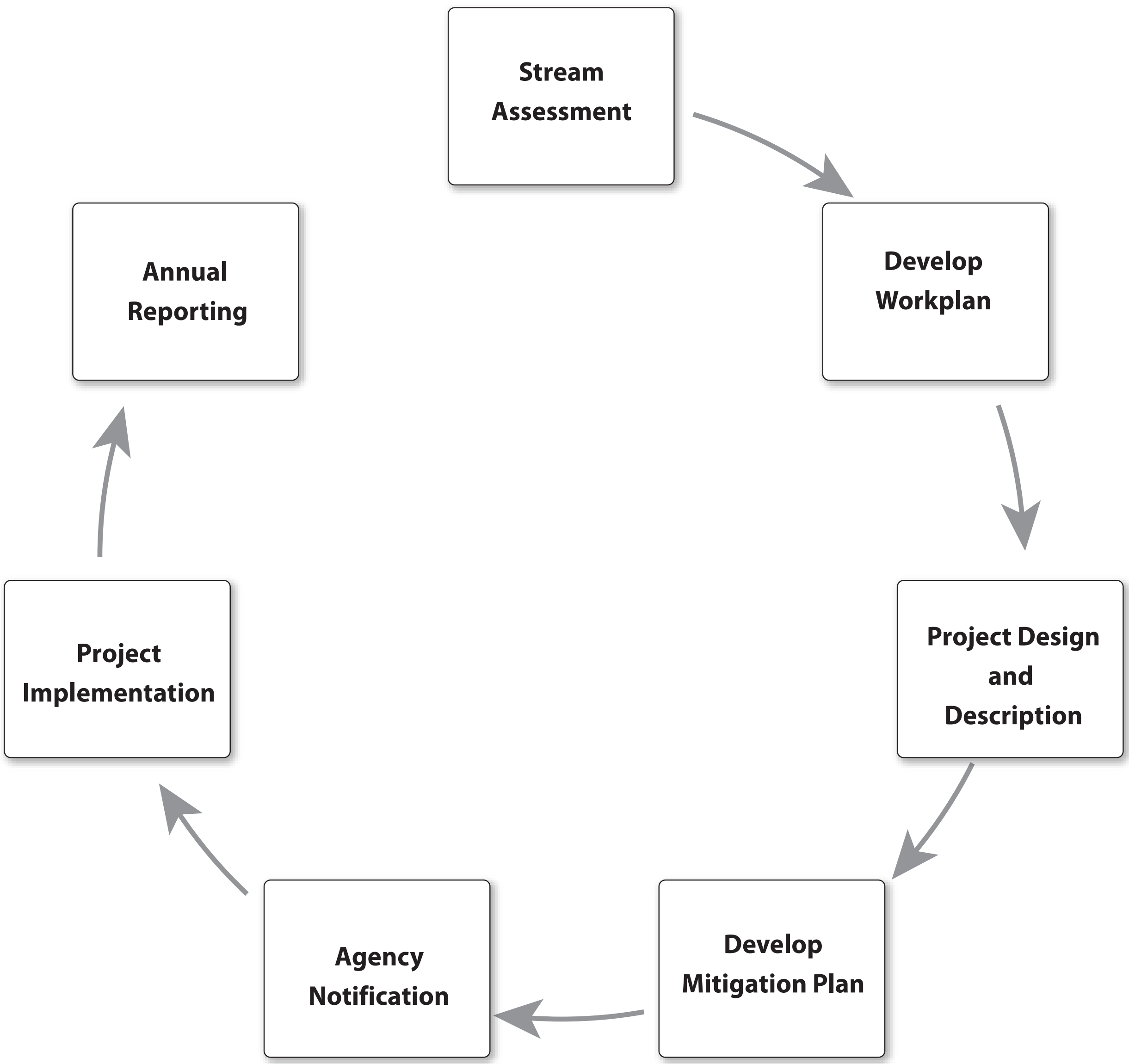

Figure 12-1
SMP Work Cycle

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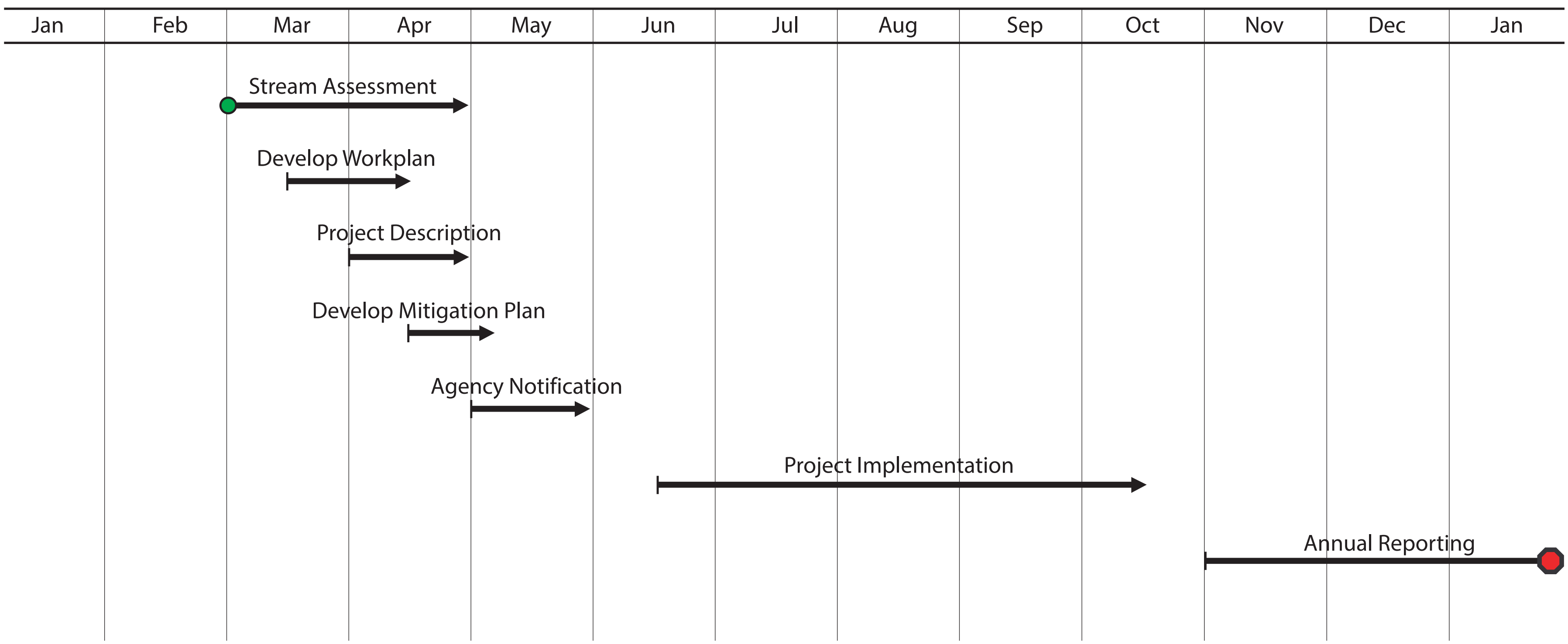

Figure 12-2
SMP Work Cycle Calendar

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Sonoma County Water Agency

Creek Assessment Evaluation Form

Copy Evaluation | Find Reach | Delete Evaluation

Date: 7/16/2019 Town: Santa Rosa ZoneName: 1A Channel Form:

Creek: NOT APPLICABLE Reach: 404Aviation1 Maintenance Personal

Channel Type:

Exotics

Blackberries Hand: Excavator:

Willows Removal Priority

Herbicide Spray Blackberry: Exotics:

N_Value 0.035 - 0.05

Pruning Upper Bank Pruning: Fence Line Pruning: Access Road Pruning:

Vegetation Maintenance Triggers

Edit

Comments:

Sediment Removal Basin: Localized Reach

Edit

Comments:

Bank Repair Bank Repair Needed:

Edit

Comments:

Add Picture

Pictures

Assessment?

V-Ditch Clearing: Road Repair: Fencing Repair

Overall Comment:

Figure 12-3

Example Stream Assessment Checklist

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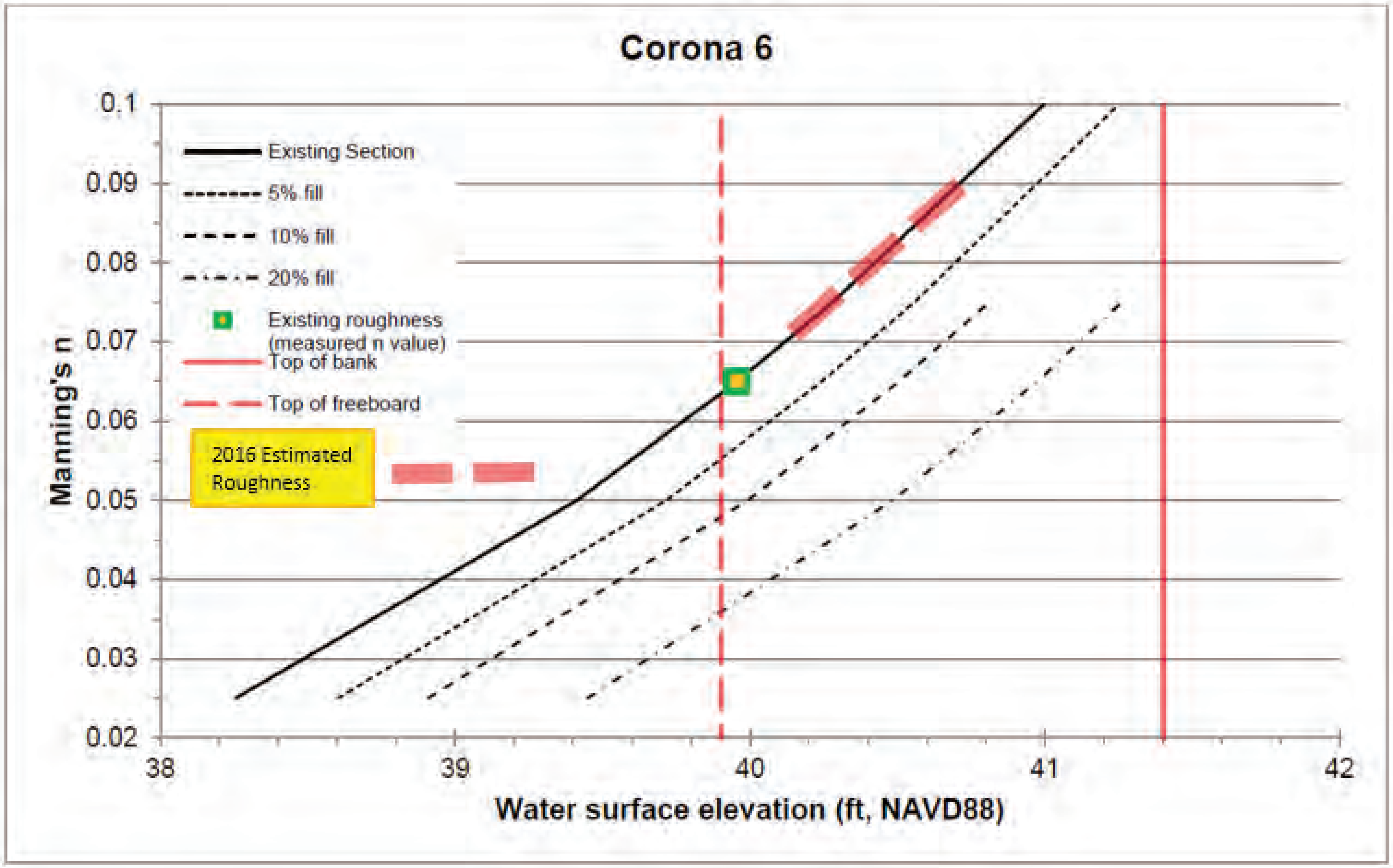

Figure 12-4
Example Nomograph – Corona Creek (Reach 6)

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SONOMA COUNTY WATER AGENCY

SMP Workplan
Project Description Template

Name of Project:	
Type of project:	❑ Sediment removal ❑ Bank stabilization
Project city:	
Project location (address and/or location description):	
APN:	
Directions to project site:	
USGS map:	
Section, township, range:	
Latitude and longitude:	
Stream name:	
Tributary to:	
Description of activity (treatment and/or design; indicate if approach varies for this activity from that described in the SMP Manual):	

continued...

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Reason for using treatment and/or design:	
Stream feet disturbed by activity:	
Total acres of project:	
Acres of waters of the United States:	
Acres of waters of the State:	
Quantity of sediment to be removed (if applicable):	
Quantity and type of fill to be placed (if applicable):	
Fill below OHWM (if applicable):	
Activity-specific BMPs that will be used for avoidance and minimization of impacts:	
Project cost:	
Attachments:	❑ Project site map ❑ Updated reach sheet ❑ Design details of proposed activity (cross-section and plan view as appropriate) ❑ Existing condition cross-section ❑ As-built cross-section ❑ Sediment disposal site information, as necessary

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Chapter 13
REFERENCES AND PREPARERS

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13.2 Report Preparation

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